Incremental Cost of an Expansion of the WPPI and RPPI Programs to Support 12,000 MW by 2013

October 25, 2005

EXECUTIVE SUMMARY

This paper summarizes the cost of a proposed federal government program expanding support for low-impact renewable electricity generation in Canada from the current 4,000 MW (Wind Power Production Incentive, WPPI) and 1,500 MW (Renewable Power Production Incentive, RPPI) to a total of 12,000 MW by 2013. Such an incentive would support 6,500 MW of new capacity at a cost similar to what was committed to the WPPI expansion and creating RPPI in the 2005 budget. A separate incentive is recommended to support solar PV installations.

BACKGROUND

The current incentives are expected to be committed over the coming five years, ending in fiscal year 2009/10. The program expansion would extend the eligibility period for receiving the incentive until 2013. The 1,000 MW WPPI originally had a budget of $260 million, to be committed between April 2002 and March 2007. 630 MW of wind turbines had been commissioned with WPPI incentives by October 2005, and WPPI funds were fully committed in 2005, supporting 730 MW of wind power installations. The WPPI 2 budget includes funding that will allow the remaining gap between 730 MW and 1,000 MW to be closed.

It is expected that 5,500 MW of new generation will be supported by the existing WPPI and RPPI programs by the end of March 2010. The Clean Air Renewable Energy Coalition has set a target of 7% of low-impact renewable energy in Canada's generation portfolio by 2010 and 15% by 2020. This corresponds to 8,157 MW of new capacity installed between 2003 and the end of 2010, and a further 10,046 MW by the end of 2013, based on assumptions and calculations made for the Coalition document *Federal Budgetary Implications of Coalition Recommendations* of October 15, 2004. WPPI and RPPI support two-thirds of the Coalition target for 2010. **However, as these programs are supposed to be committed by the end of FY 2009, no incentives exist to support further development in the coming decade. As the years starting in 2010 are expected to see most new development happening, an enabling incentive that continues current support is proposed to enhance and intensify the deployment of low-impact renewables beyond 2010.**

Expand WPPI and RPPI Targets to 12,000 MW by 2013

Figure 1 shows the expected split between low-impact renewable energy resources to be developed between 2009 and 2013, based on Coalition targets. To support each technology fairly, Table 2 assumes WPPI 3 and RPPI 2 will support equal shares of expected generation for each particular technology (around 65%). Table 1 illustrates the total capacity supported by existing and suggested incentives.

Table 2 assumes that funds from WPPI 3 and RPPI 2 will be committed between FY 2009/10 and FY 2013/14, i.e. over a five-year period. This is a one-year overlap with existing initiatives, but with the growth expected in this industry over the coming years, existing WPPI and RPPI incentives may well be fully subscribed to earlier than in 2010. The new incentives would support 1,300 MW of new capacity per year (about 900 MW of wind and 400 MW of other renewables). Due to different capacity factors for each technology, wind and non-wind electricity generation supported would be about the same. The proposed programs would support close to two-thirds of new generation required to achieve the Coalition target, which was interpolated as 9.4% of total electricity generation by 2013. **The combined cost of these programs would be similar to the funds currently committed for expanding WPPI to 4,000 MW and creating RPPI ($1.806 billion). The actual cost (net present value) to government would be smaller, and in addition up to 33% of the funds flow back into the fiscal budget as corporate income tax.**

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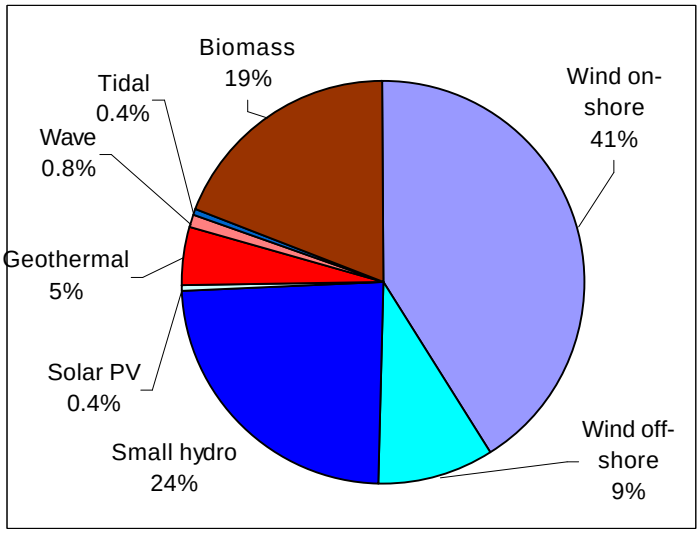

