

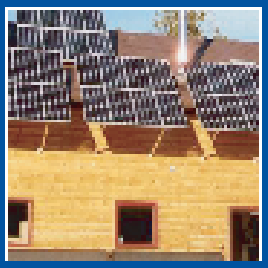

Valuing Grid-Connected Solar Electricity

Priming the Market in Ontario

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solar energy
powerful, proven, practical

1. Executive Summary

"*Solar PV is more valuable because it competes on the retail side of the customer meter not wholesale like other technologies. Key to good policy changes include consumer friendly interconnection standards, net metering and voluntary solar tariffs, which properly value distributed generation."*[1]

Canada lags other nations in both the deployment of on-grid solar electricity and in its public stimulation of this market. Ontario, with the seriousness of its projected shortfall of energy generation capacity, has a unique opportunity to put Canada "back in the game." This proposal by CanSIA will stimulate the market for PV in a sustainable method – allowing the industry and support structures to grow so that by 2015 it has the capacity to handle growth rates that will make solar PV a major supplier of electricity in Ontario in the following decades – providing upwards of 13,000 MW of generation by 2025.

Governments have the responsibility of developing a long term vision of the needs of its citizens and in developing and implementing plans to meet those needs. There is public consensus that solar energies must provide a significant portion of the future energy needs of Ontario. An important role of government is to encourage demand for this major future energy sources. The time to act is now.

The solar electric industry in Ontario is small and is limited in capacity to provide immediate energy relief. Yet it has the potential to play a major role in the future. This proposal by CanSIA recommends the introduction by 2006 of a program of Standard Offers Contracts (also called feed-in tariffs) that will begin to realize this potential. A 10-year program of selling 10-year "contracts" to the public at $0.42 per solar kilowatt-hour will begin this process.

Benefits of the Standard Offers Contract program for PV includes:

- Increasing sales for on-grid residential systems in Ontario from 50-60 systems a year to 5,000 per year by 2015;
- Increasing the average size of installed system from 0.9 kW to 3 kW;
- Resulting in an installed capacity of 40 MW of on grid residential PV and stimulating additional installations of 14 MW per year by 2015 (versus a current installed capacity of 0.3 MW and annual sales of 0.05 MW).
- Will result in a reduction of installed prices for PV in Ontario by 20% - putting the price of PV on par with other nations;
- Will stimulate further price drops in PV system costs at an average rate of 3% a year – following international trends.

This is not an expensive program for governments – if structured as a "public benefit charge" it would cost the average ratepayer $0.70 per year - less than the price of a chocolate bar.

This report has been developed in conjunction with many people in the Ontario solar electric industry. In particular the input from the following individuals and firms has been invaluable: Leonard Allen and Joel Phair (Phantom Electron), Carlos Fernandez and Gordon Shields (Spheral Solar Products), Simon Boone (Generation Solar), and David Elzinga (ARISE Technologies). Much of the research in this paper on solar activities internationally has been carried out by Jan Steckel – an intern from Germany working at CanSIA's office – and has been invaluable in providing the international "context."

Rob McMonagle
Executive Director CanSIA

2. Introduction

Solar electricity (photovoltaics or PV) is the fastest growing energy source in the world – with annual growth rates of 35% or more. In Germany the market grew by 87% and 360 MW were installed in 2004 alone.

Canada however has lagged behind our major trading partners – we have only 11 MW of installed capacity whilst Germany has 768 MW. In 2003, Canada had only 26% of the average installed PV capacity per

capita of twenty IEA reporting nations and Canadian governments invested only $0.27 per capita - just 14% of the international average. Further, Canada continues to drop farther behind as our PV sales growth rate falls below most other nations.

Yet Canada and Ontario have the solar resource - it is greater than that of the leading countries such as Germany and Japan - and our cost of electricity is not significantly different from many other nations, such as Austria or the US, both of which have considerably higher levels of solar sales.

The primary reason that Canada is behind is the lack of government programs to support the initial deployment of PV and to help reduce market entry barriers. Solar can be a major source of electricity generation in Canada - but it needs government support to develop its markets.

