Background Document for the Green Power Workshop Series

Workshop #4 – February 9 and 10, 2004

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for
Pollution Probe and Summerhill Group

This background paper is intended to be used as a resource by participants in subsequent workshops in the Green Power Workshop Series. It is not the final workshop series report and does not necessarily incorporate all information and all comments received from participants. It does, however, attempt to present useful and balanced information as the workshop series progresses.

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Introduction

The development and diversification of a nation's renewable energy portfolio provides an opportunity for countries to reduce emissions of greenhouse gases and other pollutants of concern associated with traditional electricity generation. "Green power" (i.e., low-impact renewable energy) development in many countries is flourishing as national and provincial governments provide effective incentive strategies to promote implementation of these technologies (e.g., the United States, Australia, the Netherlands, Denmark and Germany). Although Canada is a world leader in terms of waterpower development, with nearly 60 per cent of electricity supply provided through such facilities, Canada lags most OECD countries in its development of green power/low-impact renewable energy technologies. Approximately 1.2 per cent of the nation's electricity is currently derived from non-large hydro renewable energy sources.[1]

Most jurisdictions with significant levels of green power uptake typically have well-coordinated national and regional programmes. A number of important green power initiatives are in the development stage or are underway in Canada at the federal, provincial and private sector levels. Industry experts, however, have identified the absence of a comprehensive national strategy for low-impact renewable energy as a weakness in Canada's approach.[2] In Canada, the federal-provincial division of responsibility for electricity supply, which gives the majority of responsibility to the provinces, makes it difficult to implement comprehensive national programs. Federal incentive programs thus face difficulties in fully accounting for the regional nature of renewable energy supplies and related green power developments across Canada.

It is timely for Canada to explore in depth the role that new sources of low-impact renewable energy can play in both complementing and providing alternatives to traditional electricity supplies. This is the impetus behind the Green Power Workshop Series organized by Pollution Probe and the Summerhill Group. In consultation with leaders from the private, public and non-government sectors, the workshop series is designed to identify the range of options for, and steps Canada can take to promote, the development of new low-impact renewable technologies and energy sources in Canada. The workshop series is designed to build support for a national strategy for "green power"[3] development in Canada.

The objectives of this workshop series are:

1. To engage a diverse range of energy sector experts;
2. To present and discuss recent developments in technology, policy and business investments pertaining to green power; and,
3. To build consensus around a vision and strategy for the development of green power in Canada.

[1] PP. 2002.

[2] Lourie, B., C. Hilkene and M. Felder. 2002. "Encouraging Demand for Green Power in Canada." *(Paper in development)*

[3] At this stage in the workshop series (i.e., Workshop #3) the issue of defining "green power" has not been discussed in depth. This issue will be opened for comment following Workshop #3 and will be discussed at Workshop #4 in Calgary.

The purpose of this discussion paper is to provide workshop participants with a common level of information and analysis on green power in Canada. The discussion paper is a "living document" that will be revised throughout the workshop series to capture the expertise of the invited speakers and the discussions among participants. The document will ultimately set out a context and options for building a vision and strategy for the development of green power in Canada. To access or download related documents and to view further workshop details, go to

www.pollutionprobe.org/Happening/Index.htm.

Note to Readers: At this time, the paper offers an initial backgrounder for green power discussions. It will be developed and refined as the workshop series progresses and as we receive your comments.

We invite your comments and participation at the workshops to assist us in working towards a national vision and strategy.

Invited Reviewers: Please e-mail your comments directly to **martin.tampier@telus.net** and copy **mfelder@summerhillgroup.ca**.

All Readers: To get further details and access background documents, go to

www.pollutionprobe.org/Happening/Index.htm.

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Pollution Probe and Summerhill Group are acquiring greenhouse gas emission reductions to make Workshop #3 emissions neutral. This deal has been made possible by CO2e.com (Canada) Company. Emission reductions will be acquired from a Canadian emission reduction project and retired by Pollution Probe and Summerhill Group.

Discussion Guide

In reviewing this Background Document, we encourage you to focus on the areas of greatest importance to you. We welcome all suggestions and comments, particularly in the following discussion areas that are relevant to Workshop #4. While general comments are welcome, we are particularly interested in specific comments that address particular sections and outcomes from each workshop. Additional questions will be put in the Background Document as the Workshop Series progresses.

1. What changes would you like to see made to specific sections of the discussion document? What new points would you add?

2. What is your organization doing on green power? What is being planned?

3. How would you propose to define “green power”?

4. How do existing federal, provincial and municipal measures help or inhibit the development of new green power projects?

5. What would you like to see in a national vision and strategy for green power in Canada? Why?

6. What, in your opinion, are achievable green power targets for 2010, 2015 and 2020?

7. What governmental incentives and supporting policies and programs are needed to develop the green power/low-impact renewable energy sector across Canada — and to support a national vision?

Background – Green Power

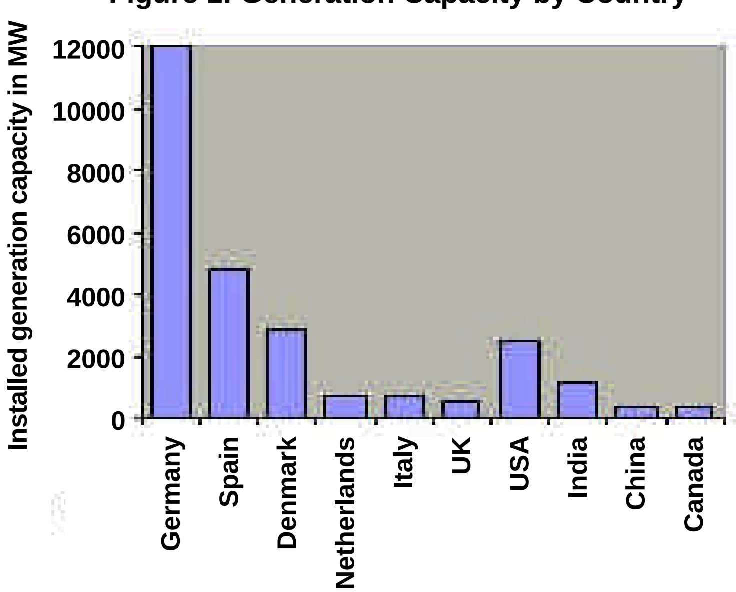
Canada has excellent low-impact renewable energy resources, the increased development of which could lead to major reductions in emissions of both greenhouse gases and other pollutant emissions, as well as diversify and strengthen the energy economy. Until recently, conditions in Canada have not been favourable to create flourishing and thriving markets for renewable energy, as compared to those in place in the United States, Europe, Australia and India.

Globally, wind and solar markets have experienced double-digit annual growth rates for the past decade. In some countries, wind power is growing by as much as 30 per cent annually. Figure 1 shows 2002 data for installed windpower generation capacities in various regions. According to Figure 1, Germany, Spain, Denmark, the United States and India are well ahead of Canada in terms of green power generation. Renewable energy development in these countries has created employment opportunities (e.g., 35,000 jobs as a result of wind industry development in Germany) as well as viable export markets (e.g., Denmark is the world's number one exporter of wind turbine technology).

Canada lags other OECD countries in terms of green power development.

In Canada, the federal government has implemented some measures to support green power technologies, such as wind power (i.e., the Wind Power Production Incentive). However, these measures do not compare in magnitude to incentives provided in the United States and are far behind the support provided in some leading European countries. By not further developing green power resources, Canada could miss achieving the benefits of domestic capacity-building opportunities and green power export markets, as well as the benefits to health and the Canadian environment.

Figure 1: Generation Capacity by Country

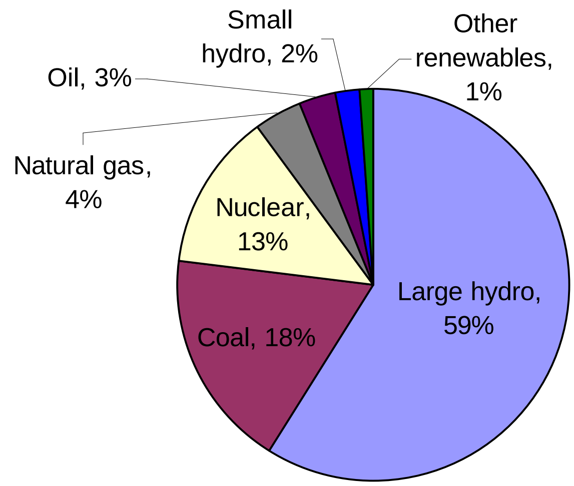


An Overview by Technology

Currently, about one per cent of Canada's electricity is derived from renewable energy other than large and small hydropower (Figure 2). Of all renewable energy technologies, small hydro and biomass are the most prevalent (Table 1).

- Small hydro is already providing two per cent of electricity, and is expanding rapidly.
- Across Canada biomass has primarily been used in the pulp and paper sector for both on-site power and heat generation; however, there is increasing use of biomass-fed power stations to generate electricity delivered to the grid, especially in British Columbia and Québec.

Figure 2: Current Electricity Generation Mix in Canada



Source: CAREC. 2003.

Table 1: Installed Renewable Energy Capacity in Canada

Technology	Installed Capacity (MW)
Onshore Wind	313
Offshore Wind	0
Small Hydro	1,800
Solar PV	10
Biomass	1,628
Geothermal	0
Wave Energy	0
Tidal Energy	20
Landfill Gas	85

Source: PP. 2002. Solar and wind data updated.

- Solar photovoltaics (PV) are currently mainly used in decentralized units spread across Canada, including remote communities.
- Solar thermal electricity generation is currently not considered to be commercially exploitable in Canada, although the use of non-electricity solar thermal applications, such as pool heaters, is expanding.
- Geothermal energy is being considered in British Columbia.

According to the Natural Resources Canada publication Energy in Canada 2000, Canada's total electricity generating capacity was 112,606 MW in 1997. The total installed renewable energy (not including large hydro) capacity listed in Table 1 is 3,856 MW. The following sections provide more detail on low-impact renewable energy resources by generation type.

Hydro-Québec has been experimenting for several years with wind power, especially in the Gaspé area where capacity factors are very high. The provincial government has required the crown utility to install 100 MW of wind power generation capacity annually until 2013.

In Alberta, wind power is driven by demand from green power programs, such as ENMAX's "Greenmax" and EPCOR's "Eco-Pack." It also benefits from large investments by Vision Quest, which is currently Canada's largest wind developer and was recently acquired by TransAlta.

Windpower

Table 2 provides an overview of installed wind energy by province/territory for Canada. Currently, most of Canada's wind power capacity is installed in Québec and Alberta (102 MW and 171.5 MW, respectively).

Canada's onshore wind potential is largest along its coastal areas and Hudson Bay. Specific inland areas, such as Pincher Creek in Alberta, Sudbury in Ontario and parts of the Maritime provinces have comparable resources with wind speeds of 15 km/h.[4] A previous analysis by Natural Resources Canada identified an overall potential of 28,000 MW for wind power generation in Canada.[5] Due to significant improvements in wind turbine technology and the potential for offshore wind farms, the Canadian Wind Energy Association (CanWEA) currently estimates that the actual potential approaches 100,000 MW.[6]

There are no offshore windfarms in Canada, although some companies, such as SeaBreeze Energy in British Columbia, are working towards developing such projects. Offshore wind plants can be easily installed in the shallow waters of the West Coast, but the deeper ocean floor off the East Coast poses greater difficulties for development. The magnitude of Canada's offshore wind power potential has not been assessed. However, the offshore potential of the North Sea (off the coast of Europe) has been evaluated and is estimated to be 3,000 TWh per year — three times the consumption of the five bordering countries.

4 Morris. 2003.
5 NRCan. 1992.
6 CanWEA. 2003.

Table 2: Installed Wind Power Generation Capacity by Province

Province	Installed Capacity (MW)
Newfoundland	0
PEI	5.3
Nova Scotia	1.3
Quebec	102
Ontario	14.5
Manitoba	0
Saskatchewan	17.2
Alberta	171.5
British Columbia	0
Yukon	0.8
Northern Territory	0
Nunavut	0

Source: CanWEA. 2003.

Offshore Wind Plants in the UK

***October 2003* —** Four MW of offshore wind capacity installed
***2006* —** 1,500 MW (planned)
***2010* —** 7,500 MW (estimated)
***2010* —** 8,800 MW (estimated total capacity offshore and onshore wind)

Source: Enjeux-Énergie, Centre Hélios, Vol.2 No. 22, Nov. 5, 2003.

Small Hydro

The current capacity of all small hydroelectric facilities in Canada is about 1,800 MW, with an annual production of 9,000 GWh.[7] Small hydro has for some time been considered to be Canada's largest contributor to the green power sector. But not all existing small hydro facilities would qualify as low-impact renewable energy according to various definitions, whereas some large (run-of-river) projects might be. Many small hydro sites use storage facilities similar to large hydro projects. The current trend in certified green power (including the Canadian Ecologo) is to only recognize run-of-river hydro projects that do not interfere with seasonal waterflow and that minimize impacts on fish and flooding patterns.

Québec and Ontario have the largest undeveloped small hydro resources, followed by British Columbia and Newfoundland. Natural Resources Canada has developed an inventory of more than 3,600 potential small hydro sites throughout Canada, with a technical potential assessed at about 9,000 MW.

[7] NRCan. 2002. p. 9.

According to Innergex:[8]

- 4,000 MW of large and small hydro potential has been identified in Ontario, 1,000 MW of which has been set aside for the private sector to develop.
- The Independent Power Producers of British Columbia have listed a large number of creeks, with a combined small hydropower generation potential of 400 to 800 MW, at a price of between $50 and $70 per MWh. Including more remote sites, as much as 1,000 MW could be developed in British Columbia. Some of this potential is currently being realized.[9]
- A memo by the Québec Renewable Energy Producers Association lists 53 projects that could deliver a total of 862 MW of small hydropower at a price of $80 per MWh or less.
- In addition, Alberta and Newfoundland have significant small hydropower potentials.

Solar Photovoltaic (PV)

In Canada, the installed capacity of solar PV panels amounted to approximately 10 MW in 2002 (estimate), up from one MW in 1992. Most capacity has been installed as off-grid distributed energy generation. Some pilot on-grid systems have been installed, approximating 92 kW of installed capacity between 1995 and 1999. The annual growth rate of installed PV capacity has been about 20 per cent.[10]

The largest solar resources in Canada can be found in southern Ontario, Québec and the Prairies. The territories have a smaller potential because of their higher latitude, which results in less direct radiation. However, if south-facing or solar-tracking (moving) solar panels were used, the largest resource potentials could be found in the southern Prairies as well as the more northern areas of Saskatchewan. The southern tip of Ontario also has good potential.

The amount of solar energy available varies with season, and also with weather conditions, latitude and time of day.[11]

Biomass and Landfill Gas

The Canadian pulp and paper industry, together with independent power producers, generates important amounts of electricity from wood wastes and spent pulping liquor, much of which is used internally by industry.[12] The current generation capacity of the pulp and paper industry and the independent power producers amounts to 1,500 MW and 128 MW, respectively. In 1999, the electricity production of the independent power producers sector was reported as 6,393 GWh.[13] The organic fraction of municipal waste is also considered to be biomass. Current electricity production from municipal waste incineration (Ontario only) is about 747 GWh/a.[14]

A preliminary analysis conducted by Pollution Probe in 2002 concluded that significant potential exists for power production from energy crops, such as switchgrass, as well as from forestry and agricultural waste.[15] More

8 Trudel. 2003.
9 BC Hydro pays more than 5.5 cents/kWh to independent power producers as part of its commitment to source 50 per cent of its new generation from renewable sources. The latest call for proposals resulted in 14 small hydro projects being accepted.
10 NRCan. 2002. p. 25.
11 Morris. 2003.
12 NRCan. 2002. p. 7.
13 Ibid. p. 13.
14 Ibid. p. 16.
15 PP. 2002. p. 117.

than seven per cent of Canada's annual consumption could be produced by electricity made from biomass. However, competing demands on limited biomass resources, including the use of biomass to produce ethanol, heat and hydrogen, or its use as raw material in other products, may reduce opportunities to make electricity from this source.

- In British Columbia, several sawmill and forestry companies are exploring biomass-to-power opportunities, and some new biomass power plants will come on-line in the next few years. The province is leading the field in Canada, with more than 700 MW of generation capacity (see Appendix 2).
- Québec already has 270 MW of biomass-based generation and Hydro-Québec is expected to bring 200 MW of biomass-derived electricity on-line over the next few years due to a provincial requirement.
- Ontario's biomass generation capacity amounts to 445 MW.
- Alberta and New Brunswick have less than half the amount that Ontario has installed, and other provinces have less than 100 MW combined.

Landfill gas is derived from the organic fraction of waste and is considered to be a biomass resource. Canadian electricity production from landfill gas (currently implemented at eight sites in British Columbia, Ontario and Québec) is 85.3 MW. So far, only larger landfills have been equipped with methane capturing systems, and approximately half of these use the energy in the gas to produce electricity. The management of landfill gas can reap double benefits in terms of carbon credit trading, through reducing greenhouse gas emissions and from displacing fossil fuel-based electricity. Landfill gas is included in the current draft of the Canadian Offset System developed by Environment Canada.

Canada's biomass resource is significant and represents a much larger factor in its economy than in the US, where biomass represents a much smaller share of the energy portfolio. Canada's residual biomass could theoretically provide 25 per cent of energy currently obtained from fossil fuels, and an increase of wood production from forestry by 25 per cent could provide another 16 per cent.[16]

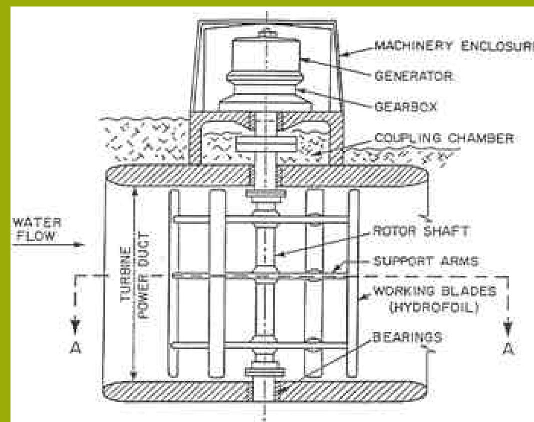
Geothermal Energy

Geothermal energy is available throughout North America, but is only commercially viable where hot and abundant geothermal fields are situated. In Canada, these conditions are mainly found in British Columbia. North Pacific Geopower is one of the companies developing geothermal power projects in Canada. For single-flash steam technology, the resource in British Columbia could be as large as 3,000 MW.[17]

Geothermal energy is also one of the least expensive renewable energy resources — at the Geysers site in California, power is produced for only 1.5 cents/kWh (US), while other sites in the US produce for 3.3 to 3.9 cents/kWh, making geothermal less costly than most wind and biomass sources. At Meager Creek in British Columbia, costs of between 3.9 and 4.1 cents/kWh (US) are expected (5.9 Canadian cents/kWh, with further price reductions to five cents/kWh in the future). The cost for geothermal energy has declined over the past years, and another reduction of 25 per cent between now and 2020 is expected.[18]

[16] Layzell. 2003.
[17] McLeod. 2003.
[18] Ibid.

The Davis Turbine: A Canadian Concept



The Davis Hydro Turbine can be compared in design and output to an ultra-efficient underwater windmill. Four fixed hydrofoil blades are connected to a rotor that drives an integrated gearbox and electrical generator assembly. The turbine is mounted in a durable concrete marine caisson that anchors the unit to the ocean floor, directs the water flow through the turbine and supports the coupler, gearbox and generator above. The hydrofoil blades employ a hydrodynamic lift principle that causes the turbine foils to move proportionately faster than the speed of the surrounding water. Computer optimized cross-flow design ensures that the rotation of the turbine is unidirectional on both the ebb and flow of the tide.

The transmission and electrical systems are similar to thousands of existing hydroelectric installations. A standardized high production design makes the system economical to build, install and maintain. The system's modular design is capable of meeting any site application from five to 500 kW for river applications, and from 200 to 8,000 MW for ocean installations.

Source: www.bluenergy.com.

Other Canadian tidal power concepts are promoted by Clean Current in British Columbia (www.cleancurrent.com) and Soluna Energy Company Ltd. in Nova Scotia.

Wave Energy

Both wave and tidal energy are being targeted by the International Energy Association's "Ocean Energy Implementation Agreement." While these energy forms are being taken seriously at the international level, Canada, although in possession of the some of the most significant resources in this area, has not supported the development of these promising technologies. Ocean technologies are approximately five to 10 years behind wind technology today, but proponents believe they could be developed rapidly with the appropriate level and design of support.

World resources of wave power are estimated at between one and 10 TW of installed capacity. At a 30 per cent capacity factor, one TW of wave power could provide five times the electricity Canada consumes in a year (about 600 TWh).

In Canada, West Coast wave power resources have been assessed at 6.1 GW of installed capacity, and East Coast resources, which have not been similarly assessed, are estimated at between four and 10 GW.[19]

[19] Triton, 2003.

These figures are for onshore potentials only — the offshore wave power potential is estimated to be even higher.

At least one Canadian company, Wavemill Energy Corporation in Nova Scotia, is developing a wave energy concept. On the West Coast, two suitable sites have been identified on Vancouver Island where some 400–500 MW could be installed.[20] Until recently, BC Hydro had planned to develop a four MW wave demonstration project near Vancouver Island. However, as a result of restructuring, BC Hydro has lost its mandate to invest in research and design, and the demonstration project was cancelled.

Tidal Energy

Worldwide, tidal stream resources are enormous and have been estimated at five TW of installed capacity. In Canada, the total West Coast resources have been assessed at two to three GW, and the East Coast potential is an estimated 0.5 to 1.0 GW.[21] BC Hydro commissioned an analysis of BC's coastal tidal stream energy potential in 2002. The results of this analysis are posted on BC Hydro's website.[22] One site near Campbell River, called Discovery Passage, features some of the largest tidal resources in the world, with a peak flow rate of 15 knots per hour. The tides coming into this area create especially large currents, which could allow 600–800 MW of capacity to be installed.

The development of the technology to harness tidal energy is still in the early stages. The simplest technology uses a barrage, or dam, to hold back the water at high tide then releases it at low tide to generate electricity. The Annapolis Royal Tidal Power Generating Station in the Bay of Fundy in Nova Scotia is a pilot project built in the 1980s to demonstrate and test this early technology. There are concerns today about the environmental impacts of these types of generating stations on fish and other ocean shore fauna. The industry has developed a different concept, called tidal stream. This technology does not block the tidal waterflow, but extracts energy using underwater devices similar to wind turbines. Tidal stream technology is being tested at small-scale pilots in France, Norway and Scotland, but is expected to be commercially available soon. Several companies in Canada are developing tidal stream technology, including Blue Energy and Clean Current in British Columbia, and Soluna Energy Company Ltd. in Nova Scotia.