Figure 1 **Expected Split between Different Technologies; Power Generation from Facilities Commissioned Between 2009 and 2013 Based on (interpolated) Coalition Target of 15% of Total Generation in 2020**

Table 1 **Existing and Proposed Support Programs**

Program	Technologies	Timeframe	MW Supported
WPPI 1	Wind	2002-2007	1,000
WPPI 2	Wind	2005-2009	3,000
RPPI 1	Non-wind	2005-2009	1,500
WPPI 3 (proposed)	Wind	2009-2013	4,464
RPPI 2 (proposed)	Non-wind	2009-2013	2,036
TOTAL			**12,000**

Table 2 **Cost of Expanding WPPI and RPPI to 12,000 MW by 2013**

Technology	Total MW installed 2009 - 2013	Generation Share in 2013	MW financed	Capacity Factors	Financed through WPPI 3 and RPPI 2	Cost in C$ @ 1 ¢/kWh*
Onshore Wind	5,900	41.1%	3,817	27%		902,900,856
Offshore Wind	1,000	9.2%	647	36%		204,045,391
WPPI 3 Total	**6,900**	**50.3%**	**4,464**			**1,106,946,247**
Small Hydro	1,850	23.9%	1,197	50%		524,283,297
Geothermal	200	4.9%	129	95%		107,690,623
Wave & Tidal	166	1.3%	107	30%		28,226,279
Biomass	930	19.2%	602	80%		421,693,808
RPPI 2 Total	**3,146**	**49.3%**	**2,036**			**1,081,894,008**
TOTAL	**10,046**	**99.6%**	**6,500**		**64.7%**	**2,188,840,255**
Discounted				*(8% discount rate)*		*919,548,044*
After tax				(33% corporate income tax)		616,097,189

Note: Solar PV is to be supported by other measures than a WPPI expansion

Creating a 100,000 Solar Roofs Program (Solar PV)

As a result of its higher cost, solar PV needs different incentives than other renewables, and while its inclusion under an expanded WPPI/RPPI scheme is possible (at a higher rate of incentive), a separate scheme could be created instead. Such a scheme could be implemented as a 100,000 Solar Roofs program. Two types of programs are described in Appendix A, a buy-down program and a feed-in tariff.

CONCLUSION

Without taking inflation or income tax provisions into account, the total cost of the measures proposed would be around $2.6 billion in nominal dollars, or around $1.1 billion expressed as net present value (2005 dollars, 8% annual interest rate). Discounting corporate income tax (33%) for the WPPI/RPPI Program further reduces the actual cost to government for all programs including solar to $770 to 885 million. The cost of expanding WPPI and RPPI for another five years is about the same as the cost for current programs.

Table 3 also shows average annual costs for each program, as well as for all programs combined. Note that this average cost does not reflect well how the program budgets are paid out over the years. For example, the solar PV Buy-Down Program would pay out most of its funds during the last program years. Also, the cost for all programs was calculated over 14 years and therefore overvalues the last few years of a solar feed-in tariff in the calculations, whereas the ten-year buy-down program cost is undervalued. However, as the suggested WPPI3 and RPPI2 end after 14 years, this seemed to be the best period for which an average can be calculated. All values are also shown when annual payments are corrected at an 8% rate of return (discounted), and WPPI/RPPI are also shown as after-tax expenses (plus discounting).

Table 3 Aggregated Cost of New Incentives

Program	Costs of Recommended Measures from 2006/2009 to 2024 (million dollars)
WPPI 3 (4,464 MW)	1,107
RPPI 2 (2,036 MW)	1,082
PV Buy-Down Program	460
OR: 40% Solar PV Feed-In Tariff	416
TOTAL	**2,605 OR 2,649**
TOTAL discounted (8%)	***1,159 OR 1,074***
TOTAL after tax (33% corp. income tax)	855 OR 770
Average annual cost WPPI3/RPPI2 (over 14 years)	**Nominal: 156,345,732** *Discounted: 65,682,003* After tax: 44,006,942
Average annual cost solar buy-down (over 10 years)	**Nominal: 46,000,000** *Discounted:23,900,000*
Average annual cost solar feed-in tariff (over 19 years)	**Nominal: 21,894,737** *Discounted: 8,105,263*
Average annual cost all programs (over 14 years)	**Nominal: 186,060,018 OR 189,202,875** *Discounted: 76,682,003 OR 82,753,432* After tax: 55,006,942 OR 61,078,371