The Canadian Solar Industries Association (CanSIA) believes that by 2025 Canada could have 39,000 MW of PV installed on Canadian homes[2] – 13,000 MW in Ontario - but only if we begin to act now.

3. Background

The Ontario Ministry of Energy (MOE), through the Electricity Restructuring Act and the Ontario Power Authority, has committed to boosting new electrical supply and support for renewable electrical energy sources. The Ontario Sustainable Energy Association (OSEA) was contracted by the MOE to provide a report with recommendations on support mechanisms for renewable energy sources. This report by CanSIA is in response to the OSEA report – and to clarify the needs of the solar industry in Ontario. It is in Ontario's best interest for CanSIA to assist in laying the foundation with OSEA and the MOE for a support program for solar electricity (PV) that is meaningful and sustainable for our industry and Ontario's homeowners.

CanSIA, in its "Sunny Days Ahead" Solar Industry Strategy, released in November 2004, made energy based production incentives (also called feed-in tariffs or Standard Offer Contracts (SOC)) one of the key financing mechanisms necessary to help boost new supply and support for solar energy in Canada.

The Canadian solar industry feels that this incentive would send a significant message to both new investors in the solar industry and to potential purchasers of solar technologies, and would create an important boost to economic development and growth for the solar industry in Canada.

OSEA's submission to the MOE demonstrates the many benefits of Standing Offer Contracts. CanSIA endorses the concept of Standing Offer Contracts for the PV technology. This report deals with the level of support for Ontario's solar industry that CanSIA believes is necessary to sustainably boost the market uptake of solar energy technology.

4. Objectives of a Standard Offer Contract for PV

CanSIA feels that the prime objectives of an attractive SOC for PV should be as follows:

- To demonstrate government support for solar. Government support, at a meaningful level, increases the public confidence in the viability of the technology and will bring new private investment into the solar industry.
- To help bridge the inequality of government support for other energy sources (nuclear & fossil fuels) with its support for solar.
- To stimulate the market for "grid-connected" PV in a manner that allows the industry to grow sustainably.

5. Solar in Ontario

Presently, the majority of the solar technology sold in Ontario is for remote, off-grid markets - used in remote cottages and for the supply of power for other remote applications such as telecommunication

towers. Globally, more than 78% of all sales of PV are in grid-connected markets however in Canada it is less than 5%.

Grid connected solar electric systems can supply many long-term benefits for Ontario and are well documented internationally. PV systems lessen the peak electricity demand resulting in less strain on Ontario's electrical transmission infrastructure and reduce the need to create capital intensive, new electricity generation facilities.

CanSIA firmly believes that, like in other nations, the grid-connected market will drive the growth of the solar electric industry in Canada resulting in making it a major supplier of electricity in Canada by the middle of this century. CanSIA also feel that the off-grid solar electric and solar thermal markets are important and believes that these markets need support at similar levels that area provided by our major trading partners.

It has been demonstrated internationally that where consumers begin producing their own energy – and have the ability to "sell" their green energy at a premium - that they become more aware of their own energy consumption and will increase their efforts to reduce consumption. Such awareness helps Ontarians to reduce their energy consumption, aiding the province's energy conservation and efficiency efforts.

6. Ontario's Solar Electrical Capacity

The David Suzuki Foundation carried out a study[3] on the potential of renewable energies in Ontario in 2004. This report found that currently over 47% of Ontario homes have the potential of installing a 3-kW solar PV array – the typical size of a residential solar system in other countries.

It is technically feasible now to install over 3,000 MW of PV on single, detached homes in Ontario – generating over 3,200 GWh annually. Given the right policy conditions the technical potential for PV on all buildings in Ontario is over 14,000 MW by 2025 – generating 13,000 GWh annually.