[20] PP. 2002. p. 118.
[21] Triton. 2003.
[22] See www.bchydro.com/rx_files/environment/environment3928.pdf.

Renewable Energy Potential in Canada

Table 3 summarizes the technical potentials identified by stakeholders.[23] Renewable energy could take a more prominent position in energy generation as its overall technical potential has been estimated to be 77 per cent of current generation.

Canada's technical green power resource potential could cover more than three-quarters of its current annual electricity consumption.

Table 3: Renewable Energy Potentials in Canada

Technology	Technical Potential (MW)	Capacity Factor	Overall Generation Potential in Canada (GWh)
Wind (onshore)	100,000	35%	306,600
Small hydro	>3,000	50%	>13,140
Solar PV			12,000*
Biomass			49,000 or more*
Geothermal in BC	3,000	95%	25,000
Tidal Energy	3,000 or more	35%	9,200 or more
Wave Power	10.100 – 16.100	35%	31,000 or more
Total	**>120,000**		**445.9 TWh or more**
Conventional (current annual generation in Canada)			576.4 TWh

** these estimates taken from CAREC. 2003.*

[23] Pollution Probe/SummerhillGroup. Montreal Workshop Proceedings. November 3 and 4, 2003.

Federal and Regional Perspectives

This section provides a brief overview of some existing and emerging federal and provincial initiatives to support low-impact renewable power. Some of the most significant developments are listed below.

Federal Measures

The 1.0 cents/kWh Wind Power Production Incentive (WPPI) was established in 2002 to assist the development of windpower in Canada. The WPPI will be in place for five years and is intended to assist in the development of 1,000 MW of new wind generation by 2007. This incentive provides a per-kWh payment to approved wind power projects throughout Canada. It was initially valued at 1.2 cents/kWh and will drop to 0.8 cents by 2006. The WPPI incented more than 90 MW of wind capacity in its first year of operation, especially in areas with high capacity factors, or on farms where leasing land for wind turbines offered another source of income.

The Market Incentive Program is another federal program that provides funds to power retailers trying to create a customer base for green power products. The program covers up to 40 per cent of eligible marketing costs and is funded with $25 million. It was initiated in 2002 and ends in March 2006.

Other federal measures include:

- CANMET, which is a Natural Resources Canada program that assists the development of green power technologies in Canada.
- The Renewable Energy Deployment Initiative (REDI), which targets distributed generation, such as solar thermal technology.
- The Industrial Research Assistance Program and Sustainable Development Technology Canada, which are both initiatives that support the development of renewable energy technologies.
- A 20 per cent green power procurement target (by 2005) for all government departments. This latter program has led to the development of new wind farms in Saskatchewan and Prince Edward Island.

Existing Canadian federal tax incentives for renewables include the Canadian Renewable Conservation Expense (CRCE) deductions under Sections 66 and 66.1 of the Income Tax Act, as well as deductions from accelerated depreciation of the Schedule II, Class 43.1 equipment utilized in a project.

- The CRCE allows for the deduction of 100 per cent of the cost incurred in the first year. Although helpful during the exploration phase of a renewable power project, the CRCE cannot reduce the actual power generation costs of projects as it only covers non-tangible expenses, such as technical assessments and feasibility studies.[24]
- Accelerated depreciation of 30 per cent per year (Class 43.1) covers the actual capital cost of a project. The Canadian Electricity Association has asked the government to expand the application of Class 43.1 to allow a wider range of emerging renewable energy technologies to qualify for the 30 per cent incentive rate.[25]

[24] CEA. 2002. p. 6.
[25] CARE. 2003(1).

Provincial Measures

Provincial renewable portfolio standards are being discussed in Alberta, New Brunswick, PEI and Nova Scotia, and have been announced recently by the Ontario government. Other measures currently in place for various provinces include:

- British Columbia has established a voluntary target to procure 50 per cent of new generation from renewable energy and natural gas.
- Alberta has set a target for renewable energy of 3.5 per cent of total generation by 2008. The Alberta government has also committed to a green power procurement target of 90 per cent for its own facilities.
- Québec has required 1,000 MW of wind and 100 MW of biomass-based generation to come on-line by 2012.[26]
- The former Ontario government announced a support package for renewable energy, including a 20 per cent procurement target, as well as property, income and sales tax incentives (see Appendix 1).
- Ontario, British Columbia, Nova Scotia, New Brunswick and PEI are all considering the introduction of net metering rules.
- New Brunswick will open its markets to some degree of retail competition, allowing large industrial and wholesale customers to choose their providers. This legislation is expected in April 2004, allowing decentralized facilities to re-sell their electricity generation back into the grid.

In many parts of Canada, there is interest in strengthening regional cooperation with neighbouring provinces. New Brunswick and Nova Scotia, for example, will have new generation capacity needs by the year 2007, meaning that cooperation and joint resource planning would be a logical step.

Utility Measures

Several utilities have started to invest in renewable energy, and some are offering green power products to industrial and retail customers. The Alberta utilities EPCOR and ENMAX were among the first in Canada to offer green power options to their customers. BC Hydro, Ontario Power Generation and some independent green tag providers in Ontario are offering green certificates. SaskPower has committed to buying 15 MW of “environmentally preferred power” each year over the next three years, and has also committed to invest in large-scale wind power plants. Nova Scotia Power and Maritime Electric Company also offer green power to their customers.

Private Investments

Private investments in the Canadian green power sector are mainly focused on wind energy projects. These include:

- Suncor, which has committed to an investment of $100 million in renewable energy facilities, until 2005, as part of its corporate climate change strategy. In a 50/50 partnership, called the SunBridge Wind Power Project, Suncor and Enbridge have developed the Gull Lake wind farm in Saskatchewan at a cost of approximately $20 million. Suncor also invests in wind power in Alberta. Planning permission was obtained in 2003 for a 30 MW wind power project in Magrath, Alberta. Together, the two projects are expected to provide nearly 15 per cent of Canada’s total wind power generation.
- TransAlta, which is another important player in the Canadian wind power market. The company is now Canada’s largest wind power provider, having acquired Vision Quest, with a generation capacity of nearly 120 MW.

[26] QC. 2003.

- Canadian Hydro Developers, which is an important developer of wind and biomass energy. The company owns nearly 50 MW of wind power turbines and several biomass/biogas and small hydro plants, with a total generation capacity of 104 MW.
- Shell and Manitoba Hydro, which have partnered to explore windpower opportunities by entering into an agreement to jointly explore the development, construction, ownership and operation of wind power generation capacities in Manitoba.
- JD Irving, which has invested in alternative power systems in the Maritimes, including small hydro, wind power and biomass technologies.
- Lastly, many other developers are currently working on wind power projects throughout Canada and have applied for the WPPI, as documented on the Natural Resources Canada website.[27] There are many private developers in other renewable resource areas, such as biomass and geothermal energy, and Canada also has a small manufacturing industry for PV, wind and water turbines, and tidal power technologies.

See Appendix 1 for an "Overview of Federal, Provincial and Private Measures to Further Green Power Development."

Synergies Between Federal and Provincial Measures in the Maritimes

Federal and provincial governments in Canada are showing increasing interest in exploring the potential for green power to help address such issues as energy security and supply, air quality, health concerns and climate change. Many of these jurisdictions have processes underway to evaluate or restructure the electricity sector and are considering the role green power can play in these endeavours. The following points provide an overview of emerging opportunities for renewable energy development identified for the Maritimes.

- The Maritimes expect an electricity deficit by 2007. Natural gas seems to be a questionable option due to price instability and the emission of criteria air pollutants, the opportunities that renewable energy offers are being considered as provinces like New Brunswick restructure their power systems. There is some uncertainty, however, about how much future growth in electricity demand can be met by renewables, what kind of support they need (if any), how to define "green" power, and what the appropriate policy measures are to support development.
- Nova Scotia released an Energy Strategy in 2001 and established an Electric Market Governance Committee to conduct a public consultation process on the Energy Strategy. This committee documented clear public support for green power. The Committee's Interim Report, while focused on traditional fuel sources, made several recommendations related to green power. These include a target of 50 MW for new renewable energy generation, allowing net metering for generators up to 100 kW in capacity, and adopting a Renewable Portfolio Standard (RPS) by 2006.

[27] See www.canren.gc.ca/programs.

- PEI has one of the highest electricity costs in Canada, in part due to a lack of hydropower and other traditional power resources. PEI is currently conducting a public consultation process to develop a renewable energy strategy for the province. The draft strategy recommends net metering, feed-in tariffs, and increasing the percentage of wind power from two to 10 per cent of electricity generation by 2010.

These jurisdictions are all discussing various options, such as renewable portfolio standards, net metering and other options that were not considered just a few years ago.

The Situation in Québec

The energy situation in Québec changed drastically between 1978 and 1990. A large quantity of greenhouse gas emissions from both industrial sources and the residential sector were reduced through the switch to electricity instead of oil as a power source, as well as through energy efficiency improvements. Today, 45 per cent of Québec's overall energy consumption is provided by renewable resources and for electricity this number is as high as 95 per cent. However, Québec is still a net importer of energy, mainly due to the use of fossil fuels in the transportation sector.

The use of biomass resources in industry, mainly in the forestry sector, has doubled and now amounts to 11 per cent of total energy consumption in the province. Sustainable biomass extraction rates may already have been reached, which would make it necessary to explore for new sources of biomass, such as energy crops. Hydro Québec's recent RFP for 100 MW of biomass-based generation, for example, resulted in 86 MW of proposed capacity.

Québec has 57 small hydro plants with a total generation capacity of 257 MW. Québec also has 25 MW of landfill gas-based power generation at Gazmont, and about 100 MW of wind power turbines in the Gaspé peninsula. Hydro Québec has been obliged to purchase an additional 1,000 MW of wind power and 100 MW of biomass-based generation over the coming seven to eight years. A small hydro development program in Québec has been cancelled, but is now being revived in a different format under the new government. The existence of initiatives targeting the development of new large hydro reservoirs, as well as emerging renewables,

Québec's Small Hydro Program

In 2001, Québec launched a renewable energy program with the aim of installing 36 run-of-river small hydro plants having a combined capacity of 450 MW over two years. This program had to be cancelled due to major problems that were encountered in its implementation. One major impediment to the success of the program was the proposed development of scenic sites for hydropower development. A project proposing to harness the energy from a 74 metre high scenic waterfall (a local tourist attraction) encountered fierce resistance from local citizens and environmental groups. The impact of this resistance eventually brought the program to a halt. Grassroots groups started an "Adopt a River" initiative against private power projects on Québec rivers. This led to the program being stopped after only three of the proposed 36 projects had been developed. The program is now being continued at a smaller scale, with the Régie de l'Énergie recommending the development of 150 MW of small hydro capacity.

demonstrates that the technologies need not be antagonistic, but can complement each other.

The political, administrative and financial barriers to large hydro development in Québec have increased, in that Hydro Québec has experienced growing difficulties obtaining hydro development permits, as well as credit for the construction of new dams.

Ontario's Great Opportunity

The electricity rate freeze at 4.3 cents/kWh introduced by the former Ontario government stalled many activities aimed at acquiring a larger market share for green power. The new government in 2003 has reaffirmed their commitment to an RPS and plans are being developed to achieve a five per cent target for renewable energy by 2007 (i.e., 1,350 MW) and 10 per cent by 2010. These plans coincide with a promise to phase-out more than 9,000 MW of coal-fired generation by 2007 and a $1.5 billion estimated cost to bring the Pickering nuclear reactor back on-line.

This scenario presents opportunities for renewable energy development in the province. Quickly deployed wind and small hydropower facilities could conceivably make up an important share of Ontario's market in a short period of time. Wind power, especially, would work well with natural gas-based power generation, as the latter can be either displaced when the wind resource is abundant, or provide back-up power when wind generates little or no electricity.

On the other hand, the Ontario renewable energy market has had to deal with setbacks. While the retail electricity price cap introduced by the former government is being increased by the new government, power retailers in Ontario are only allowed to sell electricity. This means that green power offers, which currently include a price premium for the environmental benefits of renewable energy generation, cannot be offered by power distribution companies, but need to be sold as a separate product on a separate bill (e.g., Ontario Power Generation sells green power to industry, and two retailers are targeting the retail market: www.greentagsontario.com and www.selectpower.ca). This reduces the market penetration of green power products, as most households prefer to pay for green power through their existing electricity bills, rather than being billed separately for buying green certificates.

Renewable energy developers have encountered multiple problems in achieving their green power development potential. Some of the concerns and solutions that were identified for the Ontario situation include:

- Permitting procedures need to be streamlined. For example, a two MW wind farm should not be subject to the same stringent requirement as for a wind farm larger than 25 MW. The small hydro sector, in particular, views the structural barriers imposed by having to deal with several provincial and federal agencies and departments concurrently as a far greater problem than the weakness of incentives for green power. Class assessments were suggested as an option for streamlining permitting procedures.
- Local resistance to wind projects (NIMBY) was not seen as a major impediment for the sector, as only about 3.5 per cent of projects experience such difficulties. Tedious permitting procedures were identified as a much more difficult hurdle to address (see above).
- It was noted that green electricity would not need incentives if subsidies to other forms of energy were taken away.

- Some governments prescribe "local content rules" in their green power programs. However, current green power demand in Canada's provinces is perceived as being too small to create a viable industry, and the cost of projects is increased through such requirements.

Toronto workshop panelists urged strongly that an RPS should be implemented as soon as possible in Ontario, and that an RFP for 500 MW of low-impact renewable electricity generation should be used to bridge until the time the RPS comes into effect. It was suggested that most green power developers should be included within the bounds of an RPS (which would include municipal operators, but should exclude industrial self-generation).

As a last point, panelists indicated the importance of having stable policies in place in order to create a good investment climate in Ontario.

Benefits of Green Power in Canada

This section identifies the beneficial effects that the development of the Canadian green power market would have on energy security, environmental performance of the electricity sector, public health, employment, energy price stability, and natural gas availability for other sectors.

Energy Security

Since September 11, 2001, the importance of becoming less dependent on oil imports has been of increasing concern to western industrialized countries. In 1998, International Energy Agency (IEA) countries imported more than 55 per cent of their oil and forecast a growing dependency for the coming decades. In addition to being a clean alternative to energy imports, renewable energy offers the potential to diversify energy sources. Being a domestic resource, renewable energy is less subject to transportation and supply disruptions. Moreover, renewable energy technologies can often be sited close to end-use, which has the potential to reduce transmission losses and other transportation and delivery costs.

The recent blackout in the Northeastern States and Ontario highlighted an important aspect of the current electricity supply system — namely outdated and congested power lines and the risks associated with centralized power generation. Renewable energy plants are often small and decentralized, which provides an advantage in terms of increased energy supply security and relief to congested power lines. Many small units can be connected to a local grid, or at least closer to the consumer, reducing both transmission losses and the need for increased long-haul transmission capacity.

Reducing Environmental Impacts of Energy Production

Criteria air pollutants, such as SO_2 and NO_x, have influenced energy policies during the latter part of the 20th century. With greenhouse gas emissions becoming an increasing concern at the beginning of the 21st century, renewable energy has emerged as a solution to limiting emissions of both greenhouse gases and criteria air pollutants.

In comparison to traditional sources of power generation, other benefits of green power include, but are not limited to:

- Reduction of mercury emissions;
- Reduction of methane emissions;
- Reduction of transport emissions;
- Conservation of non-renewable energy resources;
- Elimination of hazardous waste, such as nuclear and flue gas cleaning residues; and,
- Reduction of land and water use.

Renewables can also have negative environmental impacts. Emissions from biomass-based facilities need to be controlled, and there is ongoing discussion about the impacts of small hydro facilities using reservoirs. Local noise and visual impacts of renewable energy generation need to be addressed. This is compounded by the fact more single generation plants are needed to respond to energy needs than is the case with conventional large central power plants.

Benefits to Distributed Generation

In general, a large number of small units will have greater collective reliability than a small number of large units. In addition,

- Most distributed resources, especially renewables, tend not only to fail less often than centralized plants, but also to be easier and faster to fix when they do fail. The consequences of failure are far less serious for a small, as opposed to a large, electricity generation unit.
- Distributed resources tend to avoid the high voltages and currents, and the complex delivery systems, which are conducive to grid failures.
- Distributed resources can help reduce the reliability and capacity problems to which an aging or overstressed grid is liable.
- Distributed generators can be designed to operate properly when "islanded," giving local distribution systems and customers the ability to ride out major outages.
- Distributed resources can improve utility system reliability by powering vital protective functions of the grid, even if the grid's main power supply fails.
- Distributed resources can significantly — and when deployed on a large scale can comprehensively and profoundly — improve the resilience of electricity supply, thus reducing many kinds of social costs, risks and anxieties, including military costs and vulnerabilities.
- Distributed resources foster institutional structures that are more web-like, faster to learn, and are more adaptive, making the inevitable mistakes less likely, consequential and lasting.

Source: SolarAccess.com. August 20, 2003.

Health Benefits

In Ontario, air pollution-related health costs have been estimated by the Ontario Medical Association to include 1,900 premature deaths caused by smog, $580 million a year to treat victims of air pollution, and $560 million in productivity losses to employers. These numbers also include the cost of pollution from other sources, such as vehicle exhaust. Research carried out by the Ontario Medical Association shows that total annual economic losses can reach as much as $10 billion if pain, suffering and loss of life are monetarized.

Stanford researchers have tried to quantify the societal costs per unit of electricity made from coal — for example, 2,000 US miners die of complications caused by coal dust each year, and the federal black-lung disease program has cost the US government $35 billion since 1973.[28] Including environmental effects, such as acid deposition, smog, visibility degradation and global warming, as well as health effects, such as asthma, respiratory and cardiovascular diseases and deaths caused by emissions from coal-fired power stations, researchers determined that the "external" cost of generating one kWh through coal would fall between 5.5 and 8.3 cents (US).

[28] SCIENCE. 2001.

Creating Employment and a New Industry

Important job creation benefits can be obtained from strategies that promote renewable energy technologies. Employment is created at different levels, from research and manufacturing to services, such as installers and distributors. In Germany for example, the wind industry alone is responsible for 35,000 jobs.[29]

In the UK, 6,000 MW of offshore wind generation capacity will be installed by 2010 — about 15 per cent of household consumption. This will create employment for 20,000 people for the construction, installation and operation of wind parks, especially in remote and rural areas.[30] The expansion of renewable energy in the UK is proceeding so rapidly that some fear there will be a shortage of skilled human resources to maintain the current growth rate.

Denmark's support policies for wind power have made it a major exporter of turbine technology.

According to a study by the California Public Interest Research Group, renewable energy generates four times as many jobs per megawatt of installed capacity as natural gas. Results from the Renewable Energy Policy Project indicate that renewables create 40 per cent more jobs per dollar of investment compared with coal-fired plants.[31] Table 4 compares the employment creation potential of renewable energy technologies versus natural gas for power generation.

Table 4: Employment Rates by Energy Technology

Power Source	Construction Employment (jobs/MW)	O&M Employment (jobs/MW)	Total Employ-ment for 500 MW Capacity	Factor Increase over Natural Gas
Wind	2.6	0.3	5,635	2.3
Geothermal	4.0	1.7	27,050	11.0
Solar PV	7.1	0.1	5,370	2.2
Solar thermal	5.7	0.2	6,155	2.5
Landfill methane/ digester gas	3.7	2.3	36,055	14.7
Natural gas	1.0	0.1	2,460	1.0

Source: REPP. 2003. Chapter 5.

29 PP. 2002. p. 39.

30 EE. 2003.

31 AA. 2004. p. 33.

Wind Creates Income Opportunities for Farmers

A consortium of wind power leaders, including Shell WindEnergy, Padoma Wind Power, Green Mountain Energy Co., TXU Energy, Cielo Wind Power and Orion Energy, recently announced a 160 MW project in western Texas. The consortium will lease the land for the project from private farmers and ranchers who can each receive $2,000 to $3,000 per turbine annually, with no more than 2.5 acres per turbine removed from farm and ranch production for the turbines, access roads and other equipment.

Source: AWEA press release, August 20, 2003.

Renewable energy technologies can also drive exports to meet growing international demand. For example, Denmark's successful wind turbine industry is a model of how to become a world leader in exporting technology and services. Denmark maintains a hold on more than 40 per cent of the world market, and sales by its companies increased 10 times in nominal terms between 1988 and 1997. Denmark is now trying to repeat this success with wave energy devices, whereas the UK is heavily investing in tidal energy, energy crops, and especially offshore wind. Japan is the world's solar PV leader, and while its own installed capacities are unmatched, it is also becoming a major exporter of efficient solar modules and related devices.

Price Hedging and Easing Natural Gas Shortages

Renewable energy development, by displacing the need for additional natural gas-fired power generation, can help ease natural gas shortages, as well as help reduce the rate of price increases. Renewable energy technologies usually have high capital costs, but also have low fuel costs. This latter characteristic means that the electricity or heat supplied is not prone to price fluctuations, as is the case with fossil fuels. Swings in the supply of fossil fuels — attributable to supply shortages or large inventories — can contribute to fluctuations in end-use prices. These fluctuations can have economic and social repercussions that affect energy supply industries, as well as all categories of end-users.

Some green power retailers, such as Shell in the Netherlands and Green Tags Ontario in Canada, use the price stability of renewable energy to market their products, guaranteeing long-term provision of green energy without increasing prices. The monetary value of the price-stabilizing market influence of renewable energy alone has been estimated by one source to be US$5.20 per MWh.[32] If this would be accounted for in energy planning, green power would immediately become more competitive with conventional power sources. Consequently renewable energy resources may become an important price hedge against rising fossil fuel prices if significant market share is obtained. Many of the large energy companies are now investing in renewables for such reasons, as well as to hedge against climate change-related business risks.

Finally, renewables can displace fossil power generation at the operational margin, which in most cases is natural gas-derived

[32] PLATTS. 2003.

electricity. In the US, customers are facing electricity and natural gas rate hikes due to a natural gas supply shortage. The American Wind Energy Association (AWEA) estimates that an installed capacity of 6,000 MW of wind power will save approximately 0.5 billion cubic feet of natural gas per day (Bcf/day) in 2004, alleviating 10–15 per cent of the supply pressure that is now facing the natural gas industry.