Appendix A

Creating a 100,000 Solar Roofs Program (Solar PV)

Due to its higher cost, solar PV needs different incentives than other renewables, and while its inclusion under an expanded WPPI/RPPI scheme is possible (at a higher rate of incentive), a separate scheme could be created instead. One option to support solar PV would be the implementation of a Solar Roofs program based on government-funded buy-downs, similar to those offered in several US states. Historically, the grid-connected market has been the main focus of government support programs across the world, which want to capture the peak-shaving benefits of solar PV electricity. Off-grid applications command a smaller share of the world market (about 10%). A federal support program for PV should therefore focus on the residential sector as individuals were shown to be the most prepared to innovate and install solar PV systems on their rooftops. The industrial/commercial sector can be expected to also install rooftop systems, but for example in Japan the residential sector is the largest, with one home builder as the largest PV buyer in the country. Limiting the size of systems to be supported to 10 kW is an option to make sure the program mainly focuses on small residential applications. In contrast to most other nations, Canada has a large potential for off-grid and remote grid applications. This sector should therefore not be discriminated against by any support program, although according to CANMET this sector is already growing steadily in Canada without specific support programs.

A PV support program could be linked in with Industry Canada's Innovation Agenda. PV is creating employment, export opportunities and environmental benefits and the development of a stable domestic manufacturing and installation industry would require, among others, that Canadian home builders innovate the way houses are built. A PV strategy could then link in with existing initiatives, such as Zero-Net-Energy Housing. The program could also be linked with EnerGuide, as solar PV is often seen as a means to "reduce" a home's energy consumption by creating a distributed energy source.

Two types of programs are described here, a buy-down program and a feed-in tariff. While buy-downs are being used in the U.S., and have been employed in the earlier years in Germany, for example, many European countries have now moved towards feed-in tariffs as they have successfully completed initial pilot and capacity development stages.

a) Buy-Down Program

For a Canadian 100,000 solar roofs program, a 2,000 Watt system size[1] is assumed (for a total of 200 MW installed), and government is expected to introduce a buy-down program that restores 30% of purchasing costs. At the moment, the cost for solar panels is about US$4 per Watt, and the installed cost is C$10 per Watt (year 2005, retrofitted systems installed on existing buildings). CanSIA expects pricing for domestic grid-connected systems to decrease by 3% per year. The 100,000 roofs program would deliver 200 MW of solar generation capacity – two-thirds of the 344 MW expected under the Coalition target for 2020. The 200 MW target would be reached by 2015, 10 years after implementing the program, starting in 2006. Installations would continue without an incentive payment after that, as solar PV is then expected to be more cost-competitive. Also, larger solar PV concentrating dishes are expected to enter the market, but are not covered by this program as they will most likely only be used for non-residential installations. Note that most of the costs are incurred towards the end of the program as initially the rate of new installations is expected to increase slowly from current rates (about 150 kW of grid-connected systems annually). While growth rates are conservative in the first years, annual doubling of installations occurs in later years. Such growth rates are not unusual and could be observed in Japan's grid-connected market between 1994 and 1999, with current annual installations in Japan amounting to over 200 MW. The German 100,000 Roofs Program encouraged the installation of 300 MW of solar PV

[1] The usual size of systems in the Japanese residential market is currently 3-5 kW. Canadian systems are mostly smaller, but are expected to grow in size over time.

systems within just four and a half years. Japan installed way over 400 MW between 1991 and 2001 (with most installations happening towards the end of the period), when solar pricing was still much higher.