7. OSEA's Recommendations to MOE for Solar

OSEA has proposed to the MOE various Standard Offer Contract rates based upon the research conducted by Bernard Chabot and the outcomes of his Profitability Index Method (PIM). The PIM is based on the assumption that an investment in a renewable energy project must be profitable (or at least be cost neutral) for the investor. By setting a positive value for the Profitability Index a tariff rate is determined. The tariff rate is the basis for Standard Offer Contracts. The advantages of the PIM are well known however the main disadvantages (shared by almost all valuing methods that deal strictly with economics) are as follows:

- It is based on conventional economics that do not put a monetary value on the environmental costs of an investment.
- The method assumes the investor has access to capital. This favours larger commercial or corporate investors over the general public (residential) market.
- The method does not put a value on investor pride of ownership. Presently, pride of ownership is the largest force driving the residential PV grid-connected market. The current consumer purchasing decision drivers are similar to what drives the luxury automobile market.

OSEA has proposed a 25-year program – the program would last 5-years during which 20-year Standard Offer Contracts would be signed. OSEA, using the Chabot's Profitability Index Method, has recommended a SOC price of about $0.85/kWh for a 20-year contract period for solar generation. Under this contract price, according to Chabot, an investment in solar would be revenue neutral in Ontario.

If a financing mechanism for on-site solar generation was introduced in Ontario that was revenue neutral without first "priming the market", the Ontario solar industry fears it might create an unsustainable demand for its product resulting in poorly performing systems and dissatisfied customers. Building capacities in the industry, the training of installers, inspectors and LDCs, and educating the public are important issues that the first phase of a SOC program must address.

A SOC price for solar is needed, which is greater than the present retail price of electricity (as presently available for PV in net-metering) yet provides for a measured and sustainable growth strategy reflective of the current and future capacity of the industry. Growing too quickly will compromise the ability of the present Ontario solar industry to maintain the high level of quality seen in the Ontario market today.

CanSIA does not support the introduction of a rate of $0.85/kWh as it may send a message to officials, media and the public that PV is too expensive and not worth *any* investment. CanSIA would prefer that the Ontario solar energy industry grow at a sustainable rate and this high rate could overheat the demand for solar technologies in the early stage of deployment.

CanSIA believes that a properly designed program will help the Ontario solar market attract a healthy base in Ontario of supporting resources such as training facilities, research and development of new technologies, new manufacturing capacity, as well as qualified system designers and installers. These in turn will provide benefits to the Ontario economy by providing jobs and the generation of wealth.

It is important to note that there are different risks posed by Standing Offer Contracts based on who holds the contracts for energy delivery. In the wind and biomass industries where generating plants are larger or centrally located it is often the manufacturer or affiliate companies that hold the energy contracts and hence they are insulated from possible program changes as they have the security of the contracts (often long-term and at a guaranteed price). However for the solar industry – it is the industry's customers (homeowners) that have the security of the contract – the industry must rely on the support program to stimulate sales of solar products and provide the stimulation for industrial growth. For the solar industry, more so than in other renewable energy industries, a long term commitment to Standard Offer Contracts is critical – a program lasting a minimum of 5 years with 10 years being considered optimum.

It must also be noted here that the SOC rate does not represent the "cost" of PV electricity. The SOC rate is used to stimulate demand for an energy generation source which is not accounted for in the same way as conventional energy sources. Using the same accounting methods that are applied to central power generation stations (such as wind farms or coal power plants) then the cost of solar electricity is in the range of $0.30-$0.35 per kwh – and dropping each year. The "avoided cost" benefits of solar PV are significant – one study recently valued these benefits at $0.29/kwh – see appendix 13.5.

8. Sustainable Growth of PV in Ontario - the Early Adopters Market

New markets are started with innovative, pioneer companies – Canada does not have a lack of these firms – and – most importantly – pioneer customers or early adopters, who are willing to pay a premium for a new attractive product or solution.

A critical number of these early adopters are needed before the market expands into the general population. Such pioneers can be the government, on a national, provincial or local level, educational institutions such as universities, colleges and schools, and importantly for PV - individual homeowners. An important role of government is to encourage these market leaders and to create a popular demand for important future energy sources such as solar.

Currently the market for on-grid PV in Ontario is only created by "early" early adopters – CanSIA estimates that approximately 50-100 residential systems (total of about 20 kWp) are installed annually in Ontario. This market is exceedingly small due, in part, to the lack of any positive messages of support from government.