For example, a 200 MW renewable energy facility (i.e., wind generally has a capacity factor of about 30–35 per cent) can displace on an annual basis about six Bcf of natural gas required to generate the same amount of electricity. Given that most new conventional power plants will be natural gas-fired, renewable energy can play a role in reducing natural gas consumption in the power sector, thus helping to stabilize natural gas prices in the increasingly volatile North American market.

Talisman Energy Preparing for Stake in Giant Scottish Offshore Windfarm

Banff, Alberta (CP) — Talisman Energy, one of Canada's international oil and gas companies, will be a partner in a billion-dollar windfarm that is soon to be built off the Scottish coast, and which will be more than 10 times the size of Canada's largest wind energy site.

Touted as the world's first "deep water" wind system, the Beatrice Windfarm Project is in the North Sea about 120 kilometres north of Aberdeen. It is expected to have 200 massive turbines capable of producing five megawatts each. One megawatt is enough power for about 1,000 homes.

A report by the Scottish government said the facility could cost Talisman and its partner, Scottish and Southern Energy, nearly $1.3 billion, but the companies are trying to lower costs significantly. The size of each firm's stake was not announced.

Talisman chief executive Jim Buckee said Friday his Calgary-based firm will be part of Beatrice to comply with tough new demands for energy companies to have larger renewable components. Talisman is a major oil producer in the North Sea. "The government there has introduced a penalty by the year 2010 of 30 pounds per megawatt hour for generators who don't have 10 per cent renewable," Buckee said outside of an Alberta-government sponsored business forum in the Rocky Mountain resort town of Banff. "So it's this severe penalty that's pushed everybody to do anything that's renewable." Buckee also said the companies will build a project centre soon, and the Scottish and UK governments announced a $435,000 research grant for Beatrice last month.

Branching into wind and other renewable power is a growing trend among Canada's larger power companies, such as oilsands giant Suncor Energy, and Canada's largest non-regulated power producer, TransAlta Corp.

(…) Buckee said Talisman is unlikely to build any windfarm projects in Canada since the company can buy more cheaply. "So it was a question of straight operating costs," said Buckee. (…)

Source: The Canadian Press. 2003.

Efficiency Could Cut Natural Gas Prices

A new study by the American Council for an Energy-Efficient Economy (ACEEE) and Energy and Environmental Analysis Inc. found that aggressive programs to encourage energy efficiency and renewable energy could reduce the demand for natural gas sufficiently to cause a 10 to 20 per cent drop in wholesale natural gas prices. The study, commissioned by the Energy Foundation, developed estimates of the near-term and mid-term potential to implement energy efficiency, conservation and renewable energy in each of the 48 contiguous states. Those estimates yielded a potential to reduce US natural gas consumption by 1.1 per cent within a year using energy efficiency, and to reduce US natural gas consumption by 5.5 per cent by 2008 using a combination of energy efficiency and renewable energy. By easing supply constraints, such apparently minor reductions in demand could yield significant price reductions, according to the report. The ACEEE report concludes that savings to consumers and businesses over the next five years could exceed $75 billion. See the study and press release on the ACEEE website at www.aceee.org/energy/efnatgas-study.htm.

Source: EERE Network News.

Shorter Development Times

Renewable energy projects can be developed more quickly than traditional generating stations. Large power projects require a lengthy, expensive and detailed permitting process that can take several years. For example, for a large hydro project the permitting process could take five to 10 years, on average, while a small hydro project would typically take only half this time for development (i.e., in Québec, small hydro projects with less than five MW capacity do not have to go through a public hearing process).

Energy Project Lead Times

McBride wind farm (AB) — Less than a year
Coal — Six to seven years
Large hydro — Ten or more years

Although renewable energy projects also go through stakeholder consultation and a (sometimes difficult) permitting process, they can usually be developed much faster than large, centralized projects. This makes such projects a more flexible means of managing power supplies and adapting to incremental increases in power consumption.

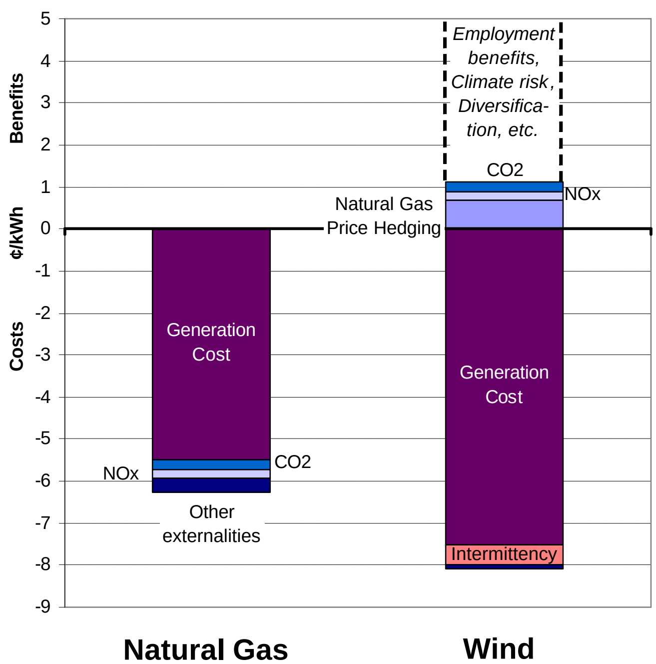
Internalizing Energy Production Costs and Benefits

Considerable work has been done over the past few years to quantify the external benefits and costs of power generation. It is estimated that if the external benefits and costs were reflected in the price of energy, wind power could compete with the prices for natural gas (Figure 3), especially as the disadvantage of intermittency only comes into play when intermittent power generation sources amount to at least 10 to 15 per cent of on-grid generation.

In Figure 3, wind power generation costs are compared to a natural gas plant. The generation cost of a combined cycle natural gas plant is projected at 5.5 cents/kWh — the current avoided cost used by BC Hydro in its renewable energy RFP. The wind power generation cost is projected to be 7.5 cents/kWh, which is a mid-range price for Canada. The assumption is that wind displaces generation from natural gas, which emits about 0.43 tons of CO_2 per MWh.

BC Hydro reduces the price it offers to renewable energy projects by 0.5 cents/kWh if they are intermittent. On the other hand, emissions-free generation from renewables generates environmental benefits, quantified on the basis of $5 per tonne of CO_2, which is a value for emissions credits that might reasonably be expected if mandatory

Figure 3: Comparison of Generation Cost and Externalities Between Electricity Generation Based on Natural Gas and Wind



Canadian emissions trading starts. The price for NO_x is assumed to be US$3,000 per tonne ($4,000 CDN).

PLATTS, which is a well-known Internet energy clearinghouse, has assessed the extra value of renewable power generation in terms of reduced natural gas consumption as being at least US$5.20[33] per MWh.[34] A European study assessed other externalities, such as health costs, noise and damage to material and crops, and determined these costs to be more than four times higher for a natural gas plant than for wind power.[35]

The value of avoided grid modernization costs through distributed generation varies greatly by location. It moves between 0–20 cents/kWh (US),[36] or even more in Canada's remote areas. This benefit was not included in Figure 3 as it only applies in special cases.

Similarly, other advantages of renewable energy, such as the reduction in climate risk (as expressed in utilities' weather insurance costs), and employment and economic benefits, were not included in Figure 3. If all benefits of renewable energy were to be quantified and included in pricing models, the combined market impact would be significant.

33 This number reflects the extra cost of price hedging. Data provided by Platts and by Lawrence Berkeley Lab both suggest that the cost of hedging gas to obtain a fixed price is in the range of $0.50 to $0.80/MMBtu ($3.50 to $5.50 per MWh at combined cycle heat rates). Southern California Edison, for example, spent approximately $0.80/MMBtu to hedge its exposure to gas costs of its Qualifying Facilities in 2002–2003. CEERT. 2003. p.9.

34 REF. 2003.

35 EU. 2003.

36 EERE. 2001.

Barriers to Green Power Development in Canada

The following section identifies barriers to green power development specifically pertaining to Canada. Pricing, market access, acceptance and demand, problems with obtaining construction permits/suitable sites, access to existing incentives, intermittency and location of renewable energy projects, as well as problems with obtaining grid access and information on where renewable resources are abundant in Canada, can all contribute to the difficulties of establishing green power resources as mainstream electricity generation options.

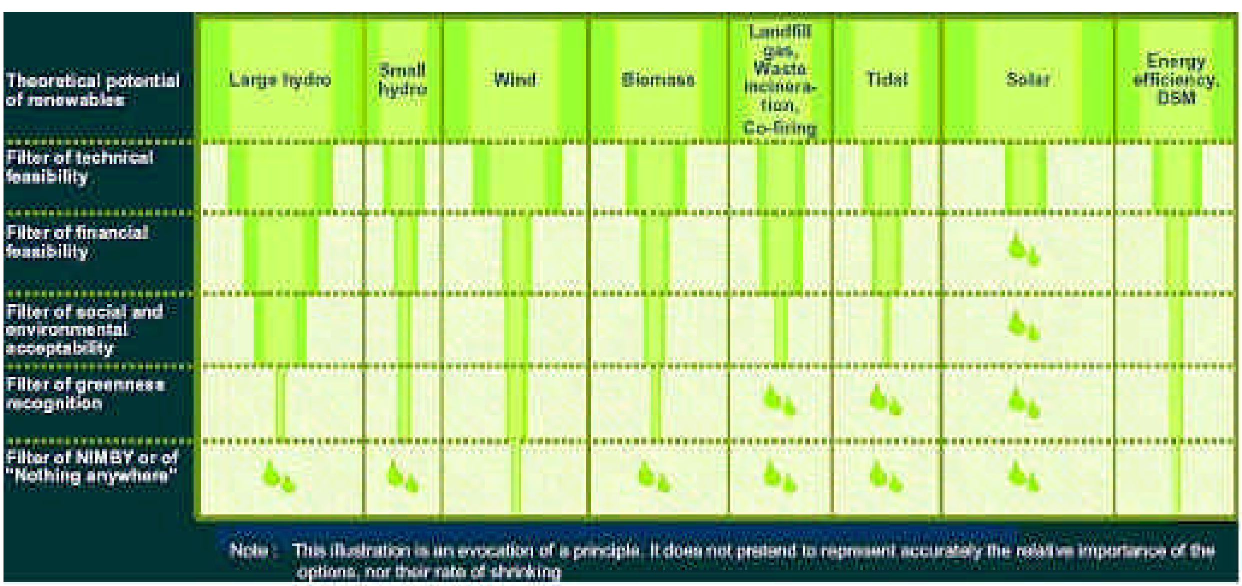
Figure 4 provides a qualitative illustration of how certain barriers can reduce the number of renewable energy projects that actually come to fruition. Finding the right solutions to tackle these barriers is the main subject of the Green Power Workshop Series.

Pricing

Apart from a few exceptions, the price of low-impact renewable energy is higher than that of fossil fuel-based electricity. This is particularly important in Canada, which has some of the lowest retail electricity prices among OECD countries due to its existing stock of large hydro reservoirs, which can produce power at two cents/kWh.

Although renewable energy facilities have considerable up-front capital costs, they do not incur fuel costs during operation (with the exception of biomass-based systems). The economic viability of renewable energy systems is therefore closely linked to the cost of capital (i.e., interest rates) and to the ability to reduce capital costs through research and development. Great progress

Figure 4: Barriers to Renewable Energy Development and Their Potential Impact on Project Implementation Rates

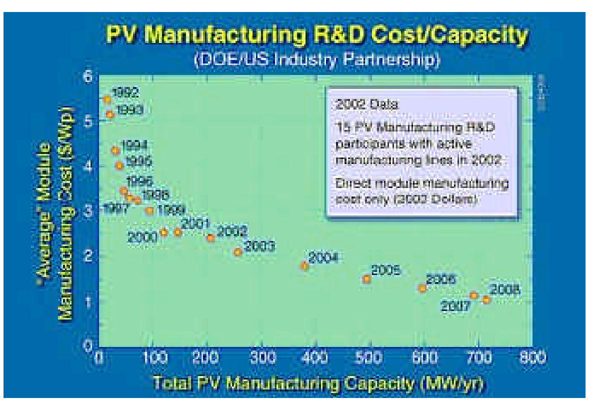


Source: Y. Guérard. Hydro-Québec. Presentation from the Nov. 3–4 Green Power Workshop in Montreal.

has been made during the past 30 years in both the photovoltaics and the wind power sectors (see Figures 5 and 6); and both technologies are still achieving cost reductions of about five per cent per year.[37] Unit costs have been reduced by an order of magnitude for wind power, and in areas with very good wind resources (e.g., Texas and the UK), wind power pricing has been competitive with that for natural gas and coal-based electricity.

As the price for renewable energy keeps falling, prices for natural gas remain volatile, with a strong tendency to rise due to increased demand in Canada and the United States through the construction of new combined cycle natural gas power plants, which is often the preferred default technology for new generation. Figure 7 shows how renewable energy prices currently compare to Canadian wholesale power prices in general, and fossil fuel-based and nuclear electricity prices in particular. It indicates that an incentive at the same level as the US Production Tax Credit (currently valued at 1.8 cents/kWh (US)) would make a large portion of Canada's renewable resource potential economical to develop.

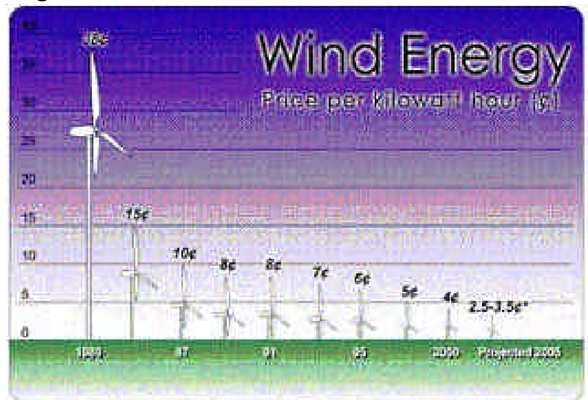
Figure 5: Price Evolution of Solar PV Modules



Source: NREL. 2002.
Data for the period of 2002 and earlier are "historical," whereas data for years beyond 2002 are "best projections."

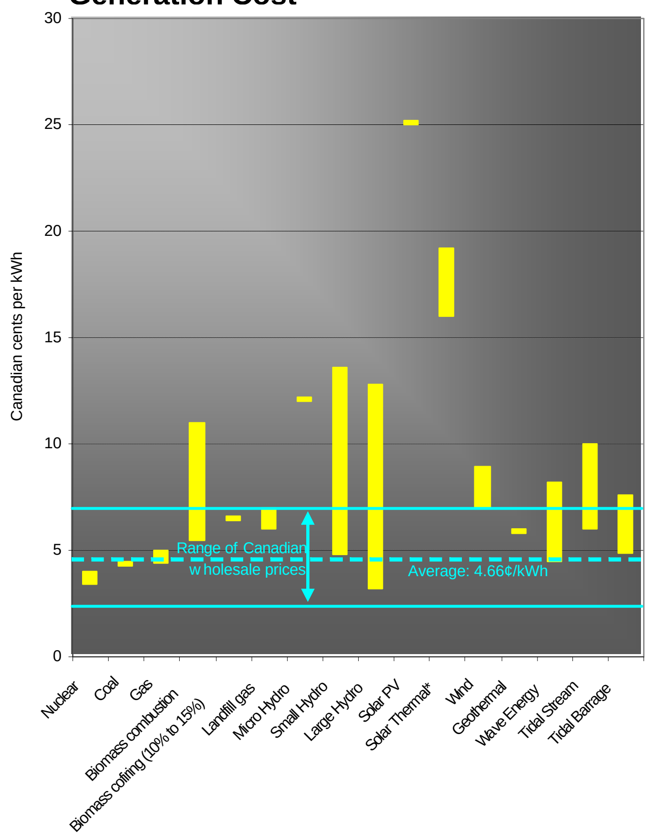
[37] NAV. 2003. p. 5.

Figure 6: Price Evolution of Wind Power



Source: RC. 2002.
Assumptions: Levelized costs at excellent wind sites; large project areas, not including the production tax credit (post 1994); in US cents.

Figure 7: Comparison of Canadian Wholesale Electricity Prices and Energy Generation Cost



Source: PP. 2002. p. 105.
Note: The real price of nuclear energy is a contentious issue. Whereas wholesale prices are low, the indirect costs for decommissioning, waste storage, etc., can be very high. In Ontario, refurbishing the Pickering 4 nuclear reactor is estimated to cost $1.5 billion.

All renewable technologies have high up-front investment costs. Capital cost depreciation and interest costs are therefore the major factors influencing generation costs. There are no fuel costs, with the exception of biomass. While operating and maintenance costs (O&M) are generally low compared to conventional power generation, there are marked differences among the technologies in the area of maintenance.

Under optimum conditions, some green power technologies can already compete in the marketplace without assistance. By 2010, further cost reductions will further improve their competitiveness.

In a December 2003 report, the International Energy Agency projected costs for various types of renewable energy to the year 2010. Table 5 reflects these findings, indicating that the highest potentials for cost reduction exist among the renewable electricity technologies that are expensive and recent in development. Such technologies tend to have a steep learning curve, with a progress ratio of about 80 per cent, meaning that every doubling of the volume manufactured leads to a cost reduction of about 20 per cent.

Globally, solar technologies are expected to reduce their costs by some 30 to 50 per cent for each of the next two decades as a result of learning and market growth.

Medium cost reduction potentials can be identified among those technologies that are in the low to medium cost range and relatively recent in development. These technologies tend to have a learning curve with a progress ratio of around 90 per cent, meaning that every doubling of the volume

Table 5: Ranges of Investment and Generation Costs for Green Power Technologies in 2002 and 2010

	Low investment costs USD/kW		High investment costs USD/kW		Low generation costs USD/kW		High generation costs USD/kW	
	2002	**2010**	**2002**	**2010**	**2002**	**2010**	**2002**	**2010**
Small hydropower	1000	950	5000	4500	2–3	2	9–15	8–13
Solar PV	4500	3000	7000	4500	18–20	10–15	25–80	18–40
Concentrating solar power	3000	2000	6000	4000	10–15	6–8	20–25	10–12
Biopower	500	400	4000	3000	2–3	2	10–15	8–12
Geothermal power	1200	1000	5000	3500	2–5	2–3	6–12	5–10
Wind power	850	700	1700	1300	3–5	2–4	10–12	6–9

Note: Discount rate is six per cent for all technologies; amortization period is 15–25 years, and operation and maintenance costs are technology-specific.

manufactured leads to a cost reduction of around 10 per cent. Globally, wind is expected to reduce its costs by some 25 per cent for each of the next two decades on this basis, and geothermal by some 10 to 25 per cent in the same period.

Smaller cost reduction potential is likely among the most mature technologies as the learning curve for these technologies and their components is fairly flat. Globally, technological development for small hydropower and biomass is much slower, likely on the order of about five to 10 per cent for each of the next two decades. Specifically, conventional components (civil works, turbines) offer low cost reduction potential, likely on the order of about five to 10 per cent for each of the next two decades.

Many best cases already show that under optimal conditions (i.e., optimized system design, siting and resource availability) electricity from biomass, small hydropower, wind and geothermal power plants can be produced at costs ranging from two to five cents per kWh (USD). Cost competitiveness is then at its best, and renewable power — even without adding environmental or other values that could be attributed to certain kinds of renewable electricity generation — could compete on the wholesale electricity market.[38]

Solar technologies are, for the time being, generally not competitive with wholesale electricity, but even they start to compete with retail electricity in circumstances in which supportive policy frameworks have been established. For instance, photovoltaic solar power is competitive in areas where high solar irradiation coincides with daily (peak) power demand and high retail electricity costs in a supportive policy environment. California and other parts of the Southwest United States are examples of such conditions, and these areas have become strong commercial markets.[39]

Market Access

Deregulating electricity markets theoretically enables green power suppliers to offer their products to retail customers, as customers are given the choice of changing their electricity provider. Two provinces in Canada — Ontario and Alberta — have restructured electricity markets to full retail competition; however, due to steep price increases in Ontario after market opening, the former provincial government froze electricity prices (November 11, 2002) and guaranteed a wholesale capped price of 4.3 cents/kWh to all customers. As this price guarantee was not applicable when a customer changed electricity providers, the green power market was severely impaired by this decision. The new Ontario government has recently revised the 4.3 cents/kWh price cap and is gradually increasing the price of electricity.

Alberta utilities have offered green power for many years and have gained market shares of about one per cent. In Alberta, growth of the renewable energy sector has been enhanced through green power sales and an aggressive government procurement program. British Columbia will partly open its electricity market to competition as well, which will allow industrial power customers to choose their power providers. This will give some limited opportunities to renewable energy generators.

In the absence of retail competition, the renewable energy industry depends on purchases of its electricity through crown utilities, which can sell renewable energy to

[38] Ibid.

[39] IEA. 2003. p. 20.

customers in green pricing programs. In Alberta, both ENMAX and EPCOR have offered green power products since 1998–99. Deregulation in 2001 increased the customer base for Alberta's utilities so that they are now competing for green power customers throughout the province. For example, ENMAX provides green power for all provincial government sites. ENMAX also supplies the members of the Alberta Urban Municipalities Association with electricity, including a two per cent green power component.

Maritime Electric Company in PEI, Nova Scotia Power and SaskPower also offer some form of green power to their customers, and BC Hydro is offering green tags to commercial customers. In most provinces, green power sales are either not possible, or are controlled by existing utilities, which limits the opportunities for renewable energy providers to gain a larger market share.

Investment in Green Power

As many renewable energy technologies currently require significant up-front capital investments, they are often seen as high risk. Finding investors can be a significant barrier to renewable energy development. This challenge can be intensified if government support for renewable energy is uncertain. For example, the biannual extension of the US Production Tax Credit (PTC) has created high volatility in the American wind power market. Investments usually increase drastically before the PTC expires, then fall to a low because of uncertainty about the extension of the credit in the next year. Canadian funding programs, such as TEAM, Sustainable Development Technology Canada and the Green Municipal Investment Fund, are trying to address financial challenges related to renewable energy projects.

Access to Wind Power Production Incentive

In Canada, different requirements exist for environmental impact studies at the provincial and federal levels. This has led to some confusion concerning the application process for the Wind Power Production Incentive (WPPI). Renewable energy developers are sometimes faced with having to redo their assessments in order to comply with both provincial and federal government demands. Also, the paperwork to obtain the WPPI is more onerous than for the US production tax credit. Furthermore, regional caps set by the federal government (in terms of the share of the WPPI that can go to a given province) have led to increased uncertainty among investors as to whether or not a project to be financed will qualify for the incentive. These caps are currently under review.