Table A1 Cost of a Federal 100,000 Roofs Solar PV Program in Canada

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Total**
MW installed, by year	0.25	0.45	0.79	1.6	3.2	6.3	13	25	50	101	202
# of systems installed	125	225	394	788	1,575	3,150	6,300	12,600	25,200	50,400	~100,000
Price per W installed, C$	9.7	9.4	9.1	8.9	8.6	8.3	8.1	7.8	7.6	7.4	**-**
Cost in C$MM (30%)	0.7	1.3	2.2	4.2	8.1	15.7	30.5	59	115	223	**460**
*Discounted cost**	*0.7*	*1.2*	*1.8*	*3.3*	*5.8*	*10.4*	*18.5*	*33*	*59*	*105*	***239***

* Net present value, at 8% annual interest rate, in 2005 dollars

b) Creating a Solar PV Production Incentive

CanSIA is asking for a special feed-in tariff for solar PV installations, similar to the mechanism that Germany is using very successfully to further solar development. This tariff would require grid operators to pay a solar generator $0.42 per kWh produced, covering about 40% of life-cycle costs. A federal ten-year production incentive equivalent to this amount would pay slightly less, as savings are incurred by the electricity produced by solar PV systems[2]. As power prices increase and the cost of solar PV installations decreases, the amount paid per unit of electricity through such an incentive program could be reduced further over time. It can be calculated as

Production Incentive = life-cycle cost of solar PV ($/kWh) x 40% - residential cost of grid electricity

Table A2 Selected 2005 Residential Electricity Pricing in Canada

Provider	Residential Pricing
Nova Scotia Power	10.89¢/kWh (proposed for 2006)
Newfoundland and Labrador Hydro	8.46¢/kWh
New Brunswick Power Corporation	8.37¢/kWh (first 1,300 kWh) 6.63¢/kWh (balance)
Maritime Electric, PEI	10.33¢/ kWh (first 1200 kWh) 8.01¢/ kWh (balance)
Hydro Quebec	5.02¢/kWh (first 30 kWh per day) 6.33¢/kWh (balance)
Toronto Hydro	5.0¢/kWh (first 1,500 kWh, bi-monthly) 5.8¢/kWh (balance) 1.04¢/kWh Transmission Charge 2.01¢/kWh Distribution Charge
ENMAX (Alberta)	8.5 ¢/kWh (3-year) 8.0 ¢/kWh (5-year)
BC Hydro	6.05¢/kWh

The delivered cost of electricity varies considerably across Canada, and the resulting incentive payment would therefore vary from province to province. Table A2 provides an overview of some electricity offers in Canada. Some provinces charge a separate per-kWh amount for transmission and delivery, whereas others integrate these costs into the electricity tariff. To calculate the actual subsidy required, it is assumed that fixed monthly or bi-monthly costs will still have to be paid, whereas electricity and delivery costs which are charged per kWh can be avoided for each kWh produced by the grid-connected PV system. Figure A1 also illustrates electricity costs in Canada, but reflects both fixed and variable cost items on Canadian electricity bills.

[2] Savings can come from net metering programs, such that energy and delivery charges are reduced by the kWh produced by the system. If the tariffs are paid to the customer through the local retailer (possibly resulting in a negative electricity bill), the latter can sell the electricity the customer produced to another customer, i.e. the government subsidy could be reduced by the amount the retailer obtains from this sale.

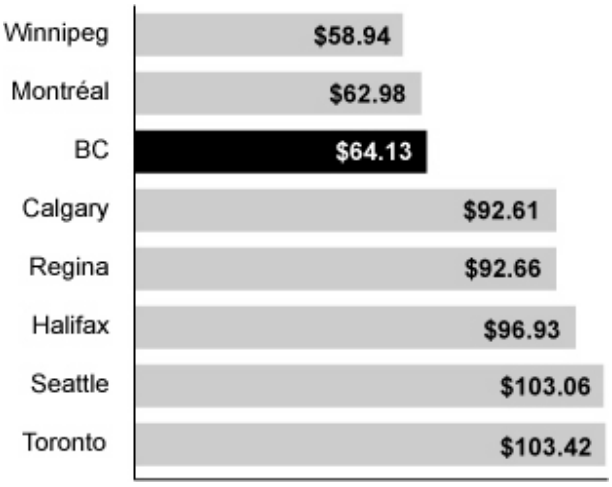

Figure A1 Residential Electricity Rate Comparison. Based in 1,000 kWh of monthly consumption, BC Hydro has compiled this rate comparison, based on 2004 tariffs. The price indicated does include delivery and basic charges, but no taxes. (Source: BC Hydro website)

Some provinces, such as Ontario and Nova Scotia, are offering or planning on introducing time-of-day billing, which is likely to improve the economic viability of solar PV, which frequently produces at full capacity during periods of peak demand. Based on Table A2 it is assumed that the average Canadian residential electricity price is 7¢/kWh, and increases 2% per year in the future. For off-grid applications, a feed-in tariff could provide the full subsidy amount of 40% of investment cost. To avoid a proliferation of small-scale contracts, a minimum system size of 1 kW could be prescribed. In remote grids, current electricity costs may be as high as the subsidy, which means that such applications would not receive an incentive under this program, seen they are already encouraged by local circumstances.