CanSIA recommends that the first stage of the SOC PV program be targeted to early adopters. This market does not require a "profit" to invest – but they do need a positive message from the government. Early adopters typically account for between 1.5-2.5% of the market. CanSIA estimates that this program would attract 30% of the early adopters, or about 13,000 homeowners, as shown in the following table.

The Early Adopter Market in Ontario

	Total	Early Adapters (at 2%)	Program Target	Total in Program
Single Family, Detached Homes in Ontario	2,200,000	44,000	30%	13,200

While the demand from early adopter homeowners could expand rapidly - the current market for residential grid-connected PV in Ontario is exceedingly small – with a lack of basic capacity such as qualified installers, distribution mechanisms, etc. Thus the limitation to the size of the program initially is the growth rate that the small industry could sustain. Based on experience in other nations and industries as shown in the appendices, CanSIA feels that a sustainable growth rate would be in the order of 50 - 75% annually.

CanSIA recommends that a reasonable deployment target be as listed in the following table.

Deployment Targets for a PV SOC Program in Ontario

Year	2004	2005	Program "Purchase" Period									
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Growth Rate	--	20%	50%	75%	75%	75%	50%	50%	50%	50%	40%	40%
No. of New Systems	50	60	90	158	276	482	724	1,085	1,628	2,442	3,419	4,786
Size of Systems (kWp)	0.9	0.9	0.9	0.9	1	1.5	2	2.5	2.5	3	3	3
New Installed Capacity (MWp)	0.045	0.054	0.081	0.142	0.276	0.724	1.447	2.713	4.070	7.326	10.256	14.358
Total New_Installed Capacity_(MWp)	--	--	0.081	0.223	0.498	1.222	2.669	5.382	9.452	16.777	27.033	41.391

The proposed program would begin in 2006 and see the installation of 15,000 residential PV grid-connected systems in Ontario by 2015.

Currently CanSIA estimates that the average size of residential solar on-grid systems sold in Ontario is 900 watts – less than 30% of the international average. This is due to the market segment that is currently attracted to purchase solar systems – "early" early adopters are making a statement – they are not driven by economics or their energy needs. CanSIA believes that the size of systems sold under the proposed SOC program will increase dramatically and will duplicate international averages of 3 kW per system by the end of the selling period – providing a double benefit from the program.

9. International Context and Experience

Over twenty nations, including Germany, have successfully launched solar incentives in their domestic markets as far back as the early 1990s. Germany has used the feed-in tariff approach since 1992 to deploy 768 MWp of PV by 2004, generating 0.5 TWh of energy per year, or 0.1% of Germany's energy requirements. In 2004 Germany installed 360 MW connected to the grid and is now experiencing annual growth rates of 50-80%. During the course of this program, Germans have seen the cost of PV technology fall by 50% and have seen more than 20,000 jobs created in the solar energy industry. Germany has a solar resources that is 20-30% less than Ontario's.

Germany is not alone in its efforts to increase the uptake of solar electricity nor are Standard Offer Contracts the sole method used to stimulate initial growth of the PV on-grid markets. Governments in other nations have also used direct purchase subsidies and tax incentives, often combined, to build the capacities of their PV markets and governments at all three levels (federal, provincial, municipal) have been involved. The table below outlines the prices offered for Standing Offer Contracts in other countries.[4] Note that the level of support for photovoltaics (solar electricity) is consistently greater than other renewable energy technologies.

First Year Fixed-Price Renewable Tariffs ($CAD/kWh)

Country	Photovoltaics	Wind	Hydro	Biomass	Contract Length	First Introduced	PV Rate When First Introduced
Austria	$0.960	$0.125			13	1994	0.06
California	$0.667				3	1983	
France <12 MW	$0.245	$0.135			15	2000	
Germany	$0.923	$0.140	$0.123	$0.185	20	1992	0.13
Italy	$0.804				29	1992	
Spain <50 MW	$0.676	$0.106	$0.106	$0.106	>25	1998	
Portugal	$0.458	$0.161	$0.132		12	1998	

Experience in Europe shows that Standing Offer Contracts work to grow the market. The European examples also show that the value placed on the different technologies varies across the countries. Fixed price tariff rates in Europe were determined from a variety of influences, from practical to political. The Profitability Index Method is only one such method for determining tariff rates.