Furthermore, existing incentives in Canada have been criticized as being too small to incent significant amounts of new renewable energy generation. For example, the WPPI (currently 1.0 cents/kWh) only amounts to 40 per cent of the US production tax credit (currently 2.4 Canadian cents/kWh). Similarly, US buy-down programs reduce the life cycle operating expenses for solar PV systems by 60 per cent, as opposed to the 12 per cent reduction achieved by similar Canadian initiatives.[40]

It is also important to note that most of Canada's current support for renewable energy development is concentrated on wind energy. Similar incentives could be used to expand other technologies, such as geothermal, biomass or wave power.

[40] NAV. 2003. p. 5.

Table 6: Canadian Power Preferences (percentage of responses)

Energy Source	Strongly Support	Somewhat Support	Somewhat Oppose	Strongly Oppose	NA
Solar and Wind	78	18	1	1	2
Hydro	60	32	3	2	2
Natural Gas	37	43	10	6	3
Coal	7	22	27	40	4
Nuclear	17	33	17	23	10

Source: CAN. 2003.

Market Acceptance and Demand

Another factor in developing the renewable energy sector is the degree of market demand by both corporate and retail customers, as well as through government procurement targets. At the federal, provincial and municipal levels, green power purchasing targets can create important demands for green power, which help to kick-start green power markets.

A recent Environics survey re-confirmed that Canadian citizens prefer environmentally benign power sources (see Table 6), but so far, not all Canadians are given options to choose green power to supply their electricity needs (see Market Access).

Based on experiences in other countries, significant market demand for renewable energy is best created through government policy. Through the use of renewable portfolio standards (RPS), feed-in tariffs and tax incentives, European countries have created flourishing green power markets that have outpaced Canada and the United States. In the absence of net metering rules, RPSs and strong tax incentives, and with relatively low-cost existing large hydropower and other conventional power sources, it is difficult for renewable energy markets to play the beneficial role in Canada that they are playing in many other countries.

Finally, although some renewable energy technologies are at the threshold of becoming commercial technologies, many still require additional research and development and/or support for the construction of pilot projects to provide evidence that they are proven technologies. Often, risk sharing between private investors and governments can facilitate the introduction of new technologies, such as wave and tidal power. In this context, Natural Resources Canada's Renewable Energy Deployment Initiative, funded with $25 million, makes a small contribution to the deployment of decentralized energy systems. Another program, the CANMET program, provides some research funding ($5 million/year) for renewable energy technologies.

To create a level playing field among countries competing for renewable energy development, and especially between the United States and Canada, it would be beneficial for Canada to investigate matching the incentives that other countries provide. Tax exemptions, production incentives and other mechanisms, such as favourable loan conditions and rebates for green power customers or equipment purchasers, are needed to attract investment. Accompanying benefits include developing a manufacturing base for renewable energy generation equipment and supporting the development of a robust research and development community. (Note: Policies and Incentives for Green Power Development will be the subject of the fourth workshop in the Green Power Workshop Series.)

Permitting and the Not-In-My-Backyard (NIMBY) Syndrome

Analysts suggest that the NIMBY explanation is too simplistic a way of portraying people's attitudes. For example, people in areas with significant public resistance to wind projects are often not necessarily always against the turbines themselves — but more opposed to the turbine developers, as, often, local people are kept out of the decision-making process.

Attitudes towards concrete projects are site specific, in that opposition can be formed towards the developers, the bureaucracy, and/or the politicians. Attitudes are primarily formed by the interaction with central actors, and the extent of involvement of local interests is a major explanatory factor in the (lack of) development of opposition. Lack of communication among the people who will have to live with the turbines seems to be a catalyst for converting local skepticism into actions against specific projects. Conversely, information and genuine dialogue is essential to acceptance. Involvement of the local population in siting procedures, a transparent planning processes and a high communication level are all important to site's success. Succinctly, if opposition is to be minimized, all involved parties have to be offered real opportunities to influence a project.[41]

Advice for Developers to Mitigate NIMBY Problems

The following steps have been proposed to deal with NIMBY issues in the renewable energy field:[42]

1. **Investigate** — Ensure consistency of the proposed project with existing land uses.
2. **Design** the project so that it fits with local land use patterns.
3. **Find a fit** between what a community will support and the developer's business plan and objectives.
4. **Involve** the local community before land is purchased or leased.
5. **Information** provided to the community must be accurate, credible and balanced — only then can trust be built.
6. Emphasis must be placed on substantive **consultation**, do not follow a "check-off box process."
7. Public/government relations strategies should be consistent with local community attitudes.
8. **Avoid rushing** the project — controversy only leads to further delays.
9. Support **community ownership**.
10. Don't use the term "NIMBY" — consider this to be "consultation with local stakeholders."

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[41] DWIA. 2003.
[42] BHCC. 2003. Pollution Probe/Summerhill Group. Toronto Workshop Proceedings. December 8 and 9, 2003.

Some companies, such as SeaBreeze Energy in British Columbia, face significant local resistance to the development of renewable energy projects. SeaBreeze is currently attempting to develop offshore wind parks between Vancouver Island and the Lower Mainland, but has been unable to obtain building permits due to local people fearing the depreciation of property values and the loss of scenic views. The public is also concerned about noise and bird kills. Offshore wind faces an additional obstacle in that it is a new technology. So far, no offshore wind farms have been constructed in North America.

Many small hydro projects in British Columbia and Québec have encountered stiff local resistance from interest groups, such as kayaking clubs and other users of streams and rivers. Often, only mitigation or compensation can lead to the successful completion of a project. Moreover, projects have to comply with the Navigable Waters Protection Act.

In Canada, Environmental Impact Assessments (EIAs) for renewable energy projects, such as biomass-based generation, have often been identified by proponents as being too demanding. Proponents have argued that EIAs should take into account the positive environmental aspects of these technologies. The benefits of less restrictive regulations on First Nations land is illustrated by the Breton Windworks wind power project. Wind projects on First Nations land are not subject to the same legislative restrictions as on public land. Three turbines will soon be installed by the Breton Windworks to meet 75 per cent of power needs. Developing wind projects with First Nations can offer attractive opportunities for the renewable energy sector.

TransAlta Delays Plans to Build Windfarms in Ontario

Toronto, ON — TransAlta will not invest in windfarms in Ontario until it can sort through the complicated regulatory issues at the provincial and municipal levels, according to *Canadian Press.* Opposition to proposed turbines from residents of Prince Edward County has delayed permit approval, while the province has "a whole bunch of complications," the news agency quoted president Steve Snyder. Last year, the Calgary company spent $37 million to purchase 67 turbines with Vision Quest Windelectric, and Snyder wants to increase wind from 15 per cent of corporate generating capacity to 33 per cent over the next decade.

Source: Canadian Association for Renewable Energy. May 2, 2003.

Internationally, the refusal of construction permits has hampered the deployment of renewable energy in the UK and the Netherlands. In Britain (both England and Wales) only 25 per cent of projects have succeeded in obtaining permits, as opposed to Scotland, which has achieved a 70 per cent permitting rate. This is mainly due to the Scottish Executive issuing strategic and technical planning guidance for renewables in 2000, and again in 2002. A 2000 survey in Scotland showed that local public opinion became more favourable to wind farms after their construction, which suggests that initial public concerns were sustained in practice.

JD Irving PEI Wind Project

JD Irving Ltd., a large forest products company, is active in the Maritime Provinces and is working to meet energy needs with its own renewable power facilities. The company relies on black liquor and bark to generate power and heat, as well as on two small wind turbines and a small hydro facility (being expanded from 3.7 to 15 MW). Anticipating its future needs for electricity, the company attempted to develop a 60 MW wind farm at Malpeque in PEI. The company encountered two major hindrances to this project:

1. Many local residents were against the wind farm, fearing problems with noise, bird kills, flicker or ice throw. JD Irving was able to illustrate these concerns were for the most part unfounded; however, viewscape issues still presented a major obstacle to the development of the wind farm.
2. Due to these concerns, the project specifications had to be modified repeatedly in respect to both scale and location. JD Irving is now seeking permission to set up two turbines and has changed the proposed siting arrangements several times. Unresolved questions remain with (a) respect to possible exports of green energy to neighbouring provinces using Maritime Electric's transmission network, (b) the ownership of emission credits and (c) how the project will fit into the Province's RPS plans.

Denmark and Germany have standardized national permitting procedures for wind, and have required municipalities to set aside areas where wind development is encouraged. The Dutch government cooperates with the provinces to identify suitable places for wind development. Denmark has used another means of increasing public support for renewable energy — community ownership. This vehicle provides opportunities for local involvement in the planning process, as well as economic benefits for local people that invest in the technology (in Scotland, it has been proposed that electricity prices be reduced for homes located closest to wind power developments in order to increase acceptance among the population).

Denmark has a tradition of implementing wind co-operatives, in which local people share ownership of wind turbines. The Danish municipality of Sydthy has 12,000 inhabitants, and more than 98 per cent of its electricity consumption is provided through wind power. The municipality is unique in this respect, with 58 per cent of households having one or more shares in a co-operatively owned wind turbine. People who own shares in a turbine are significantly more positive about wind power than people having no economic interest in the subject.[43]

Intermittency and Location

Apart from geothermal energy, all emerging renewable energy resources are intermittent. For example:

- Wind energy availability will vary according to geographic location, daily wind patterns and seasonal differences in wind intensities.
- Wave energy also depends on wind, and tidal energy varies according to moon phases.

[43] DWIA. 2003.

Renewable Energy Misconceptions

A number of misperceptions by the general public can act to hamper the deployment of renewable energy. Specific examples that have been cited include:[44]

"Wind turbines are noisy" — It is possible to stand under a modern turbine and have a normal conversation.
"Wind turbines kill a lot of birds" — Today's slow-turning turbines can be avoided by birds, and counts of bird kills have been very low.
"Wind turbines will take a lot of land away from other uses" — Turbines occupy very little land area and allow for alternative land uses in their immediate vicinity.
"There is not enough solar energy in Canada" — Canada is better situated geographically to capitalize on this resource than many of the market leaders, such as Germany and Japan.
"Solar PV technology is unproven" — Solar PV is in use worldwide and is a reliable and mature technology.
"Solar energy is too costly" — Payback periods for solar energy systems are often less than 10 years. Decentralized systems need to be envisaged, and not only large-scale central generation.
"There is little potential for more biomass-based power generation" — Such assessments are often made on the premise that power plants have to be large (30 MW and larger). There is a lot of potential for small-scale plants, between one and 10 MW, and for agricultural manure digesters.
"Ocean energy is for the distant future" — Several concepts for wave and tidal energy are at the pilot stage and, within five to 10 years, could be developed to a comparable level as wind power (given the right incentives).
"Renewable energy technologies are niche technologies" — Canada's low-impact renewable energy potential is very large and could meet two-thirds of our current electrical power needs.
"Renewable technologies are expensive" — Taking into account the external costs of conventional power generation by putting a value on the environmental and other benefits of low-impact renewable power, most technologies can already compete with conventional energy generation.

- Biomass supplies may vary depending on the season, and their geographic location may vary over time so that transportation of biomass to a central location can have implications for pricing and environmental issues, such as air quality.
- Solar energy is also intermittent, but coincides with daily consumption patterns in the summer, thus shaving off some of the peak demand in areas where air conditioning can be a major contributor to power demand.

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44 Pollution Probe/Summerhill Group. Halifax Workshop Proceedings. December 8 and 9, 2003.

Combining several renewable energy sources, or linking them with spinning reserves[45] or large hydro reservoirs, can alleviate or eliminate many of the problems posed by intermittency.

Location is another issue for renewable energy. The best wind resources may exist in remote areas without grid access, and linking such areas to the main electricity grid can become a major cost factor in renewable energy development. Making grid extensions, or strengthening existing power lines, can prevent a project from being developed unless the cost is shared by all electricity consumers, as is currently being done in Texas to support the deployment of wind energy. Other options, such as combining several kinds of renewable energy (e.g., offshore wind and wave or tidal energy) at the same location can reduce the unit cost of installing extra power lines.

Grid and Transmission Access

With already high capital costs, renewable energy projects, which are often small-scale, can be unduly burdened if they have to bear the full cost of linking new facilities to the existing electricity grid. For example, a "first" wind park may need to finance its own transmission line, even though future turbines developed in the region may benefit from that investment. Some jurisdictions are trying to address this issue through cost sharing between investors and consumers.

In Alberta, for example, obtaining grid access can be a costly undertaking for renewable energy providers. A plant larger than 25 MW could be required to pay as much as $90,000 for a Functional Specifications Study, a $500,000 grid access fee, and $1.7 million for system costs (possible system losses caused by the new generator). On the other hand, plants can also receive credit for good locations when system losses are actually reduced by the new operations. Currently, plant operators and power customers in Alberta each pay 50 per cent of the transmission cost, which again can place a substantial financial burden on renewable energy producers. Discussions are underway to change this situation and put the charges for transmission costs fully on the customers.

Transmission rules for green power exports to neighbouring provinces and the US do not exist everywhere in Canada, which is another impediment to renewable energy development.

> BC Hydro is currently rewarding renewable energy projects with a per-MWh "credit" by reducing the bidding price it receives by an amount equal to the estimated carbon credit value and the other environmental benefits that can be attributed to renewables. BC Hydro also subtracts amounts related to the location and intermittency of renewables, which can discount the extra value of environmental benefits.

[45] A spinning reserve is any back-up energy production capacity that can be made available to a transmission system with ten minutes notice, and that can operate continuously for at least two hours once it is brought on-line.

Lack of Standards and National Technical Rulemaking

In order to make renewable energy a mainstream technology, more Canadian engineering standards are needed. For example, the situation for wind turbines is problematic for the following reasons:

1. It is often difficult to determine which authority has jurisdiction in technical matters; and,
2. The information in some existing standards is conflicting.

This results in manufacturers having difficulty in discussions with various jurisdictions about whether or not their turbines have sufficient strength to withstand local wind loads. Wind loads have been identified as one of the issues that imported technology has to deal with in Canada, as very strong winds can occur here. The Canadian Standards Association is currently working on a number of technology standards for the renewable energy industry.

No standard connection and approval standards currently exist in Canada for distributed generation, such as solar PV or manure digesters on farms, which means the approval of such systems is the sole responsibility of local building inspectors. In addition, special — and often expensive — meters may be required, although they are not technically necessary.

Work to standardize interconnection rules for distributed energy generation units is underway in Canada; for example, the Micropower Connect Initiative. Natural Resources Canada, Industry Canada and the Electro-Federation of Canada support the initiative and recognize that the lack of harmonized standards is one of the most important barriers to renewable energy development. The initiative's guidelines for Canada were completed and forwarded to the Canadian Standards Association in September 2003. The elaboration of a Canadian standard based on the guidelines will facilitate the installation of solar PV, wind, fuel cell and microturbine technologies. It is crucial that the concerns related to each of the renewable energy technologies be considered in order to establish a framework that includes all potential sources of green power.

Canadian Standards Association and Green Power

The Canadian Standards Association (CSA) is very active in the development of standards for several key areas of green power research, development and manufacturing. Performance, energy efficiency and renewables (PEER) standards continue to gain significance as part of the overall strategy to reduce greenhouse gas emissions, and CSA has developed standards for wind turbines, solar panels and earth energy systems (to a total of 60 PEER standards today).

The CSA (www.csa.ca) is involved in the development of standards for components of distributed energy systems and is working with Natural Resources Canada, the Electro-Federation of Canada, manufacturers of alternative energy infrastructure and utilities to establish a technical committee to develop guidelines and standards for the interconnection of green energy sources to local distribution systems. CSA also participates in the development of amendments to the Ontario Distribution System Code in order to remove barriers to connecting distributed generation to local distribution systems.

The Commission for Environmental Cooperation

The Commission for Environmental Cooperation (CEC) was created a decade ago as a result of an environmental agreement with the United States. The CEC deals with three main areas:

1. Regional cooperation on biodiversity, law, pollution prevention, health and environment, economy and trade;
2. Citizens' complaints about regulatory non-compliance; and,
3. Information and analysis (e.g., North American Pollutant Release Inventory, study on the Environmental Challenges and Opportunities in the North American Electricity Market).

The CEC also acts as a renewable energy information clearinghouse, especially through initiatives such as the creation of an electricity generation database for five different power sources in North America, consumer surveys on the readiness to pay for green power, developing a common methodology for the quantification of the environmental benefits of renewable energy, market-based mechanisms, such as emissions trading, and work on the creation of a North American tracking system for renewable energy certificates (www.cec.org/electricity).

Resource Mapping

Renewable resource assessments are crucial for both policy making and for facilitating the deployment of renewable energy technologies. The federal government is currently carrying out limited wind resource mapping. Provincially, British Columbia is the most advanced as BC Hydro has carried out resource assessments for wind, biomass, tidal and small hydro energy resources. Some wind mapping is also ongoing in the Yukon, Manitoba and New Brunswick. Environment Canada is working on meso-scale mapping, but information is only available on a macro-scale, which is not sufficient to identify suitable wind power sites.

Assessments of resources other than wind are so far limited to British Columbia, while various uncoordinated studies on the availability of biomass in Canada have also been done.

Regulatory and Structural Barriers

Many problems associated with the implementation of renewable energy projects have to do with regulations and institutional structures that were put in place before renewables became mature technologies

Some examples of related barriers include:

- Subsidies for diesel that lower the price of energy in remote communities below that of wind power, although wind power in these communities could be less expensive than diesel-based electricity;
- Absence of requirements for the inclusion of renewable energy features in new buildings;
- Low tipping fees for municipal sludge in Canada, as opposed California, for example, where fees of $USD40–60 per ton have led to the development of alternative treatment technologies;

Geothermal Resource Mapping in the US

The US Department of Energy (DOE) has announced the availability of new geothermal resource maps that show low- to moderate- and high-temperature geothermal energy resource locations in 13 Western states. These maps reveal a wealth of geothermal development opportunities. The Idaho National Engineering and Environmental Laboratory, with its 30-year history of geothermal research leadership and program management, produced the maps as part of the DOE's *GeoPowering the West* activity (supported by professional geologists and others from each of the states). These resource maps are a starting point for educating individuals, energy professionals, economic development associations and businesses about locating, developing and using potential geothermal energy resources.

The maps have also been consolidated into a Western United States geothermal resources regional map to provide a broader view of regional potential for power and direct-use applications. Geothermal working groups, established in several states, including Nevada, Idaho, Oregon, Utah, Arizona, New Mexico and Washington, have used these maps to generate interest and initiate actions to develop their respective geothermal resources.

Source: SolarAccess.com. October 17, 2003.

Wind Mapping in Canada

Environment Canada and Natural Resources Canada are trying to make better wind resource data available to Canadian industry through Wind Energy Simulation Tools (WEST) kits. WEST uses two coupled models (meso- and micro-scales) and a post-processing analysis. WEST will also have a forecasting capability (built at the level of wind farm requirements) in about one year's time (i.e., by late 2005).

The originally Linux-based tool will soon be available on Windows XP Professional and is designed to be easily used by the wind power industry. WEST will be part of the National Research Council's Environmental Simulation (EnSim) model and will also use the GIS system (i.e., input and output could be in GIS format). Licensing of WEST will be made through the EnSim system and will commence on March 31, 2004.

The Wind Atlas project is another tool under development for the wind energy industry and Canadians in general. The Wind Atlas is a multi-stakeholder project involving the government and the private sector. The project is being considered for inclusion in the suite of Canada's Climate Change and Innovation Fund projects. A series of maps with resolutions from 25 kilometres to 200 metres will be required to refine the Atlas and this will require continuous development and improvement. It is planned that the 25-kilometre to 200-metre resolution maps will be made available to the public. These maps will provide a rough idea of wind distribution in Canada. The private sector will focus on regional aspects, high-resolution analysis and micro-scale wind data. The target date for the transfer of the Atlas to Geomatics Canada for inclusion in the National Atlas for Canada is early 2004.

- Absence of mechanisms for the transmission of green power across the border for export. So far, only Manitoba and Québec allow wheeling to the US;
- The exclusion (to date) of renewable energy producers from Canada's greenhouse gas offset system;
- Lack of a cohesive policy with respect to allocating Crown Land, which is holding up the development of small hydro sites (e.g., Ontario); and,
- Requirements to conduct full-scale environmental assessments that can make smaller renewable energy projects uneconomic.

In order to increase the generation of new renewable energy, it is imperative that Market Rules reflect the realties of small power generation units; for example, through a distinct class of compliance that can reduce administrative burden. Overall, these regulations and structures should be adapted to accommodate new forms of energy entering the marketplace.

Limited Financial Support from Government

While there are several programs that support the generation of renewable energy in Canada, such as CANMET's research or the REDI initiative, overall funding is often insignificant compared to the support provided to other energy technologies, and compared to other countries' renewable energy budgets. As Table 7, there is no support for several renewable energy technologies at the deployment stage at all in Canada. Some programs, such as TEAM or the SDTC, could provide support for various emerging technologies, but have so far not supported them.

Although governments and private businesses invest about $220 billion in research and development in Canada every year, and annual venture capital funding amounts to $3.58 billion, many technologies do not make it to market because of funding gaps before commercialization and before market readiness. The situation for clean technologies is even more inadequate as — only about 100 clean technology projects received venture capital financing in 2002.[46]

To succeed, renewable energy technologies need to be supported in all burgeoning stages; from research and development through to the venture capital and pilot project stages prior to commercialization. As conventional electricity generation in Canada is less costly than in other OECD countries, renewable energy needs higher levels of support to be able to compete successfully, so long as its environmental and other benefits cannot be capitalized on and conventional energy does not have to internalize its external costs. Other countries have provided support in several ways:[47]

- In Finland, new renewable energy projects are eligible for grants equivalent to between 10 and 35 per cent of investment costs.
- Sweden provides grants of between 15 and 25 per cent of investment costs to new wind power, small hydro and biomass plants.
- Germany provides cheap loans to renewable power projects of up to 50 per cent of investment costs through the Deutsche Ausgleichsbank.
- Germany, Japan and the Netherlands fund solar PV panels by up to 75 per cent of installed costs.
- Spain provides grants of between 10 and 40 per cent to renewable power projects (wind and biomass).

[46] SDTC. 2003.
[47] PP. 2002. p. 93.