As can be seen from Table A3, the overall cost of such a program ($416 million) would be very similar to the buydown program suggested under a, but would be paid out over a much longer time frame. Annual payments would peak in 2015 at $43 million, and would then decrease to zero by 2025. Calculating the cost as Net Present Value in 2005 dollars (8% annual interest rate) brings the actual cost of the program down to $154 million.

To reduce the administrative cost of such a program, innovative mechanisms could be explored that include the PV system vendor as a beneficiary. Paying the incentive to vendors, who may in turn lease the PV system to their customers, may reduce lease fees, but keep administrative costs down for the government program, which only has a limited number of companies to be paid, instead of many thousand customers across Canada. Another method would be an integration of the subsidy into customers' electricity bills, and payment of the incentive to utilities instead of directly to single customers.

Detailed Data on Solar PV Incentive Payment

Table A3 Assumptions for Solar PV Incentive Payment

Program Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
MW installed	0.25	0.45	0.79	1.58	3.15	6.3	12.6	25.2	50.4	101	(new installations continue without subsidy)									**202**
Electricity supported (GWh)	0.24	0.67	1.43	2.95	5.99	12.06	24.20	48.48	97.05	194	194	194	193	191	188	182	170	146	97	
Electricity price (¢/kWh)	7.00	7.14	7.28	7.43	7.58	7.73	7.88	8.04	8.20	8.37	8.53	8.70	8.88	9.06	9.24	9.42	9.61	9.80	10.00	
Cost of PV ($/kWh)	0.97	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65	0.63	0.61	0.60	0.58	0.56	
Subsidy (40%, in ¢/kWh)	31.78	30.47	29.20	27.96	26.75	25.57	24.42	23.29	22.19	21.11	20.06	19.03	18.03	17.04	16.08	15.13	14.21	13.30	12.41	
Subsidy (total, in C$MM)	0.08	0.21	0.43	0.85	1.66	3.20	6.15	11.76	22.46	42.81	42.41	41.96	41.41	40.67	39.56	37.76	34.67	29.11	18.92	**416**
Discounted cost	*0.08*	*0.19*	*0.36*	*0.66*	*1.19*	*2.11*	*3.73*	*6.56*	*11.53*	*20.21*	*18.42*	*16.77*	*15.23*	*13.76*	*12.31*	*10.81*	*9.13*	*7.05*	*4.22*	***154***

MW installed: The installation rate needs to increase significantly from currently about 0.15 MW/year; initially 75% increase from year to year, later doubling of annual installations

Electricity supported: Under 10-year contracts, this is the amount of solar PV generation to receive the subsidy, based on a 17% capacity factor and a 65% system efficiency (annual generation = peak capacity x capacity factor x 8760 hours/yr x system efficiency)

Electricity price: Current average Canadian residential electricity price, assumed to increase by 2% per year

Cost of PV: This is the PV life-cycle cost. The calculation assumes the same per-MW installed costs as given in Table 3, and an 8% interest rate with continuous compounding over 25 years.

Subsidy (40%) This is the subsidy to be paid per kWh for all generation coming on-line in that year. It is calculated as life-cycle cost in the year of installation less electricity cost in the year the subsidy is paid out. The subsidy would cover 40% of life-cycle costs for the first ten years of system life.

Subsidy (total) Total annual payments from the program. Payments continue until 2024 as the last system is commissioned in 2015 and receives the subsidy for 10 years. To calculate the incentive paid to projects each year, it was based on 40% of life-cycle costs in the year it was commissioned, but reduced by the actual power price, i.e. the payment decreases slightly over time for all installations (details not shown in the table).

Discounted cost Net present value of incentive (in 2005 dollars), assuming an 8% annual rate of return (not compounded)