10. A Canadian Rate for PV Standard Offer Contracts

CanSIA believes that a SOC rate that provides approximately 40% of the cost of the installed PV system would be sufficient to stimulate the initial sales of grid-connected PV systems into the early adopter homeowner market in Ontario. At this early stage of deployment this rate should be sufficient to lower entry barriers for early adopters. Table 13.2 in the appendices shows the SOC rates at different support levels and contract period lengths. In both of the below cases the support level is constant at 40%:

- $0.42 per kWh over a 10-year contract
- $0.25 per kWh over a 20-year contract

While the cost of the program is approximately the same for 10 or 20-year contracts, CanSIA believes that a shorter contract period – but a longer program period – would more adequately meet the needs of the solar industry in Ontario as the benefits for the industry (and sales growth) relate more to the program "selling period" than the length of the contract provided to homeowners. We believe that a 10-year program of Standing Offer Contracts with 10-year contract periods is the preferred program for PV in Ontario.

- OSEA proposal: 5-year "sell" program; contracts lasting 20 years; total program = 25 years
- CanSIA's proposal: 10-year "sell" program; contracts lasting 10 years: total program = 20 years

An important element in a SOC program for PV is that the rate should be reviewed on a regular basis to insure that it is stimulating the market adequately. As the early-adopters market matures and the "early purchasers" begin entering the market it may be necessary to base the rate more on Chabot's Profitability Index Method. However PV installed prices are expected to fall dramatically as the market expands in Canada. CanSIA estimates that if sales per capita were to match international averages then this would immediately stimulate a 20% price drop in Canada. Further PV prices internationally are trending downwards at 3% per year and Canada will follow this trend. Finally, electricity rates in Ontario – while volatile – can be expected to move steadily upwards in coming years.

11. The Cost of the PV Standard Offers Contract in Ontario

It must be remembered that the SOC rate is not the same as the subsidy rate. As the electricity is "purchased" from the owner of the PV system – the utility now has the ability to resell this electricity to other ratepayers and, as this is a "green energy" source, the utility may be able to sell this electricity at a premium "green" price. As this energy will be sold back to the actual PV system owner or to immediate neighbours there are virtually no transmission and distribution costs associated to this electricity.

The cost presented in the below table is based on current electrical rates in Ontario and does not take into account the potential of time of day or "smart" metering in which electrical rates are higher during daylight hours – this could make a significant impact on lowering the cost of the program.

Annual costs ($,000) over the first 10 years

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total over 20 Years
Cost (discounting retail cost of electricity)	$49	$100	$199	$457	$967	$1,915	$3,320	$5,827	$9,293	$14,086	$149,443
Total Value of SOC	$68	$139	$278	$643	$1,372	$2,739	$4,790	8,483	$13,652	$20,888	$ 229,773

One possible mechanism to fund the program is through a public benefits charge that is spread over the entire ratepayer base. If this mechanism is adopted it represents an insignificant value – the typical homeowner would only see their energy bill increase by an average of six cents per month ($0.70 per year) because of this program.

Program Cost Spread Over Ratepayer Base

	2006	2015	Average 2006 -2015	Averaged over program term 2006-2026
Assumption of Total Electricity Consumption in Ontario [TWh/year]	150	150	150	150
Program Costs / Total Consumption [$/kwh]	$0.00000045	$0.000139	$0.000035	$0.000077
Additional cost for an average Ontario household using 25 kWh / day [$/year]	$0.004	$1.27	$0.32	$0.70

12. Concluding Remarks

Ontario has the solar resource and Ontario has the potential market for residential on-grid PV systems. What it lacks is a solar industry that has the current capacity to supply immediately a major contribution to Ontario's ever increasing energy demand.