Table 7: Federal Support for Renewable Energy

	Wind	Solar PV	Geo-thermal	Bio-mass	Wave	Tidal	Small Hydro
Research and Development	PERD, IRAP CFI						
Pilot/ Demonstration	TEAM	CANMET	?	TEAM SDTC	?	?	TEAM
Commercial-ization	IC/TCP, SDTC						
Deployment*	WPPI Procure-ment Targets	-	-	REDI	-	-	-
Marketing	MIP						

Note: Several provincial initiatives also support the deployment of renewable energy (e.g., green power procurement, renewable energy targets in British Columbia and Québec). The Federation of Canadian Municipalities provides federal funds for feasibility studies in the energy sector.
TEAM: Technology Early Action Measures; PERD: Panel on Energy Research and Development; WPPI: Wind Power Production Incentive; REDI: Renewable Energy Deployment Initiative; SDTC: Sustainable Development Technology Canada

- The UK now provides generous capital grants for offshore wind and energy crops.
- The US has numerous state programs to support renewable energy, RPS provisions and tax credits.
- Other countries with significant geothermal resources have provided government support for the exploration and development of geothermal reservoirs, whereas Canada has not done so.

The Canadian federal government invested US$11.99 million in 2000, with $4.5 million allocated to biomass, $2.7 million to wind, $1.5 million to small hydro (defined as < 10 MW), $1.2 million to solar PV, $1.1 million to solar thermal, $580,000 to large hydro, $110,000 to solar thermal/electric and $70,000 each to ocean and geothermal energy. Of Canada's total research and development spending in energy in 2000, renewables received 7.3 per cent, nuclear 29 per cent, fossil fuels 24 per cent and conservation 25 per cent.[48]

Canadian programs are poorly funded compared to other countries. For example, CANMET has an annual budget of $5 million and REDI has $25 million. The Netherlands (population 16 million) spends $300 million a year on renewable energy and the UK spends $560 million.[49] European governments, in particular, have shown leadership in bringing about a change in energy production — Germany calls its policy the "Energy Turn" (Energiewende).

48 CARE. 2003(4).
49 PP. 2002. p. 95.

"If I Had a Billion Dollars …"

1. Alberta Oil Sands Project
The Oil Sands benefit from an Accelerated Capital Cost Allowance, a Resource Allowance and the Canadian Exploration and Development Expense. All of these can be deducted at a rate of 25 per cent. The tax provisions effectively mean a company doesn't have to pay income tax on a new project until the capital cost has been recovered.

Investments in net present value terms to 1996 of about $18 billion (i.e., about $35 billion in current dollars) are expected to take place in the oil sands between 1996 and 2030. During this same period, production from this investment is expected to be in the order of 14 billion barrels of oil, with gross revenues of $84 billion (Net Present Value). From this activity, federal corporate income tax revenues under the current tax regime are projected to be about $9 billion. Total tax expenditures associated with this investment in the oil sands are projected to total $816 million for the period from 1986 to 2010, representing 4.5 per cent of the total investment expected until 2030. Tax revenues were only $78 million from 1996 to 2002, but they should total more than $3 billion for the period 1996 to 2010.[50]

Although controversial, the Oil Sands Project is an excellent example of what might be achieved with the same level of investment in the renewable energy sector. Pierre Alvarez, president of the Canadian Association of Petroleum Producers, said the tax regime for the oil sands, developed by a task force four or five years ago, has "probably been the most successful piece of public policy in the past five years." The Oil Sands Project went from investment of a few hundred million dollars per year to four to five billion dollars per year, due to the tax incentive.[51]

2. Nuclear (Fission) Energy
The Canadian nuclear energy sector received annual subsidies that totaled $156.5 million for the year 2000. Atomic Energy of Canada Ltd. has received $16.6 billion in subsidies since it was founded in 1952.[52]

3. Ontario Retail Price Cap
The $293 million spent to finance the Ontario 4.3 cents/kWh retail price cap for electricity in 2003 "would go a long way toward financing the Liberal commitment of bringing a greater number of clean, renewable generation sources on-line," according to the provincial engineers' society.[53] The price cap cost the province $700 million since its inception. (The new Ontario government is now gradually removing the price cap.)

[50] DoF. 2001.

[51] CNEWS. 2003.
[52] OC. 2001.
[53] CARE. 2003(3).

CANMET Energy Technology Centre (CETC)

The CANMET Energy Technology Centre (www.nrcan.gc.ca/es/etb/index_e.html) is one of the main research arms of Natural Resources Canada. It focuses on the following science and technology areas — advanced combustion, greener buildings, sustainable hydrocarbons, energy efficient industrial technologies, sustainable communities, renewable energy and distributed power. Its work on green power is carried out in two of its centres — Varennes, Québec and Ottawa. The CETC at Varennes is both a research facility and an agency helping renewable energy, energy efficiency and other climate change related technologies get to the pilot project stage.

Some of the main areas the Varennes Centre is concentrating on are:
Intelligent Buildings— Building operation controls that help identify system faults and reduce energy consumption by up to 30 per cent in many public and commercial buildings.
Process Integration — Helps make the best use of waste heat and energy, optimizing the use of energy in industrial facilities.
Refrigeration Design — Helps ice rinks and supermarkets reduce their GHG emissions and become more energy efficient.
Photovoltaics — Pilot projects with Canadian companies that help demonstrate the capabilities of this renewable energy technology.
RETSCREEN — A capacity-building program that trains renewable energy experts through workshops and offers free RETSCREEN software for the evaluation of new renewable energy projects.

The CETC in Ottawa also has an extensive set of programs to optimize both fossil fuel and renewable energy systems (other than solar PV).

Sustainable Development Technology Canada (SDTC)

Sustainable Development Technology Canada (www.sdtc.ca) is a federal government-funded initiative that targets Canadian climate change technologies. Equipped with $350 million in funding from the government of Canada, the SDTC had completed four rounds of submissions by the end of 2003. For the November 2003 round, 100 submissions were received, 30 per cent of which were related to biomass.

SDTC favours consortia, not single companies, in its funding decisions. The fund is designed to fill the gap that private investors leave in the clean technology area, in which few projects are funded through other mechanisms, such as venture capital. SDTC seeks technologies that can make it to market in a short time and that represent areas in which Canada can excel.

Currently, about nine per cent of project submissions get approved: for example, 10 out of 117 projects were approved in Round Three, and total SDTC funding for this round was $20 million.

SDTC is taking a proactive role in the Canadian sustainable development landscape by getting involved in technology road mapping and collaborating with other Canadian and international organizations.

Other Barriers

Several other important concerns facing renewable energy include:[54]

- There appears to be a great deal of hesitancy among utilities and governments about the shift to renewable energy. Renewable energy resources, in general, are thought of as emerging and largely unavailable technologies, or small niche technologies that cannot be applied large-scale, although these same technologies are being applied successfully in Europe and the United States. While a considerable need for new electricity options has been identified, there is a great amount of uncertainty about how to incorporate renewables into the present infrastructure. Comments related to limitations of the technology, resource assessment needs, costs, policies and regulatory mechanisms, and consumer awareness. For example, it was noted that Nova Scotia's provincial energy strategy document focuses most of its attention on conventional sources, with a few pages dedicated to renewable energy sources. This approach is reflected in other jurisdictions as well.

- At a time when green power is being discussed so widely and so many questions are being asked, the limitations of the national representation of renewable energy associations were noted. So far, several Canadian energy associations (CanSIA, CanWEA, CanBIO, etc.) either have no offices, rely on voluntary contributions from their members, or have small offices with few staff and resources. This situation limits the possibilities to attend multiple meetings and talk effectively to key players in government in order to answer questions, participate in consultation processes and represent the interests of the industry. It was also noted that it was a challenge to find opportunities to work together.

Concerning the current federal-provincial approach to renewable energy, and existing federal incentives and programs, the following points were mentioned:

- It was noted that there is no clear federal policy for renewable energy, but that each department seems to follow its own prerogatives, which are often incompatible with those of others, and which ultimately hamper the development of the industry.

- Renewable energy clearly provides greenhouse gas emission reductions. However, in the federal offset system, renewables have been excluded from obtaining credit for reducing emissions — denying them important opportunities to obtain extra value for the environmental benefits of clean power generation.

- WPPI and federal purchasing programs are two ways of supporting renewable energy generation. However, facilities that receive WPPI are not eligible for the purchasing program, and vice-versa. In addition, while WPPI provides support over a 10-year period, which is necessary for renewable energy projects to obtain financing, the procurement program only provides contracts for five years, increasing financial insecurity for developers.

[54] Pollution Probe/Summerhill Group. Halifax Workshop Proceedings. October 1, 2003.

- WPPI is limited to 1,000 MW. Annual installation rates in Germany and the US far exceed this number.

- WPPI is limited to wind and is less than half of the value of the American renewable energy tax credit.

- REDI is funded with $25 million over several years (1998–2004). Compared to programs in other countries, or subsidies to the fossil fuel and nuclear sectors, this is a very small amount. Prince Edward Island, for example, has dedicated $12 million to the development of its renewable energy resources.

- Federal green power procurement policies sometimes fail to incent emerging energy sources. In Québec, for example, government offices claim they do not need to purchase wind power as they already receive emissions-free large hydropower. Procurement rules also exclude all projects larger than 20 MW, which further reduces the options.

Technical Aspects of Renewable Energy

Tackling Technical Problems

Stakeholders have identified the following technical "short list" of recommendations to be considered in the overall development of emerging renewable energy resources in Canada.[55] These recommendations are further detailed by technology in Table 8.

- Synergies among different resources and technologies should be emphasized. For example, in remote communities without good hydro resources, wind power can displace diesel-fuelled electricity generation, and existing diesel generators can be used to provide back-up power sources.

- Local resistance to green power development is an issue that has to be addressed. Community involvement is crucial for green power projects to succeed. Many projects have run into resistance from local communities across the country. If project developers want to increase their chances of success, they need to be sensitive to community needs, and must inform and involve the residents in the early stages and throughout the development of the project. There are great opportunities for improvement in this respect, especially with developments in areas affecting native communities. There is a need for clarity around definitions, and a need for resource mapping for all resources at a national level. For example, although Germany and Spain are expanding their small hydro base, in Canada, progress is slower because of a lack of clear policy from governments and a lack of concretely defined environmental guidelines for small hydro. Some regional assessments of small hydro resources have been conducted; however the data are inconsistent because the definition of "small hydro" is unclear. Existing assessments are mainly limited initiatives by small associations. Government support would be needed to fully map the resource for small hydro across Canada.

- To enhance the development of emerging renewable technologies, such as ocean power, both technology transfer and information exchange with other countries need to be increased. Also, testing and certification guidelines should be developed to compare different emerging concepts. A national test lab and technology standards need to be created. There is also a need for research and know-how development in terms of operational and maintenance requirements, biofouling, environmental impacts and forecasting of wave heights. Synergies between and among different technologies should be explored in order to minimize intermittency (e.g., by using a combination of tidal energy and pumped storage).

- To allow renewable energy systems to proliferate in Canada, transmission planning must take possible new developments into account. Current transmission capacities may have to be increased in order for new projects to come on-line.

[55] Pollution Probe/Summerhill Group. Halifax Workshop Proceedings. October 1, 2003.

- The potential benefits from energy efficiency projects are also very high. The process to promote green power should align itself with the goals for energy efficiency. Although many of the options for energy efficiency are relatively inexpensive and cost-effective, they are not being applied systematically in Canada. New government policies are needed, with a clear message that promotes both energy efficiency and low-impact renewables. Moreover, Canada needs to adopt an integrated approach, as not enough progress can be made by pushing projects one at a time.

Table 8: Challenges to and Opportunities for the Development of Renewable Energy Technologies in Canada

Wind Power	• Need weather predictions — real-time, seasonal and 0–72 hours. • Need to know the accuracy of wind mapping. • Need a wind resource mapping tool for the private sector. • Big wind is ready for market, but small wind power still needs more investment in its development. • Need national standards with a consistent approach (e.g., CSA recognition of IEB standards) and a testing facility. • Need to resolve interconnectivity issues. • Support symbiosis with diesel fuel in remote communities. • Investigate potential for wind in decentralized sites or on high-rise buildings. • Intermittency can be reduced through interconnection of wind farms spread over large areas.
Solar	• Need weather predictions — real-time and 6–12 hours. • Need to deal with misconception of limited solar resource potential in Canada. • PV technology is well developed, but price is still a challenge. Need incentives for the installation of solar panels. • Need well-publicized demonstration projects. • Need an integrated solar system approach that uses daylight, PV and thermal solar. • Need coordinated research and development. • Need national standards with a consistent approach (e.g., CSA recognition of IEB standards) and a testing facility. • Need construction incentives. • Need to resolve interconnectivity issues.

Table 8 continued...

Biomass	• Need to re-consider the regulatory framework in terms of Kyoto and green power (for example, growing trees increases taxes since trees are not considered an agricultural activity). • Need a national roadmap for small biopower development. • Municipal solid waste needs to be pre-treated before it can be used. • Tax credits, waste disposal credits, offset credits and renewable portfolio standards should be considered to support biomass. • Biomass should be represented in the working group on interconnection standards. • Need a focus on off-grid, local power use and using heat directly (i.e., industrial and community energy systems). • Need to increase interaction between business and universities so they can cooperate on research. • Need to counteract an information deficit — some provinces do not promote certain technologies because they have invested in local "pet" technologies. • Need a point system to evaluate renewable energy systems in order to incorporate the value of fertilizer, odour reduction, etc. • Some existing biomass maps are not public. Mapping efforts should be consolidated. • Leave some biomass behind for sustainability purposes.
Ocean Energy and Small Hydro	• Resource assessments for ocean and small hydro resources are critical to fostering technology development. • A number of technologies have achieved proof of concept, but aid is needed to bridge the venture capital gap. • Need to develop a consistent framework for evaluating various schemes for extracting wave energy to determine which would be most cost-effective — perhaps by the National Research Council. Similarly, there should be agreed upon rules for developing such technologies. • There should be exploration of the synergy between small hydro and tidal resources in the sense that tidal is ripe for pump storage type systems due to twice-daily peaking. The timing of peaks from differently placed tidal facilities is also an attractive option. • Microhydro needs to be considered in addition to small hydro. • Definition of small hydro has to be addressed.

Table 8 continued...

Transmission and Grid Issues	• Costs for new transmission lines should be shared between grid corporations and the developers, also among several developers (e.g., 20 wind developers on Lake Superior). • Need consistent interconnection rules and standards. • There should be a "Sustainable Grid Rule." As a general principle, transmission tariffs and other modalities of transmission should not be based on location, as renewable resources are often located far from the grid. There should be a single tariff for all users, all options and all locations. This would be a sustainability principle for the greater good. • Interconnectivity issues to be resolved and impacts of intermittent systems on the grid need to be modelled. • New technologies should be accepted on the grid. • Net metering and time of day billing should be introduced.
Common Challenges	• Government vision and leadership are crucial — a Sustainable Energy Program should be created. • Need a paradigm shift towards acceptance of renewable energy. • Climate Action Plan needs to clearly articulate the role of renewable energy in a future plan, not just on a 10 per cent increase, but on the basis of life cycle assessment or full-cost accounting. • Need consistent national and international standards. • Need a testing and assessment facility for renewable energy technologies in Canada. • Need focused and clear communication on technology options and associated benefits — public education and campaigning against misinformation. • Need to work better with communities and first nations. • Different kinds of renewable energy should not be competitive, but cooperative, and speak with united voices towards government. • Reassess subsidizing diesel in remote communities in order to allow for lower-cost renewable energy to come in. • Large producers are unionized and small distributed capacity is seen as privatizing and hence a threat to unionized employees.

Creating a Domestic Renewable Energy Industry

Stakeholders have indicated there is a need to create domestic capacity to manufacture equipment for renewable energy systems.[56] Many provinces require "domestic content" in their renewable energy programs, but fail to create the stable markets needed to sustain domestic manufacturing capacity. So far, limited Canadian domestic capacity exists, meaning that the majority of equipment has to be imported.

Table 9 summarizes the state of several renewable energy technologies in Canada, as well as domestic manufacturing capacities, and identifies which of them still need support at this stage.

Table 9: Readiness of Renewable Energy Technologies in Canada

Technology	Readiness	Canadian Products	Cost Effective Without Incentives	Comments/Issues
Small Hydro	Yes	Yes	Now	Environmental Guidelines for Site Development
Wind	Yes	Blades and Electronics Only	2010	Manufacturing
Photovoltaics	No (2010)	No (2005)	2025	BIPV Affordable Products
Biomass (Forest Waste)	Yes	Yes	Now (CHP)	LFE Emissions Reduction Targets
Biodiesel	Yes	Yes	No	
Electricity from Waste	Yes	Yes	Yes	Air Pollution
Landfill Gas	Yes	Yes	Site Dependent	Fiscal Incentives
Fuel Cells	No	Yes	No	
Power Electronics	Yes	Yes	Costs are falling	Canadian Leader

Source: Filion. 2003.

[56] Pollution Probe/Summerhill Group. Montreal Workshop Proceedings. November 3 and 4, 2003.

The following points highlight additional considerations in regards to specific renewable technologies:

Wind

- Ontario has the capacity to make blades for wind turbines. In Québec, the NEG Micon wind turbine plant in Boucherville was decommissioned after the first 100 MW was installed because the government did not help sustain the level of demand for wind turbines that would have supported continuing production in Québec (i.e., 75 MW per year).
- The import of wind turbine materials can pose problems since this equipment often cannot resist the strong winds in Canada.
- For onshore locations, wind turbines of one to two MW capacity are the right choice for Canada. In some remote areas, crane availability to lift turbines into place may be a limiting factor in determining maximum turbine sizes (e.g., some turbines are as large as a Greyhound bus).
- Wind power can enhance farm revenues when turbines are installed on agricultural land. The turbines use very little land and conventional uses can continue around them.

Solar PV

- With the right support, solar photovoltaics could become a major player in Canada. A Canadian company, Spheral Solar(TM) Power, a subsidiary of ATS, is working on rooftop PV systems that could offer lower cost solar power and that are visually attractive. Another company, XANTREX in British Columbia, is making the power electronics needed to convert DC solar power to AC in order to connect it to the electricity grid. In Japan, the world's leading solar PV market, one single homebuilder is buying an entire line of Sharp PV cells directly from the factory, without an intermediate vendor. This builder has already sold 30,000 solar electric homes. Government support for solar homes in Japan has existed since 1996, starting with a $50,000/50 per cent subsidy, which has now been reduced to 17 per cent. Sales are still growing each year. In Canada, a small number of pilot projects have been established in Waterloo, at Queen's University, as well as in BC and Edmonton.

Geothermal

- In the absence of government support for geothermal resources in Canada, all equipment currently has to be imported (e.g., from Japan) where Mitsubishi and Fuji are major suppliers. The cost of exploring geothermal resources is high: one exploration well costs $6–8 million. In Nevada, 80 per cent of drilling costs are borne by the government, but Canada has no such program in place.

Ocean

- Ocean energy technologies are thought to be some five to 10 years behind wind technologies. Whereas the cost of wind energy has decreased from 55 cents to only four cents US per kWh today, tidal power technology costs could be reduced from 10 to 3.5 cents in just five years, according to Blue Energy. However, there is currently very little research expenditure compared to wind. This effectively blocks the development of a sector in which Canada could still gain a large market share, besides exploring its own vast resources in the ocean energy field. Several companies in Canada are working on ocean technology, but pilot projects are needed to establish them as proven technologies.

Biomass

- Biomass technologies need not be large. There are small-scale concepts in Canada, such as Entropic Energy's Turbion concept, which could be applied at the community level and do not need high local concentrations of biomass.
- There is a large resource of agricultural waste in Canada. Manure from feedstock operations could be used to produce both electricity and heat with digester technology. The technology is available, but is not used due to very low electricity prices in Canada and the absence of targeted government support and policy. This would be a technology that is particularly beneficial for rural areas, benefiting both the energy and agricultural sectors, and reducing greenhouse gas emissions. Additional benefits of manure digesting technology, such as better odour control, pathogen elimination and production of organic solid and liquid fertilizers, should be taken into account.
- Intersan in Québec has a landfill gas technology that does not simply capture methane, but enhances its production by achieving and maintaining optimum moisture content in the waste. This concept allows for control of the production of gas to a certain extent and accelerates biodegradation, increasing the space available in the landfill by 25 per cent. The duration of landfill gas production is halved from about 30 to 15 years, while gas production doubles. If this technology was applied more broadly, increased energy production and greenhouse gas emissions reductions would result, as well as reduced demand for natural gas. In Québec, for example, landfill gas production could equal 25 per cent of natural gas imported from Alberta.

As with Denmark, which is involving local inventors in the development of wave power technology, Canada should encourage inventors to contribute to the development of new energy sources. "New physics," "free energy" and other concepts could have huge potentials to meet future energy needs. However, inertia, misinformation and vested interests often work to preserve the status quo, and some promising inventions can languish for decades. Without support, the lead in developing emerging technologies will shift to countries in which support is provided, and the benefits in terms of manufacturing and export capacity will be lost to Canada.

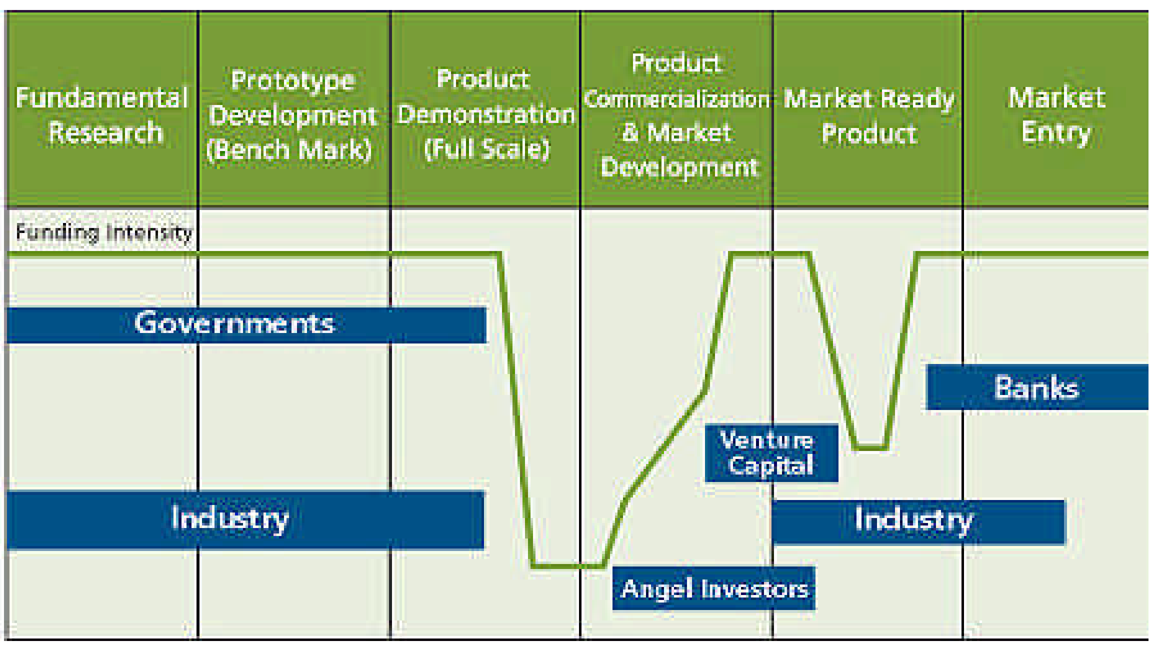
Financing Renewable Energy in Canada

Technologies go through several stages until they are market-ready. Figure 8 shows the various financing mechanisms that exist, and that significant financing gaps exist between demonstration and commercialization, as well as the "market-ready" stage. Stakeholders have indicated there are a number of energy investments in North America that have implications for Canada.[57]

Investor Perspectives

The Enron crisis destroyed much faith that investors previously had in the integrity of the energy sector. Merchant power plants were downgraded by rating companies and now have difficulty in finding investors. Furthermore, emphasis has been placed on acquiring power purchasing agreements, as opposed to merchant plants that operate in daily markets. Most investors are not ready to take risks with respect to new technologies, such as new natural gas turbine technologies. The number of lenders has been reduced to less than 13, from 40 in the "pre-Enron" era.[58]

Figure 8: Available Funding and Funding Intensity for Energy Technologies



Source: SDTC. 2003(1).