Other nations have identified solar technologies as representing a tremendous energy source for future needs – and have invested in these technologies to prepare them for their role. Consequently other nations are beginning to reap the rewards of these government investments – in energy generation, in new jobs and in wealth creation.

Ontario – through the Standard Offer Contracts proposed here by CanSIA can begin investing in the future of its energy supply – an energy supply that is both environmentally benign and economically sustainable. This investment is minor – costing the average ratepayer less than the cost of a single chocolate bar annually over the length of the program. It will stimulate the growth of the solar industry so that it has the capacity to provide upwards of 13,000 MW of generation by 2025.

Capacity building must begin as soon as possible if Ontario is to participate in the benefits of solar technologies being experienced internationally. CanSIA is calling on the Ontario government to introduce the necessary mechanisms to introduce standard offer contracts for solar, and other renewables, by 2006.

13. Appendices

13.1. Examples of Deployment Growth Rates

Year		1	2	3	4	5	6	7	8	9	10
Maryland Residential Roof Top Program	Projection	100%	100%	100%	100%	100%	100%	100%	66%	63%	60%
NRCan – Proposed PV Rooftop Program	Projection	14%	125%	61%	61%	61%	61%	61%	61%	61%	61%
Sales of PV in Germany	Actual (starting in 1995)	39%	44%	57%	50%	29%	64%	71%	42%	48%	87%
Sales of Wind Energy in Canada	Actual (starting in 1999)	10%	56%	5%	38%	38%					

13.2. Standard Offer Contract Rates

Development of Feed In Tariffs considering time and subsidy rate

↓ years of payment / → total subsidy (inflation considered)

	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5	.283	.377	.471	.565	.660	.754	.848	.942	1.037	1.131	1.225	1.319	1.414	1.508	1.602	1.696	1.790	1.885
10	.156	.208	.260	.312	.364	.416	.468	.520	.572	.624	.676	.728	.780	.832	.884	.936	.988	1.040
15	.115	.153	.191	.230	.268	.306	.345	.383	.421	.459	.498	.536	.574	.613	.651	.689	.728	.766
20	.095	.127	.159	.190	.222	.254	.285	.317	.349	.380	.412	.444	.476	.507	.539	.571	.602	.634
25	.084	.112	.140	.168	.196	.224	.252	.280	.308	.336	.364	.392	.420	.448	.476	.504	.532	.560
30	.077	.103	.129	.155	.180	.206	.232	.258	.283	.309	.335	.361	.387	.412	.438	.464	.490	.515

↓ years of payment / → total subsidy (inflation not considered)

	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
5	.256	.341	.427	.512	.597	.683	.768	.854	.939	1.024	1.110	1.195	1.280	1.366	1.451	1.536	1.622	1.707
10	.128	.171	.213	.256	.299	.341	.384	.427	.469	.512	.555	.597	.640	.683	.725	.768	.811	.854
15	.085	.114	.142	.171	.199	.228	.256	.285	.313	.341	.370	.398	.427	.455	.484	.512	.541	.569
20	.064	.085	.107	.128	.149	.171	.192	.213	.235	.256	.277	.299	.320	.341	.363	.384	.405	.427
25	.051	.068	.085	.102	.119	.137	.154	.171	.188	.205	.222	.239	.256	.273	.290	.307	.324	.341
30	.043	.057	.071	.085	.100	.114	.128	.142	.156	.171	.185	.199	.213	.228	.242	.256	.270	.285

To calculate the feed in tariff CanSIA used the formula "*feed in tariff = (installation costs x percentage of subsidy)/(Energy produced a year x time frame of contract)".* Thus, the feed in tariff is based on the subsidy level.