[57] Pollution Probe/Summerhill Group. Toronto Workshop Proceedings. December 8 and 9, 2003.

[58] McLeese. 2003.

Clean Tech

Interestingly, "clean tech" investments have increased in recent years, although overall energy sector investment has declined. By 2003, clean tech had grown to 9.8 per cent of venture capital in North America, from only two per cent in the year 2000. Investments in the alternative energy sector have grown by 27 per cent per annum over past five years.[59]

Since 2002 (seven quarters), US$2 billion has been invested in clean tech ventures $20 million of which goes to energy projects across North America. Approximately 70 per cent of total investment goes to distributed renewable generation; the remainder to energy storage and transmission/distribution technologies. Ten per cent of clean tech investment comes to Canada, which is better than average, as usually 97 per cent of total clean tech investment goes to the United States.[60]

Angel Investors

Apart from venture capital, other forms of investment come from "angel investors," who provide smaller amounts of funding, but finance projects at an earlier stage (i.e., from an idea to a prototype).

Venture Capital

Venture capitalists and the government-funded Sustainable Development Technology Canada provide "venture capital, which takes a project to the market."

Energy Companies

Finally, large companies, such as TransAlta, Suncor and Shell, have earmarked large-scale investments in the renewable energy sector and mainly provide money at the deployment stage.

Table 10 summarizes the criteria that stakeholders have identified as important for the selection of successful projects in the renewable energy sector.[61] In general, green power projects at this stage need to yield at least a 15 per cent return on investment to attract investors — in the case of venture capital, even higher (e.g., 50 per cent). Policies and incentives must take this into account.

Stakeholders noted that the US Wind Power Production Tax Credit (currently rated at about $0.018/kWh) plays an important role in financing projects, and that these factors are incorporated into lending assessments.

Asked about the influence of the Kyoto Protocol's entry into force on the willingness to invest in green power technologies, experts referred to climate change regulation being discussed at the federal level in the US, as well as state regulation. It is expected that even if Russia does not ratify Kyoto, regulation of greenhouse gas (GHG) emissions will still be passed in the mid-term. After all, renewable energy projects not only reduce GHG emissions, they also reduce the overall ecological footprint of energy production, which means Kyoto politics are only one aspect of many that should be considered.

59 SDTC. 2003(2).
60 Parker. 2003.
61 Pollution Probe/Summerhill Group. Toronto Workshop Proceedings. December 8 and 9, 2003.

Table 10: Investors and their Criteria for Renewable Energy Projects

Investor	Investment Type	Investment Criteria
Angel Investors	Micro-capital to build prototypes: $20,000 to $500,000 per project	***Micro-determinants of success*** — Quality of idea; business model; network; best practices; management team; financing; strategic relationships; advisory board and director; market environment; etc. ***Macro-determinants*** — Political risk and stability; infrastructure; foreign exchange; public policy; related industries; industry cluster maturity; etc. ***Green power-specific issues*** — Business risk; liquidity/long time to harvest or exit; high level of technical expertise; comparative lack of green-experienced entrepreneur pool; need for deep-pocket long-term partners; need for cluster-specific strategic alliances; regulatory dependence; etc. ***Main reasons for accepting or rejecting a project*** — Is the technology known?; How good is the management team?; Has the project been recommended by someone?
Venture Capital	$2 million and greater	Do not innovate at several levels at the same time: either innovate a market or a technology, but not both. Encourage regional clusters (e.g., BC hydrogen). Southern Ontario could create a solar industry. Québec could do bio-industry — recognize clusters (academic support, capital markets, etc., all at the same spot). Follow-up capital after VC must be secured because the first project implementation often does not get financed. ***Main reasons for accepting or rejecting a project*** — VC investors are looking for very high returns (50 per cent); Project must fit the investor's portfolio; Quality of management team is important.
SDTC	~$2 million (prototype/ venture capital)	New or improved technologies or processes. Proposals are submitted to expert review. Consortia have preference over single applicants. ***Main reasons for accepting or rejecting a project*** — Needs to be a "technology"; Applicants must know their competition and markets; Need to define the distinguishing elements of technology; Need strategic investor(s) that will adopt the technology once it works.

Table 10 continued...

Investor	Investment Type	Investment Criteria
Clean Power Income Fund	Long-term loans at deployment stage (20 years)	Incentives, such as WPPI, helpful. Easy siting/ permitting (e.g., wind). Like wind because of decreasing cost, warranties. ***Main reasons for accepting or rejecting a project*** — Power Purchasing Agreements with credit-worthy takers over the period of financing; High-quality equipment (warranty)/insurance against technology failure; Independent engineer's report important.
Energy Majors	Total of $1–2 billion (TransAlta)	Location (important for wind). Entrepreneurial spirit. Legislative context — Alberta's Small Power R&D Act moved agenda ahead early. Timely approval, speedy construction. ***Main reasons for accepting or rejecting a project*** — Technical confidence in company; Cost curves — what is electricity price in five to 10 years?; Power Purchasing Agreements — can you supply the power that you have a PPA for?; Financial market hurdles must be confronted. Private sector companies must manage their risk well and will consider that in their investment strategy.

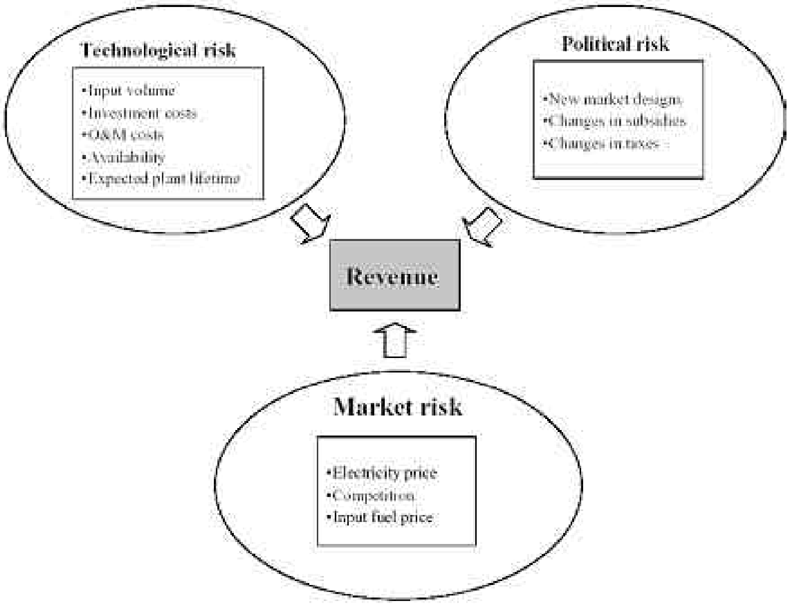
Figure 9 illustrates that a renewable energy project is confronted with three different types of risk:

1. Market Risk — holds all risks related to the currently chosen market structure;
2. Technology Risk — covers all technical risks related to the costs and availability of the plant; and,
3. Political Risk — is related to possible changes in the system based on political decisions (e.g., the switch from a feed-in tariff to an RPS), and also includes permitting and NIMBY problems.

Governments have a lot of influence on both Political Risk and the Market Risk, as governments can make a long-term vision and commitment to green power, and thus create a stable market pull. For example, an RPS will considerably reduce investor risks. Some aspects of Technological Risk can also be addressed through subsidies, buy-back schemes or fiscal measures that reduce the up-front investment cost.

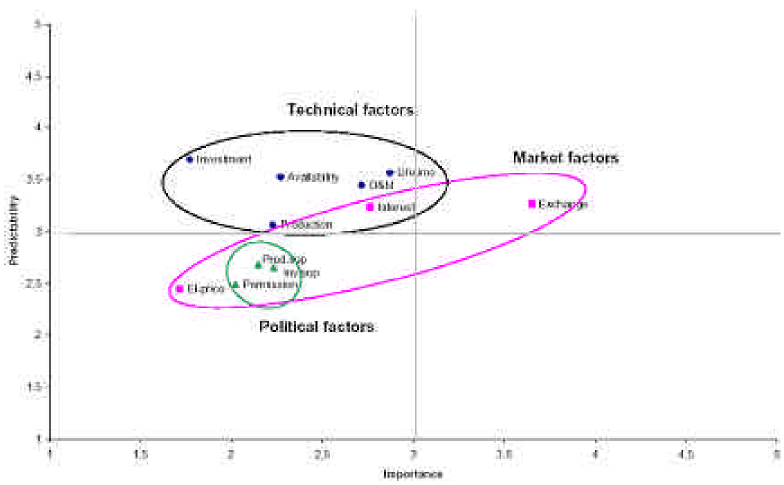
In a survey of investors in renewable energy projects in Europe, it was found that all political factors — including obtaining a permit, subsidies and production incentives/ support — are looked at as risky and that the technological factors are looked at as low-risk factors. The electricity price is looked at as risky, the interest rate is viewed as a low risk and the exchange rate is seen as negligibly risky. Most investors said that the investment costs are very important, whereas O&M costs and lifetime are not. This is illustrated in the horizontal direction

Figure 9: Risk Factors for Green Power Investments



Source: ECN. 2003. p. 44.

Figure 10: Survey Results on Relative Importance of Investment Risk Factors



Source: ECN. 2003. p. 47.
Note: The ranking for Importance is 1 = very important … 5 = not important, and for Predictability is 1 = very uncertain, … 5 = certain.

in Figure 10. Overall, investment cost was rated as the most important technological risk parameter. From the political factors, the permission of local authorities and councils was stated as the most important factor. This is also in line with many of the responses that said political factors are almost impossible to include within Net Present Value calculations due to their low predictability.[62] Many of these findings will also apply to Canada and should be considered in the creation of a flourishing green power market.

[62] ECN. 2003. p. 47.

Tapping into the Voluntary Market

Several utilities and power retailers in Canada are offering green power at a premium price (see Table A1 in the Appendix). Monopoly utilities offering green power do this under "green pricing" programs, which provide an option to customers to receive a percentage of their consumption from renewable energy sources in return for a monthly premium charged to them through their electricity bill.

In deregulated markets (e.g., Ontario and Alberta), power retailers engage in green power marketing, and some of them are using green power certificates to compete for customers independently of their service area (i.e., the physical grid that the renewable energy is fed into). Deregulated markets tend to allow for higher green power product subscription rates than regulated markets with monopoly crown utilities.

"Voluntary and mandatory green power programs can exist side-by-side. Actually, such circumstances result in the best market success."

John Sawler, Green Power Marketing Manager, Ontario Power Generation

Green power certificates are also used by companies like BC Hydro to reach large industrial and commercial customers with a green power option. These certificates represent the unbundled benefits of low-impact renewable energy generation and can be sold independently (both with respect to timing and geographical origin) of the actual electricity, as opposed to "bundled" green power, which represents both the electricity and the benefits from a power station that directly feeds into a customer's grid.

Vision Quest Windelectric Inc.

Vision Quest is Canada's largest wind power operator and retailer. The environmental benefits of its generation are sold as both bundled and unbundled "tag/certificate" products. Vision Quest has obtained certification for its products under EcoLogo, GreenLeaf (Canada) and Green-e (US) standards. The company is trying to develop 46 MW of wind generation in Ontario and is currently operating 120.7 MW of wind turbines in Alberta, with another 130 MW proposed.

The company's marketing experience shows that wind and solar are generally accepted as "green" by their customers, whereas hydro and biomass-based generation requires some education before it is accepted as such. As the "greenness" of electricity is an abstract concept and no tangible product is delivered to green power customers, the challenge is to "bottle" green power in a way that represents value to the consumer. This is done in several ways, including illustrating how many trees would need to be planted to save the same amount of carbon dioxide emissions as is saved by green power, providing door stickers that show the household is purchasing green power, through newsletters on the company's activities, and with partner accounts (e.g., coupons granting discounts at participating environmentally conscious dealerships).

Premiums for residential green power products in Canada vary between two and 9.09 cents/kWh (commercial customers pay a maximum of 7.5 cents). The Alberta government is one of the most important green power customers in Canada, sourcing 90 per cent of its electricity from green power, which is equivalent to a 70 MW wind farm.

Governments can help voluntary markets through green power purchasing for their own electricity needs, as well as through power source disclosure requirements. Labeling the origin of electricity (e.g., on the electricity bill) is a powerful educational tool and will show many customers what it is they are actually buying. For example, Albertans refer to power lines as "hydrolines," although their electricity mainly comes from other sources.

Voluntary green power marketing has been traditionally been a niche market in North America and generally only the most environmentally conscious customers may be ready to pay a premium. The limited effect of voluntary programs means that strong regulation and/or economic drivers must prevail to create meaningful amounts of new generation.

Mandatory and voluntary markets for green power can exist side-by-side. Due to economies of scale and the educational effects of government regulation, the best voluntary markets actually emerge in jurisdictions that have both types of market at the same time, such as Texas. For example, although a very aggressive RPS might take up all newly added generation and make it difficult to find green power generation that can be sold in voluntary markets on top of the mandatory quotas, environmentally conscious consumers may still want to exceed the official green power requirement and allow for successful marketing efforts.

Ontario Power Generation

Ontario Power Generation mainly sells green power to commercial customers, but through retail partners it also reaches retail markets. The company found that businesses buy green power for three main reasons:

1. it is part of their sustainability strategy;
2. they want to use it to increase their "green image" to increase sales; and,
3. they want to hedge against rising electricity costs.

This latter reason is becoming of interest since long-term contracts at fixed prices can be concluded with customers that want to become independent of price fluctuations in the fossil fuel markets. In Alberta, where prices were allowed to flow freely, many customers became interested in price hedging through renewables.

"Voluntary green power programs are good for public education, but government regulation is needed to develop large quantities of low-impact renewable energy."

Joan McDougall, Manager, Green Power Program, Nova Scotia Power

Financing Distributed Generation

Net metering is one option to support decentralized power generation. Manitoba, Yukon, and parts of Ontario offer this possibility. Net billing legislation is also under development in British Columbia (see Table A1 in the Appendix). The United States, European countries and also Scotland have programs in place that generously contribute to the installation cost of renewable energy systems at the residential level. Developed by the Energy Saving Trust and due to enter its second year next month, the Scottish Community and Householder Renewables Initiative offers grants and project support to assist the development of new community and individual renewable energy domestic schemes in Scotland. In this way, people objecting to what they see as the conversion of the countryside into an industrial landscape can still reap the benefits of sustainable energy without such consequences.

In Scotland, as much as 30 per cent of the purchase and installation costs for different sustainable technologies is available, with a maximum grant of GBP 4,000. Eligible sources include micro hydroelectric, micro wind and solar energy (including water and space heating), ground source heat pumps and automated wood fuel boilers and stoves. Buying any one of these technologies would, at present, achieve far more for the environment than signing up to a green electricity tariff, and many Scots are already making the choice to go renewable. The deputy enterprise minister, Lewis Macdonald, said: "Renewable energy is not just about large-scale schemes — it can form part of people's everyday lives."

Source: CO2e.com, December 19, 2003.

Preparatory Information for the Calgary Workshop

Renewable Energy "Visions"

Participants in the first three workshops of the Green Power Workshop Series repeatedly emphasized the need for government leadership and a national vision and strategy for green power development. This section presents some existing "visions" developed within and external to Canada as a basis for discussion at the fourth workshop in Calgary (February 9–10, 2004).

International

There are a number of international initiatives with respect to green power, including the Plan of Implementation from the 2002 Johannesburg Summit, which seeks to increase renewable energy portfolios, but does not set targets or timetables, and the UK-led Renewable Energy and Energy Efficiency Partnership (REEEP), a coalition of governments, businesses and organizations working towards an expansion of renewable energy and energy efficiency.

USA

A national RPS specifying a renewable energy target of 10 per cent had been under discussion for inclusion in the new Energy Bill, but was eventually discarded. Meanwhile, an increasing number of US states have adopted renewable portfolio standards, with varied specifications ranging from 1.1 per cent by 2007 in Arizona (60 per cent solar) to as much as 20 per cent of renewables in California by 2017.

> *"Nearly all green power development in the US is driven by RPSs."*
>
> Steve Probyn, Clean Power Income Fund

The Apollo Alliance: The most recent initiative in the US is the Apollo Alliance, a coalition of labour, civil rights and environmental groups, business and politicians. The alliance's New Apollo Project promotes the introduction of a renewable energy-based energy system in the US, with similar strong government support as was given to the Apollo Program in the 1960s. The group calls for federal investment of US$300 billion over a period of 10 years for several industry sectors and has issued a 10-point plan for energy independence.[63]

The plan calls for the increased development of renewable energy, recommending to "diversify energy sources by promoting existing technologies in solar, biomass and wind while setting ambitious but achievable goals for increasing renewable generation, and promoting state and local policy innovations that link clean energy and jobs." The Apollo Project suggests federal investment of US$49.17 billion in renewable energy, which is, in turn, expected to create nearly one million jobs in America.

[63] AA. 2004.

More specific recommendations in the Apollo report include:

- Provide the Production Tax Credit for a period of 10 years and extend it to other green power technologies than wind;
- Match state system benefits funds with federal moneys;
- Develop green power purchasing, research and development, investment tax credits, workforce development programs and demonstration programs;
- Set a national goal for renewable energy of 15 per cent by 2015 and 20 per cent by 2020.
- Develop regional research and development projects to develop renewable energy technologies and make sure these are developed evenly throughout America;
- Promote net metering and fair interconnection rules;
- Triple US biomass consumption, including using biomass to cover up to 14 per cent of electricity demand; and,
- Develop a "smart electricity grid" based on distributed generation.

The Solar Catalyst Group: The Solar Catalyst Group presents a national vision for solar photovoltaic energy in the United States. Their "Current Growth" scenario extrapolates current market growth of between 25 to 30 per cent annually, with an average 24 per cent growth annually over the next two decades. The "Accelerated Growth" scenario seeks to double the installed capacity of the business-as-usual scenario by 2025. It requires straightforward measures, such as standardized, affordable financing for end users. Finally, the "Hypergrowth" scenario aims at reaching a 10 per cent target by 2025, and would require very strong government leadership. Table 11 shows the numbers of the three scenarios suggested by the group.[64]

Table 11: Projected PV Growth Under Three Pathways (to 2025)

	Current Growth	Accelerated Growth	Hypergrowth
Compound annual growth rate	24%	28.5%	38%
Cumulative Installed MW in 2025	35 GW	70 GW	290 GW
Electricity Production Equivalent in 2025	63,000 GWh	126,000 GWh	522,000 GWh
Percentage of Projected US Electricity Consumption in 2025	1.2%	2.4%	10%
Assumes each kilowatt-hour installed provides an average of 1,800 kilowatt-hours a year. Includes only installations greater than 40 watts.			

Source: International Energy Agency. 2001.

[64] SCG. 2003.

The American Wind Energy Association: In its strategic paper "Wind Energy and Climate Change,"[65] the American Wind Energy Association proposes a set of policies to achieve a goal of 30,000 MW of installed wind power generation capacity, and a 10-point list of policies needed to achieve this goal:

1. A 10-year extension of the existing wind energy production tax credit (PTC).
2. A federal Renewables Portfolio Standard (RPS) of five per cent by 2005 and 10 per cent by 2010 should be included within federal electric utility restructuring legislation.
3. A federal agency renewables purchase requirement, steadily increasing over time.
4. A Small Turbine Investment Tax Credit (STIC).
5. A federal commitment to multi-year spending of $60 million annually for wind technology development.
6. "Net Metering" for renewable energy systems of one MW or less.
7. Establishment of renewable energy as a "must take" resource within utility power pools.
8. A strengthened existing Export/Import Bank program to more effectively support wind development around the world.
9. Incentives for developing countries to pursue wind projects.
10. A global resource assessment program aimed at mapping high quality wind sites.

Europe

The Directive on the Promotion of Electricity produced from Renewable Energy Sources is the main legislation affecting renewables at the EU level. This directive aims at facilitating a medium-term significant increase in renewable energy generation within the EU, considered within the context of the objective of doubling the share of renewable energy from six per cent (in 1997) to 12 per cent (in 2010) of the gross inland energy consumption. This has been translated into a specific share for consumption of renewables of 22.1 per cent in 2010 from 14 per cent in 1997. The directive also establishes targets for the penetration of renewables in each member state (see Table 12).

United Kingdom

To take an example of a member state, the UK has some of the best renewable energy resources of the European Union. Although only a small percentage of today's power mix comes from renewables, the UK's strong RPS policy (called the Renewables Obligation Order) combined with certificate trading has created a steep increase in generation. The UK is well on track to reach its 10 per cent goal for 2010. An Energy White Paper states a more ambitious goal of 20 per cent for 2020.

UK Renewable Energy Targets

UK (2010) — 10.4 per cent
UK (2015) — 15.4 per cent
White Paper (2020) — 20 per cent
Scotland (2010) — 18 per cent
Scotland (2020) — 40 per cent
(current share of renewable energy is 2.6 per cent)

[65] AWEA. 1998.

Table 12: Indicative Renewable Energy Targets in Europe for 2010 (including large hydro)

	Total electricity consumption (GWh)	**2010 Target** (%)	**2010 Target** (GWh)
Austria	70,626	78.1	55,189
Belgium	105,151	6.0	6,309
Denmark	44,400	29.0	12,876
Finland	96,614	31.5	30,240
France	537,701	21.0	112,917
Germany	613,277	12.5	76,660
Greece	72,463	20.1	14,565
Ireland	33,800	13.2	4,462
Italy	359,018	25.0	89,755
Luxembourg	7,951	5.7	453
Netherlands	132,688	9.0	11,942
Portugal	62,037	39.0	24,194
Spain	255,614	29.4	75,151
Sweden	162,563	60.0	97,538
United Kingdom	500,342	10.0	50,034
European Union	***3,054,244***	***21.7***	***662,160***

Source: ECN. 2003. p. 11.

The UK's Renewables Obligation has recently been extended to 2015 in order to maintain a stable investment climate for renewable energies. It will increase by one per cent each year to 15.4 per cent in 2015.

Scotland, having the best wind and ocean-based resources of the UK, has set itself an even more ambitious target — 18 per cent by 2010. In March 2003 the government announced a 40 per cent target for 2020.[66]

[66] SE. 2003.

Canada

Federal and Provincial Initiatives: In 1996, Natural Resources Canada announced a Renewable Energy Strategy. Activities under the strategy can be grouped into three pillars:

1. Enhancing Investment Conditions — Natural Resources Canada worked with the federal Department of Finance and industry to ensure that renewable energy investments receive appropriate tax treatment. This process led to the creation of the Canadian Renewable and Conservation Expense category in the income tax system.
2. Technology Initiatives — This concerns research and development funding under the interdepartmental Program on Energy Research and Development (PERD), as well as the creation of technical standards with the Canadian Standards Association.
3. Market Development Initiatives — Starting with the Renewable Energy Market Development Program, Natural Resources Canada has moved on to create new initiatives, such as the Market Incentive Program and the Wind Power Production Incentive.

No numerical targets have yet been defined under this strategy.

Canada's Climate Change Plan sets a target of 10 per cent of newly added electricity generation capacity in Canada from green power. This target is seen as extremely modest by the renewable energy industry, as it would only add about one per cent of green power in Canada's energy mix by 2010.[67]

[67] Assumed newly added capacity by 2010 — 14,100 MW. Ten per cent = 1,410 MW, split between wind (50 per cent, at capacity factor 0.3) and other renewables (50 per cent, mean capacity factor 0.8).

The Climate Change Plan target of 10 per cent of new capacity from renewables would only result in an addition of one per cent of renewable energy to Canada's energy mix by 2010.

At the provincial level, several initiatives are underway (see Table A1 in the Appendix). Some of the most significant initiatives include emerging renewable portfolio standards in New Brunswick, Alberta and Ontario, the 1,100 MW target for wind and biomass in Québec, and the 50 per cent "BC clean energy" target for newly added capacity.

The Ontario Electricity Conservation and Supply Task Force made some recommendations to the provincial government regarding the future of Ontario's energy supply.[68] The January 2004 report also makes detailed recommendations on renewable energy, and the most relevant recommendations have been included in Appendix 5. They cover issues such as:

- Government leadership and guidance on the composition of Ontario's future energy mix;
- Rapid implementation of the RPS;
- Support for distributed generation;
- Streamlining of permitting procedures;
- Development of a long-term transmission development plan to facilitate new generation coming onto the grid; and,
- Research and development, training and the creation of centres of excellence.

[68] ECSTF. 2004.

Independent Power Producers of Ontario (IPPSO)

As policies to support green power in Ontario are in transition due to a change of government, IPPSO has issued its recommendations to government. The organization supports the recommendations of Ontario's Renewable Energy Task Team.[69] The Team has identified four themes, which constitute the "pillars" of a successful renewable energy strategy for Ontario, meaning that inaction in any of the areas would frustrate the achievement of the overall objective:

1. **Government Leadership —** Require addition of one per cent (1,500 GWh) of current provincial load be added each year between 2003 and 2010. Establish renewable energy as "core business" for concerned ministries and create a Renewable Energy Secretariat.
2. **Valuing New Renewable Energy —** Remove the retail price cap; provide long-term (15–25 years) power purchasing agreements to green power providers, possibly via a tendering process.
3. **Accessing Transmission —** As the existing generator-pay approach to new transmission is a barrier to new generation, increasing the overall cost of electricity, LDCs/Hydro One should pay transmission cost for system upgrades to a limit of $60,000 per MW, and that renewable energy generators pay any cost above this limit.
4. **Proactive Tax Regime —** Existing provincial measures are insufficient. The federal government should:
   - provide an exemption for the federal capital tax of 0.225 per cent;
   - expand the qualification for Class 43.1 by eliminating, or increasing, the 50 MW cap on waterpower;
   - adopt a refundable tax credit for renewables;
   - expand funding for the Wind Power Production Incentive (WPPI);
   - raise the WPPI payment and increase the national program target from 1,000 MW to 4,000 MW;
   - introduce similar incentive programs (with new funding) for other renewables; and,
   - address renewable energy-related recommendations in the Canadian Electricity Association's 2003 federal budget submission.

The Clean Air Renewable Energy Coalition: The most comprehensive "vision" for renewable energy in Canada so far is the one developed by the Clean Air Renewable Energy Coalition, an alliance of energy companies and developers, ENGOs and the Federation of Canadian Municipalities that promotes low-impact renewable energy. In its vision document,[70] the coalition encourages the following targets and recommendations:

[69] RETT. 2002.

[70] CAREC. 2003.

1. Define a comprehensive Renewable Energy Vision for Canada, including resource assessments, research and development money for emerging technologies, and feed-in tariffs (different for each technology).
2. Set long-term targets for Renewable Energy in Canada — A minimum of seven per cent of Canada's electricity production in 2010, and 15 per cent by 2020.
3. Commit to a package of long-term and broad market and government incentives — specifically:
    - The Federal Wind Power Production Incentive (WPPI) be increased to the equivalent level of the Production Tax Credit in the US in order to provide a level playing field for investment (estimated at 2.7 cents/kWh).
    - This type of incentive be extended to other renewable energy technologies currently at a pre-commercial level.
    - Federal climate change-related money be used to expand the Market Incentive Program funding to (a) $30 million per year, (b) extend it to 2012 and (c) consult with the provinces and territories to develop a broader-based green energy rebate and education program for consumers.
4. Develop partnerships between the Federal Government and its Provincial and Territorial counterparts to provide incentives or measures to increase Renewable Energy investments in Canada through government green power purchases (minimum of 30 per cent of electricity needs by 2010, and more after that) and provincial mandated generation targets for low-impact renewables through RPS or other support policies.
5. Recognize the potential for Renewable Energy in a carbon-constrained economy.

Canadian Wind Energy Association: The Canadian Wind Energy Association has set its own target — 10,000 MW of installed wind turbines by the year 2010, or five per cent of Canada's annual electricity generation.[71] The CanWEA strategy for achieving this goal consists of the following measures:

1. Implement market-wide production-based revenue incentives for wind energy. This means that all wind power suppliers — large or small, profitable or emerging, public or private — can take advantage of federal government financial incentives.
2. Remove tax barriers for wind energy development, allowing all players, regardless of size or earnings to benefit from the existing accelerated depreciation in our tax laws.
3. Implement renewable energy portfolio standards with certificate trading in the provinces and territories.
4. Establish net metering, or net billing, in all provinces and territories.
5. Develop a comprehensive wind energy atlas for Canada.
6. Introduce electricity product labelling for all electricity sales in Canada.
7. Continue to provide education and marketing materials to the Canadian public and business on the benefits and costs of wind energy.
8. Establish a Greenhouse Gas (GHG) Emission Reduction trading system incorporating renewable energy.
9. Continue to provide financial support for wind energy technology research and development.
10. Purchase green power to meet federal, provincial and municipal government electricity needs.

[71] CanWEA. 2001.

Canadian Solar Industries Association: The Canadian Solar Industries Association (CanSIA) has also issued its own vision for photovoltaic and other solar-based energy.[72] CanSIA suggests that with proper planning, solar photovoltaic power could be supplying one per cent of Canada's electricity supply and more than two per cent in Ontario by 2025 — these values could be doubled through proper planning. A number of actions are needed for solar PV to meet its potential in Canada for supporting electrical grid energy.

1. A National Renewable Energy Plan — Canada needs a formal comprehensive plan for the development of renewable energies.
2. Renewable Portfolio Standards
3. Net Metering and Interconnection Standards — Different rules and standards for electrical bi-directional meters are significant barriers to solar PV deployment in Canada. A national standard for net metering and interconnection to the grid is critical to guaranteeing a level playing field and allowing for reduced installation costs
4. Feed-In Policy — Allowing customers to sell excess power back to the grid at a premium will stimulate the market for solar. In Germany, for example, the premium that utilities pay for solar electricity from small producers is almost 300 per cent of the retail price and is one of the main reasons that Germany is one of the global solar leaders.
5. Elimination of Electric Rate Subsidies and the Introduction of Time-of-Day Metering — Solar electricity, while expensive based on artificially low average rates, begins to make economic sense when faced with peak period costs.
6. Subsidies — A commitment to providing market and industry-based subsidies for solar technologies is required and could be financed through a public goods charge (called a system benefits charge (SBC) in the US).

[72] CanSIA. 2003.

Renewables and Climate Change: Five of Canada's renewable energy associations have teamed up to provide their input for Canada's Climate Change Plan.[73] They advocate a stronger role for green power in Canada's effort to reduce greenhouse gases than the official Climate Change Plan now specifies (i.e., 5.1 Mt versus 3.9 Mt in the plan). Measures relevant to green power recommended for reaching this goal include:

1. Stimulate the Development of a Low-Impact Renewable Electricity Market:
   - Consumer information on electricity products (enabling measure);
   - Market-wide incentives for low-impact generation (consumer credit, production credit, RPS);
   - Green power procurement; and,
   - Removal of tax barriers to renewable generation.

2. Support Consumer-Based Renewable Technology Use:
   - Net metering;
   - Consumer credit for rural renewable electricity generation; and,
   - Municipalities and federal government 50,000 solar roofs partnership.

Renewable Energy Policies and Incentives

Table 13 lists current renewable energy policy approaches in European countries. Most countries are using feed-in tariffs, which allow for renewable energy generators to sell unlimited amounts of their generation to the grid operator at government-set tariffs. These tariffs are generally decreasing over time to accommodate price reductions through technology improvements, but are usually set at high levels that allow less attractive sites to be developed and provide interesting returns in order to incite private investment.

[73] LIRE.

Table 13: Renewable Energy Policies in Europe

Incentives / Country	Feed-in tariff	Investment subsidies	Fiscal incentives	Financial incentives	Quota obligations / TGC	Tendering systems	Green pricing
Austria	x	x	x	x			
Belgium	x	x	x		x		
Denmark	x	x	x				
Finland		x	x				x
France	x	x	x			x	
Germany	x	x		x			x
Greece	x	x	x	x			
Ireland						x	
Italy	x		x		x		
Luxembourg	x	x	x	x			
Netherlands	x	x	x	x			x
Portugal	x	x	x	x			
Spain	x	x		x			
Sweden	x	x			x		
United Kingdom		x	x		x	x	

Source: ECN. 2003. p. 13.
Note: Quota obligations correspond to the North American term "RPS."
TGC — Tradeable Green Certificates.

Nearly all countries also provide subsidies — for research and development and also for the deployment of renewable energy technologies — and fiscal incentives. Only a few countries, such as the UK, have started working with renewable portfolio standards (quota obligations). Tendering has been tried by several countries in the past, but was abandoned mainly due to its ineffectiveness in deploying large enough amounts of new generation capacity. There are also some successful green power marketing attempts; for example, the Netherlands is leading the world with a subscription rate of 20 per cent of the population.

Table 14 compares the US and Canada incentives for green power, both at the federal and provincial/state levels. The latter implies that some of the states/provinces provide these incentives, but many do not, or only partly offer them. The table shows that on the whole, incentives in the US are more favourable than in Canada, apart from biomass, in which Canada seems to be at an advantage. Canada provides accelerated depreciation for all technologies, but other incentives are not available for each technology.

Table 14: Incentives for Green Power in Canada and the US

Key Incentives	PV		Wind		Biomass		Low Impact Hydro		Conc. Solar Power		Geothermal	
	US	CDN	US	CDN	US	CDN	US	CDN	US	CDN	US	CDN
Federal												
Tax Credit Against Investment	✓								✓		✓	
Accelerated Depreciation	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Tax Credit Against Production			✓	✓	✓	✓						
Tax Credit for Alternative Fuel					✓							
State / Province												
Rebate Against Investment	✓											
Tax Credit Against Investment[1]	✓	✓	✓	✓		✓	✓	✓	✓			
Property Tax Exemptions	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Sales Tax Exemptions	✓	✓		✓		✓	✓	✓	✓			
Tax Credit Against Production			✓				✓					
Tax Credit Against Sales[2]		✓	✓	✓		✓	✓	✓				

1) Ontario offers corporate tax write-off and capital tax exemption against purchase of assets for generation of energy from renewable sources.
2) Ontario offers tax holiday when electricity sales from renewable sources begins.

Source: NAV. 2003. p. 10.

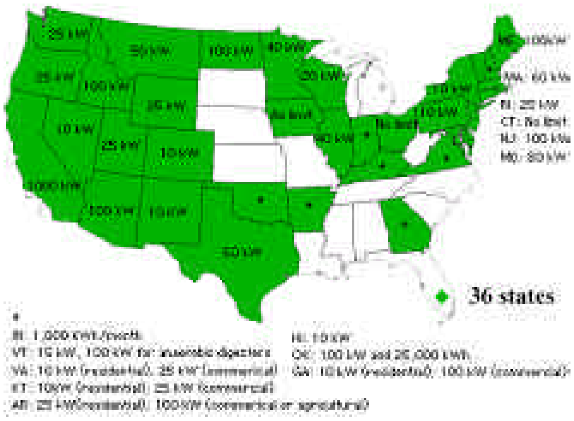
What the table does not show is that US incentives also tend to be higher — for example, the US Production Tax Credit is valued at (US) 1.8 cents/kWh, whereas the Canadian Wind Power Production Incentive provides (CDN) 1.0 cents/kWh. There are no buyback programs in Canada for solar PV, whereas several US states offer these. Finally, the US is also ahead of Canada in terms of renewable portfolio standards, system benefits funds and net metering provisions (see Figure 11).

A federal Caucus Working Group on Environmental Technologies, chaired by Julian Reed, examined the potential and challenges for renewable energy in Canada and made the following recommendations to further develop these resources:[74]

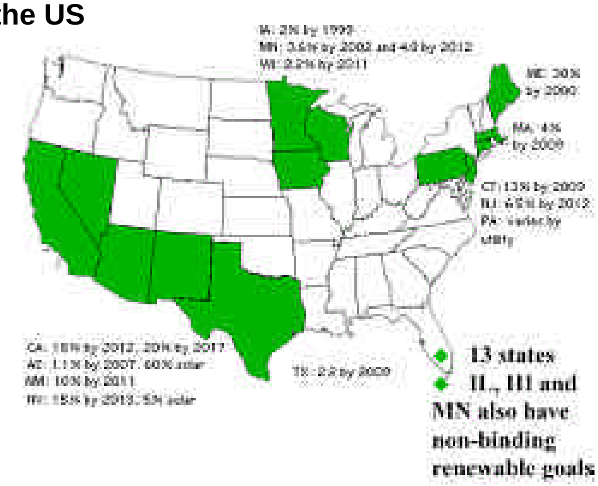
1. Economic Incentives — Provide the same government support and fiscal incentives to green power as is given to conventional energy producers, or remove existing subsidies from established producers; expand the Wind Power Production Incentive to all forms of renewable energy; increase investment in new renewable energy technology through the expanded use of flow-through shares and/or the reintroduction of limited partnerships.
2. Better Accounting of Hidden Costs — The hidden health, environmental and social costs associated with conventional fossil fuel-based energy must be reflected in the market price. For example, federal studies show that 5,000 deaths in Canada every year result from air pollution. A domestic emissions trading system would impose an economic cost on dirtier, less efficient technologies, while rewarding cleaner technologies.

[74] CWGET. 2002.

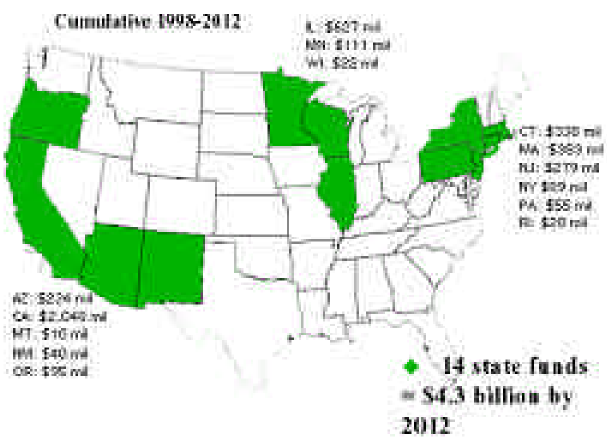
Figure 11: Green Power Support Programs in the US



Net Metering



Renewable Portfolio Standards



System Benefits Funds

Source: UCS. 2003.

3. Policy Instruments — Federal Green Energy Procurement programs should be expanded by seeking similar procurement commitments from other levels of government and major industries; a Renewable Portfolio Standard (RPS) could promote the development of renewable energy in Canada.
4. Government Leadership — Government must make renewable energy a major component of Canada's innovation agenda, through:

- encouraging development with the same zeal and effort that led to the successful development of Canada's frontier oil and gas and nuclear power industries;
- coordinating and increasing funding for pilot and large-scale demonstration projects; and,
- creating a federal regulatory agency that can remove obstacles to renewable development, increase support for public education programs, and continue to expand our excellent record in research and development.

The Government must also increase access to investment capital for renewable energy start-ups. For example, through expanding the Green Municipal Investment and Green Municipal Enabling Funds to help municipalities reduce greenhouse gas emissions from their landfills through the use of anaerobic digestion technology.

Forging the Canadian Approach

Canada's situation is different than most OECD countries. Canada has abundant large hydro resources that provide for more than half of Canada's current electricity needs. Consequently, electricity prices are among the lowest in industrialized countries as many of the existing dams are written off and can provide electricity at extremely low prices. Long-standing subsidies to alternate conventional power sources have also contributed to lower electricity prices. The combination of these factors has put more expensive renewable energy technologies at a competitive disadvantage in Canada compared to countries where conventional electricity costs are much higher.

Furthermore, Canada's jurisdiction over energy matters lies with the provinces, and although government has made some attempts to improve the situation (e.g., through the Wind Power Production Incentive), federal-provincial coordination and cooperation has so far been lacking. These circumstances have to be taken into account when designing a Canadian approach to green power policies and incentives.

The following is a collection of elements that should be integrated into a Canadian strategy to promote green power, suggested by participants of the first three Green Power in Canada workshops and complemented by the findings of recently published studies.

The Role of Government

Free market advocates hold that governments should not intervene in markets through subsidies or other means, but should let the market decide about which technologies and resources should be used to generate electricity. However, workshop participants held that governments should interfere in renewable energy markets for the following reasons:

1. There is a market failure in energy markets because the external costs of conventional forms of energy are not reflected in prices;
2. The incremental cost of adding renewable energy sources to the power production portfolio benefits everyone and should therefore be borne by society, not individual volunteers. Voluntary approaches (paying a premium) are not effective;
3. Governments have a role and opportunity in developing the new renewable energy industry; and,
4. The federal government sets the climate change policy framework in which renewable energy should play a major role.

A report on renewable energy issued by the International Energy Agency (IEA) in December 2003 details policy intervention opportunities for governments that want to support this sector. The report notes that policy makers should recognize not only the broad similarities of renewables, but also their differences; as uniform treatment is not effective. Renewable energy technologies are maturing at different rates and have different limitations, such as intermittence and public acceptance. The report highlights the on-grid use of solar photovoltaics (PV), which in the best resource locations is increasingly close to the cost of retail power when supportive polices are in place, such as California.

For other technologies in locations where resources are strong, wind, bioenergy, small hydro and biopower are competitive on a kilowatt-hour basis with fossil fuels for electricity production. In off-grid market niches, solar PV, small wind, small hydro and biopower can have a competitive edge. These technologies are particularly appropriate in developed countries for small industrial and agricultural applications, such as remote sensing, water pumping and railway switching.

Crucial Points for a National Renewables Strategy in Canada

The following points of view were put forth by various workshop participants:

1. The deployment of renewable energy systems is not a technological issue, but a policy issue.
2. Coordination between and among governments is crucial to reducing costs and to creating coherent and effective strategies to support the renewable energy market. Cooperation among provinces is also necessary to create maximum demand for renewable energy technologies, in order to reach demand levels that will attract local investment in manufacturing capacity in Canada.
3. Voluntary green power programs mainly serve educational purposes, but have limited effects on the deployment of renewable energy systems. Strong policies are needed to develop large quantities of renewable energy generation capacity.
4. Observing the US market is crucial for Canada. Although Canadians do no always have to follow the American lead, Canadian policies must be compatible with those in the US in order to be able to export renewable energy.
5. There is even larger potential in energy efficiency than in renewable energy. This should be considered an energy source and included in all efforts.

Renewables UK

Renewables UK was set up in March 2002 by Brian Wilson, Minister for Energy and Competitiveness, and is part of the Department of Trade and Industry's Renewable Energy Industry Directorate. Renewables UK is a small team whose role is to help secure maximum benefits for UK industry from the rapidly growing worldwide renewables market and to assist in overcoming barriers to renewables projects in the UK via the Renewables Advisory Board. This means optimizing the benefits of renewable energy to the UK in order to maximize opportunities in manufacturing, services, exporting and jobs.

Renewables UK is working closely with individual companies, regional support agencies, other government departments, trade associations and the devolved administrations to:

- Maximize UK content in projects in the UK and overseas;
- Communicate opportunities;
- Overcome barriers to developments;
- Disseminate information; and,
- Coordinate the continued development of, and support for the UK supply chain.

Source: www.dti.gov.uk/energy/renewables/renewables_uk/overview.shtml.

6. Incentives can do service in the short term, but there is a need to create markets that are self-sustaining without incentives in the long run.
7. Canada should participate in the North American work on creating a tracking system for Renewable Energy Certificates. Certificates should not be bundled with the electricity (linked to the existence of transmission lines), but should be freely tradable to create a liquid Canada-US market.
8. The government needs to create a unit that promotes green power. Most departments are guardians of their responsibilities (protection of natural resources, etc.) and none is there to actually help this sector overcome barriers. Other countries have already set up such units (see Text Box: Renewables UK).

Table 15 identifies a number of challenges for green power technologies on both the supply side and the demand side. These points confirm the crucial role of government in providing a significant demand pull, helping emerging concepts to come to market, and assisting with the creation of standards and other circumstances that will enhance the development of stable markets.