13.3. Examples of Government Support Programs

1. Canada: Renewable Energy Deployment Program (REDI)
- For "green heat" technologies in industrial applications: 25%
- For remote communities: 40%

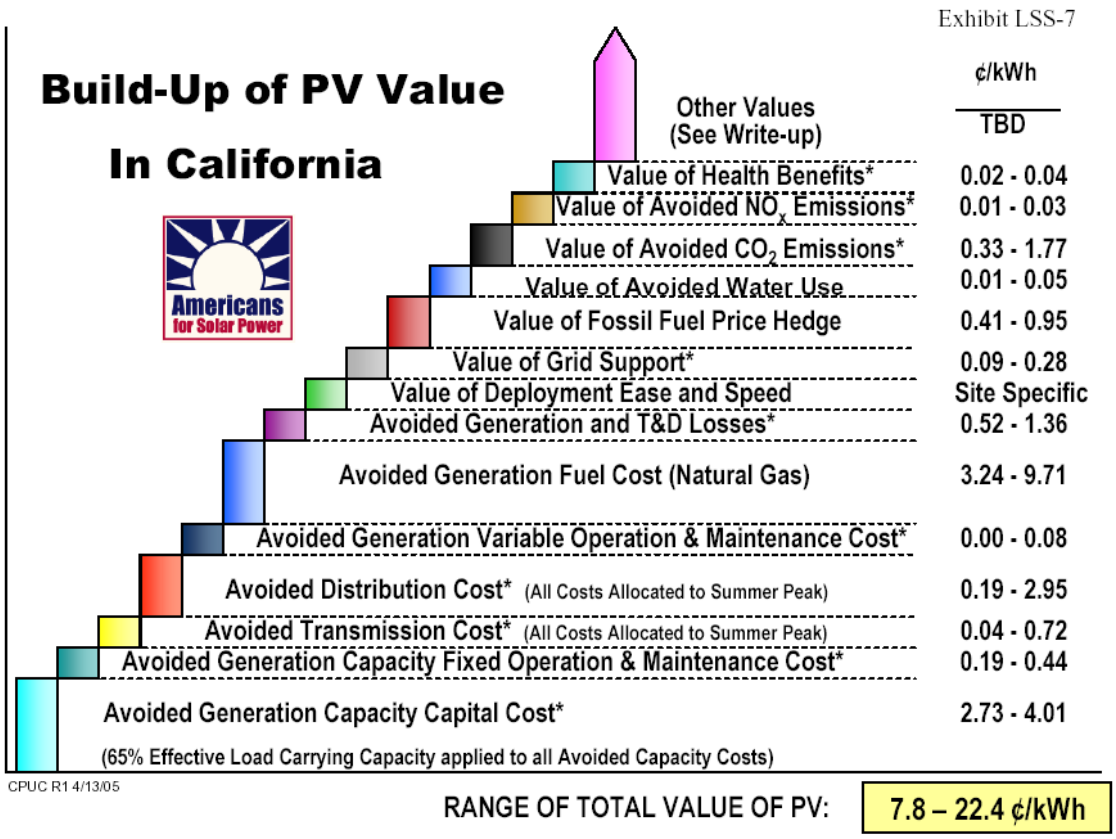
2. Ontario North Heritage Fund
- Internal energy generation for small businesses (includes PV): 50%

13.4. Calculation of the PV SOC Rate

Ontario Scenario (CAN$)			
System Size	(kW)	2	
Costs ($/kW)	($/W)	$10.00	
Total System Cost	($)		$20,000
Sun hours per day in Ontario (Toronto)	(Hours)	4.17	
PV Electricity Generated	(kWh per year)		2,400
Standard Offer Contract Subsidy	(%)	40%	
System Cost after subsidy	($)		$12,000
Ontario KWh tariff	($/kWh)	$0.11	
PV program term	(years)	10	
SOC Payments (the first year)	($)		$1,008
Feed-in Tariff over program term	($/kWh)		$0.42

13.5. Benefits of On-Grid PV

Source: Submission to the California Public Utilities Commission by the Americans for Solar Power (ASPv) coalition, May 2005



[1] Submission to the California Public Utilities; Americans for Solar Power; May 2005; http://www.forsolar.org/?q=node/98

[2] Sunny Days Ahead – Insuring a Solar Future for Canada: A Solar Plan for Canada; CanSIA, November 2004' www.cansia.ca

[3] Smart Generation – Powering Ontario with Renewable Energy; David Suzuki Foundation, 2004

[4] OSEA Ministry of Energy report, 2005