The Market Element – Tradable Green Power Certificates

In order to make provincial renewable portfolio standards more equitable, renewable energy certificate trading can be used. This facilitates the development of the least expensive resources and does not put any undue burden on retailers that do not have access to cheap green power in their service area. This approach is currently being used in several jurisdictions in Europe, Australia and the US. When designing

Table 15: Challenges for Green Power Technologies

Supply Side	Demand Side
Technology: Reliable and field-proven renewable energy technologies are just beginning to emerge in Canada, but many more have the potential to come forward.	***Fairness:*** Existing subsidies for fossil fuel and nuclear power, and the lack of full-cost accounting, result in disproportionately high costs for renewable energy.
Expertise: The integrated efforts of marketing, financial, operational and technical expertise are required to fully commercialize emerging renewable energy projects.	***Certainty:*** The lack of clear and consistent government direction and priorities means that only the most philosophically-aligned and/or courageous investors will invest in renewable energy projects.
Infrastructure: The lack of manufacturing, delivery and marketing infrastructure is preventing many worthwhile renewable energy technologies from entering the market.	***Consistency:*** Outmoded and inconsistent codes, standards and regulations impede the development of many worthwhile renewable energy projects.

Source: SDTC. 2003(2).

certificate trading systems, the following should be considered:[75]

- Provincial certificate trading in Canada would be dominated by one (or a few) player(s). In order to create a liquid market for certificates, a Canada-wide trading system is preferable.
- The UK system serves as a good example: it is based on clear rules, includes penalties and provides long-term support (i.e., the RPS requirement lasts until 2027).
- The Maine system was less successful because it included large hydro, which led to an oversupply of certificates.

Recipe for a Successful Green Power Policy

1. Create a stable tax and regulatory regime.
2. Enhance demand through renewable portfolio standards.
3. Create a level playing field by removing subsidies from conventional energy sources (i.e., let the market decide the true price of electricity).
4. If this is not possible, provide incentives to the green power sector so that it can compete against conventional generation.
5. Educate policy makers, investors and the general public about the benefits of green power.

[75] CO2e. 2003.

A Portfolio of Possible Solutions

The following tools have been identified to encourage renewable energy development in Canada.

1. Net Metering — Net metering would help encourage decentralized on-site systems by both private and industrial/ commercial customers.

2. Tax Relief Measures — Tax relief measures could be used to make up for the gap that WPPI leaves between renewable energy and fossil wholesale prices.

3. Higher Subsidies — Renewable energy would benefit from government support at the same level as was provided to the oil and nuclear sectors in the past. Among other initiatives, suggestions were made to increase the amount, duration and resource applicability of the Wind Power Production Incentive.

4. Education — The general public is often misinformed about both the benefits and the perceived drawbacks of renewable energy, which increases problems with NIMBY and can frustrate green power marketing efforts. Also, governments and utilities are often not aware of the advantages and opportunities linked to renewable energy, and are said to have unfounded concerns about real costs and intermittency problems. Specific mechanisms that help address NIMBY include conveying that renewables are profitable and are environmentally acceptable, and ensuring that proposed developments are appropriately communicated to the local community.

5. Increasing Electricity Prices — Canada's retail prices are among the lowest of the industrial countries, which increases the price gap between renewable and conventional energy sources. Increasing electricity prices to better reflect the environmental cost of conventional electricity would close this gap. There are socially responsible ways to achieve this, as shown by the success of programs in the Netherlands and Germany, where old-age security contributions were lowered when electricity prices were increased.

6. Full-cost Accounting — Full-cost accounting aims at incorporating negative environmental impacts in fossil-based electricity prices. Accounting for related variables, such as utility weather insurance and other costs, would help renewables gain market success.

7. Industry Canada Refurbishing — This federal department has no person responsible for renewable energy sources.

8. Government Purchasing — Several initiatives to source electricity for government buildings from renewable energy are already underway, such as the federal 20 per cent commitment and the Alberta 25 per cent commitment. Some proponents are asking to increase these numbers even more, and to aim for 100 per cent by a set target date.

9. Renewable Portfolio Standards — Several Canadian jurisdictions are already developing such standards, which have been shown to be effective in green power development when the standards are carefully planned and targets are adequately set. In Nova Scotia, for example, it has been suggested that an RPS requiring an increase of 1.5 per cent in renewable energy generation would only increase electricity bills by about 0.75 per cent.

10. A National Renewable Energy Plan — This could link in with the provincial RPS systems currently in discussion or under development. Although the federal government has no jurisdiction in the energy sector, the government could still set such a target, which might encourage nationwide cooperation on its implementation.

11. Renewable energy roadmaps could provide the necessary government guidance and initiative to develop the sector. For example, a roadmap showing the steps needed to move Canada towards small biopower systems (less than 10 MW) could help identify the challenges and facilitate a strategy to remove the barriers.

12. Voluntary Programs — Initiatives, such as the federal $30 million Market Incentive Program, aim at supporting voluntary Green Power programs, offering renewable electricity to residential and/ or commercial customers at a price premium.

13. Carbon Tax — Several European countries have introduced carbon and energy taxation. Canada should consider such steps to remain in line with these developments.

14. Real-time Pricing — While encouraging energy efficiency and the prudent use of electricity, real-time pricing could also help the renewable energy sector. For example, solar PV yields the highest output when it is needed most — on hot days in the summer, when annual energy consumption peaks and power is most expensive.

15. Resource Mapping — A federal wind resource mapping initiative is already underway, but other resources, such as biomass, geothermal and ocean energy, should also be examined at the federal level.

16. Creation of RenewCanada — Just as the government created PetroCanada to provide an alternative to Canadians, a "Renew Canada" corporation could help enhance investment in renewable energy sources across the nation.

17. Creation of a Renewable Energy Agency — This agency would function at both the federal and provincial levels and would have the main task of promoting green power. It could also be the one-stop agency for a streamlined permitting procedure for renewable energy project siting.

18. Coordination Among Renewable Energy Associations — The development of an integrated platform would do much to leverage association resources and to speak with one voice to governments, in addition to taking advantage of common interests.

19. Coordination Within Industry on the Best Incentives for the Development of Renewable Energy Policy Support in Canada — There is a need for industry and other stakeholders to develop and provide recommendations to government as one coordinated entity. It was stated that, to date, government policy developments reflect stakeholder requests made on a non-integrated basis.

20. Require 0.5 per cent of the Budget for New Federal and Institutional Buildings to be Spent on Renewable Energy and Energy Efficiency Measures — This is the same number currently applied for artwork in new buildings, and would provide manifold opportunities to increase energy efficiency and utilize solar PV systems across Canada.

21. Create Renewable Energy Purchasing Intermediaries — Such entities could, for example, be created within the structure of existing Independent Market Operators and would take over the investment risk through long-term Power Purchasing Agreements with green power producers. These agencies would then re-sell the green electricity to retailers, which would create better investor confidence than if projects had to sell their power directly to retailers with limited long-term credibility.

22. Define a Clear Land-use Policy — Provincial governments should assist municipalities in identifying possible areas for green power development with suggested template zoning standards, the identification of restricted/prohibited areas and clear-cut crown land use policies.

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Appendix 1: Overview of Federal, Provincial and Private Measures to Further Green Power Development

Table A1: Federal, Provincial and Private Measures to Further Green Power Development (based on Pembina 2003)

Province/ Territory	Purchase Obligations	GP Procurement	Green Power Retail	Production Incentive	Tax Incentive	Other
Nova Scotia	50 MW (voluntary) RPS planned.		Nova Scotia Power			Scotia Wind Fields community investment fund.
Newfound land						Two private wind projects earmarked for St. John's.
PEI		Power from five MW wind farm.	Maritime Electric Company Ltd.			
New Brunswick	RPS planned					NB Power Wind speed monitoring initiative.
Québec	1,000 MW of wind and 100 MW of biomass by 2010.				Additional tax credit for industrial investments on Gaspé peninsula that create employment.	
Ontario	RPS Announced (five per cent by 2007 or 1,350 MW; 10 per cent by 2010); OPG: Voluntary purchase of three TWh of electricity supply from renewable energy by 2005.	20 per cent	OPG; Green Tags Ontario; Toronto Hydro; Toronto Renewable Energy Cooperative; Oakville Hydro Energy Services.		100 per cent corporate income tax deduction for new assets used to generate electricity from alternative or renewable energy sources. A sales tax rebate on building materials purchased after Nov. 25, 2002, and before Jan. 1, 2008 that are incorporated into facilities that generate electricity from clean, alternative or renewable energy sources. A 10-year property tax holiday on eligible facilities that begin generating electricity after Nov. 25, 2002, and before Jan. 1, 2008, using clean, alternative or renewable energy sources. Provincial sales tax rebates on new residential solar installations, and budget proposals that would extend this to wind, micro-hydro and geothermal heating/ cooling systems.	Renewable energy set-aside in emission trading (2001). Funding to establish a Centre of Excellence for Electricity and Alternative Energy. Net-metering (optional, currently regulated by local distribution companies).

Table A1 continued. . .

Province/ Territory	Purchase Obligations	GP Procurement	Green Power Retail	Production Incentive	Tax Incentive	Other
Manitoba						Wind power resource assessment study.Net metering.
Saskat chewan	SaskPower: 45 MW of capacity to be solicited by 2005 (voluntary).	16 per cent	SaskPower			Up to 150 MW of wind though joint ventures by 2007.
Alberta	Renewable and alternative energy portion of total provincial energy capacity by 3.5 per cent by 2008.	90 per cent	ENMAX			“ME First” $100 government loans for municipalities to develop solar and wind power and energy efficiency measures.
British Columbia	50 per cent of new generation (voluntary).		BC Hydro green tags (large commercial customers only) West Kootenay Power. Aquila.		PST exemption for renewable energy equipment.	British Columbia resource assessments. Net metering planned.
Yukon		Investment in two wind turbines.				Wind energy resource mapping.Net metering. Alternative Energy Initiative ($3M for small-scale projects).
Northwest Territory		Investment in wind turbines in several remote communities.				
Nunavut		Nunavut Power Call for Expressions of Interest for wind.				

Table A1 continued. . .

Province/ Territory	Purchase Obligations	GP Procurement	Green Power Retail	Production Incentive	Tax Incentive	Other
Municipal		Toronto (25 per cent); Calgary "Ride the Wind;" Pincher Creek, AB (10 MWh per year); Nelson, BC (100 per cent small hydro).	n/a			Federation of Canadian Municipalities: Green Municipal Enabling and Investments Funds to invest in municipal government projects, which have an environmental benefit. Total budget is: $250 million (grants: $50M; loans: $200M).
Federal	Ten per cent of new capacity (Climate Change Plan target).	20 per cent	n/a	WPPI	Class 43.1 accelerated depreciation on renewable energy equipment — 30 per cent per year declining balance. Canadian Renewable Energy and Conservation Expense (CRCE). 100 per cent write-off of pre-development expenses, including test wind turbines.	MIP SDTC NRCan Renewable energy research, development, demonstration and commercialization programs through CANMET.

Appendix 2: Alternative Capacity Data

The Canadian Industrial End-Use Energy Data Analysis Centre at Simon Fraser University, Vancouver, publishes annual data on renewable energy facilities in Canada. The Centre's first report came out in May 2003. The data included in this report are presented below as an alternative to the data provided in the Background — Green Power section of this backgrounder. Some of the differences could be explained as follows:

- The solar PV numbers do not reflect all distributed private panels;
- The wind data do not take into account the latest numbers from the Canadian Wind Energy Association; and,
- The Nova Scotia tidal plant has a capacity of 20,000 kW, as a correction to the figures provided below.

Table A2: Electrical Capacity by Province (CIEEDAC)

Province/ Territory	Electrical Capacity (kW)								Per cent Total
	Hydro	Wind	Biomass	Biogas	Solid Waste	Solar PV	Tidal	Total	
Alberta	843,750	94,350	201,500			16		**1,139,616**	1.63
British Columbia	11,629,742		710,750	4,050		15		**12,344,557**	17.68
Manitoba	5,004,420		22,800					**5,027,220**	7.20
New Brunswick	907,090		182,912					**1,090,002**	1.56
Newfoundland & Labrador	6,866,398							**6,866,398**	9.84
Nova Scotia	399,300	1,200	54,200			10	3,700	**458,410**	0.66
Northwest Territories	58,630							**58,630**	0.08
Nunavut		360				3		**363**	<0.01
Ontario	8,150,202	13,050	445,820	9,300	25,400	186		**8,643,958**	12.38
Prince Edward Island		5,280	2,000					**7,280**	0.01
Québec	32,844,926	102,060	270,400	4,000		30		**33,221,416**	47.59
Saskatchewan	835,860	17,100	21,000			5		**873,965**	1.25
Yukon	76,300	811				3		**77,114**	0.11
Total Resource	**67,616,618**	**234,211**	**1,911,382**	**17,350**	**25,400**	**268**	**3,700**	**69,808,929**	
Per cent of Total	96.86	0.34	2.74	0.02	0.04	<0.01	0.01		

Table A3: Percentage of Provincial Supply from Renewable Energy (CIEEDAC)

Province/Territory	Electrical Capacity (kW)		Per cent
	Renewable Energy	Installed Capacity	Total
Alberta	1,139,616	8,877,000	12.8
British Columbia	12,344,557	13,556,000	91.1
Manitoba	5,027,220	5,141,000	97.8
New Brunswick	1,090,002	4,564,000	23.9
Newfoundland and Labrador	6,866,398	7,344,000	93.5
Nova Scotia	458,410	2,306,000	19.9
Nunavut and Northwest Territories	58,993	251,000	23.5
Ontario	8,643,958	29,530,000	29.3
Prince Edward Island	7,280	117,000	6.2
Québec	33,221,416	35,098,000	94.7
Saskatchewan	873,965	3,069,000	28.5
Yukon	77,114	131,000	58.9
Total	**69,808,929**	**109,984,000**	**63.5**

Appendix 3: Details on Green Power Definitions

A Note on Definitions of "Green"

Whereas the term "renewable" is well defined and includes large and small hydropower, solar, geothermal, wind, ocean and biomass-based power generation, there is no national or international agreement as to what represents a "green" power source. In the US, the Green-e label criteria developed by the Californian Center for Resource Solutions are most influential on renewables development. The Low Impact Hydropower Institute (LIHI) has developed guidelines specifically for hydropower projects, which are incorporated in the Green-e label criteria. In Europe, a European Green Electricity Network (EUGENE) promotes a common definition of "green" within the European Union. At the moment, various definitions still exist in European countries, and even within a country several definitions and certification schemes can exist.

In Canada, TerraChoice is developing definitions of certifiable "green" power sources jointly with Environment Canada. The outcome of this process is expected this year and will be crucial for standard-setting, as the new EcoLogo criteria will have a major impact on which projects may be supported by various national and regional programs, and which may not. The British Columbia government, SaskPower and others also have defined sources eligible as "green" under their respective programs. Ontario's former Energy Minister John Baird, classified a natural gas cogeneration project as "alternative energy" within the provincial energy strategy.[76]

Table A4 provides an overview of the main differences between some of the attempts to define green power. The key issues related to definitions are:

- New plants as opposed to old/existing plants;
- Additionality requirements;
- Inclusion/exclusion of certain waste-related biomass feedstocks;
- Inclusion/exclusion of "cleaner," but non-renewable, options, such as natural gas and CHP;
- Definition of "green" hydropower; and,
- Single label or multi-tier system.

Green power labels are aimed at the voluntary green power market. The criteria need not be applied in the same manner to regional government-mandated requirements, such as renewable portfolio standards. There is a lot of agreement that the voluntary green power market should be seen as additional to, and separate from, the mandated market (i.e., a kWh used to comply with a mandate cannot be sold to a customer as "green" energy).

The Canadian Environmental Choice Program currently uses a combination of listing green energy sources and additional performance criteria:

- During project planning and development, appropriate consultation with communities and stakeholders must have occurred, and prior or conflicting land use, biodiversity losses and scenic, recreational and cultural values must have been addressed.

[76] CARE. 2003(2).

Table A4: Various Definitions of "Green" Power

Source	CHP	WtE	LG	BM	WD	PV	ST	LH	SH	GT	WE	TE	Comments
Canadian Low Impact Electricity Guideline (draft) [ECP-79]			x	x	x	x		x	x	x	x	x	Hydro: has to comply with performance criteria (48-hour shaping). Requires additional measures in planning stage and during operation, such as prior stakeholder consultation, environmental management. Biomass: wood wastes, agricultural wastes and/or dedicated energy crops, biofuels.
BC Clean Energy	x	x	x	x	x	x			x	x	x	x	Based on BC Energy Policy of November 2002. Also includes fuel cells and energy efficiency improvements.
SaskPower			x	x	x	x			x				Also includes flare gas and heat recovery for electricity production (e.g., from natural gas compressor stations). Additional criteria defined for each category.
Pembina Green Power Guidelines			x	x	x	x	x		x	x	x	x	Biomass: wood waste, feedlot waste, energy crops. Small hydro: run-of-river only. Also includes fuel cells if hydrogen is not derived from fossil fuels.
US Green-e logo			x	x	x	x			x	x	x	x	Biomass: co-fired fuels (mainly landfill gas). WtE: Certified if local rules accept it.
EU Renewable Energy Directive (10/2001)		x	x	x	x	x		x	x	x	x	x	Biomass: biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. Also acknowledges solar hot water heaters.
EUGENE	x			x	x	x			x	x	x	x	CHP: Condensing power excluded, overall efficiency min. 85 per cent, limits for specific emissions apply. Hydro: New or expanded power plants can only be labeled as green if the hydropower facility leads to a substantial improvement of the local and regional ecological quality, in excess of legal compliance. Biomass: energy crops, agriculture and forestry wastes, other organic wastes, sewage gas; unseparated urban solid waste and sewage sludge excluded.

RPS: Renewable Portfolio Standard; CHP: Combined Heat and Power; LG: Landfill Gas; WtE: Waste-to-Energy; BM: Biomass; WD: Wind; PV: Photovoltaic; ST: Solar Thermal; LH: Large Hydro; SH: Small Hydro; GT: Geothermal; WE: Wave Energy; TE: Tidal Energy

- No adverse impacts can be created for any species recognized as endangered or threatened.
- Supplementary non-renewable fuels must not be used in more than 2.00 per cent of the fuel heat input required for generation.
- Solar (cadmium containing wastes must be properly disposed of or recycled).
- Wind (protection of concentrations of birds, including endangered bird species).
- Water (compliance with regulatory licenses; protection of indigenous species and habitat; requirements for head pond water levels, water flows, water quality and water temperature; and measures to minimize fish mortality and to ensure fish migration patterns).
- Biomass (use only wood wastes, agricultural wastes and/or dedicated energy crops; requirements for rates of harvest and environmental management systems/practices; and, maximum levels for emissions of air pollutants).
- Biogas (maximum levels for emissions of air pollutants; and leachate management).
- Other technologies that use media, such as hydrogen or compressed air, to control, store and/or convert renewable energy.
- Geothermal technologies.

The British Columbia government includes natural gas in its energy policy, stating that 50 per cent of newly constructed capacity should come from renewables and natural gas over the coming ten years. SaskPower has defined criteria for several green power sources in the framework of its Environmentally Preferred Power Program.[77] These criteria refer to EcoLogo definitions, as well as minimizing land use, avoiding protected areas and requiring little new electricity infrastructure.

The US Green-e[78] standard for tradable renewable energy certificates admits solar electric, wind, geothermal, LIHI-certified hydro, and biomass generated from the following fuels: landfill gas, digester gas, plant-based agricultural, vegetative and food processing waste, bioenergy crops, clean urban waste wood and mill residues. A "new" facility is defined as one that started operating after January 1, 1999. The standard defines emission limits for biomass-powered plants, as well as labeling and disclosure requirements.

The new EU Renewable Energy Directive[79] defines renewable energy by identifying the sources: renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases). "Biomass" shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste.

Holding that the EU's "certificates of origin" do not distinguish environmentally benign energy sources, the Swedish Society for Nature Conservation (www.snf.se) and the Finnish Association for Nature Conservation (www.ekoenergia.info) have teamed up to mutually recognize their ecolabels for electricity called "Good Environmental Choice" (Bra miljöval) and "Norppa recommends eco energy."

EUGENE is another European initiative, bringing together experts from environmental and consumers organizations, and research institutes. The EUGENE standard[80] was finalized in April 2002. It has been strongly

[77] SP. 2003.

[78] CRS. 2002.

[79] EU. 2001.

[80] EUGENE. 2002.

influenced by existing standards, such as the German Oeko Institute's "OK Power" label. The standard allows for two different kinds of labelling: electricity from existing power plants is called a "supply offer," and programs in which customers pay up-front to support the construction of a new plant in the future are called "fund offers." Due to the systems used to support renewable energy in some European countries (e.g., universally applicable feed-in tariffs vs. renewable portfolio standards in the US) additionality is one of the standard's core criteria — it establishes two classes of additionality: "silver" and "gold."

Creating a North American Standard for "Green" Hydropower

Canada's Centre Hélios (www.centrehelios.org) in Quebec is working on the development of standard criteria for new hydropower projects and capacity increases of existing reservoirs, in order to determine which projects deserve to be labeled "green." The Centre works with a group of stakeholders from both Canada and the US in order to facility cross-border trading with renewable energy.

Agreement could be found within the working group that the traditional 30 MW threshold does not represent an accurate criterion about the environmental impact of a project, and that the criteria must reflect the public's values. Consensus on how to deal with scenic value of rivers and impacts on tourism are much more difficult to evaluate.

Whereas existing Low Impact Hydropower Institute (LIHI) criteria are well accepted in the US, they cannot be easily applied to Canadian circumstances due to the different setup of the market. On the other hand, Canada's EcoLogo criteria are not approved by the Cabinet and encounter lots of opposition from industry. Also, while the application of LIHI criteria are very transparent, the EcoLogo evaluation process is not public and the decision process to award the logo cannot be easily verified.

The working group is attempting to evaluate projects based on two main criteria:

1. Water flows: strong preference for run-of-river — downstream flow modification to be minimized; and,
2. Impoundments: no significant impoundment; storage can be green if it displays patterns of a natural lake and allows for the formation of healthy littoral zone (small fluctuations).

Appendix 4: List of Related Literature

Promoting Green Power in Canada: A Look Across Borders

This comprehensive overview was completed by Pollution Probe for Environment Canada in November 2002 and provides detailed information on renewable energy policies in Europe, the US and Australia, as well as the situation in Canada, including a preliminary resource assessment and policy recommendations.
www.pollutionprobe.org/Reports/greenpower.pdf

Green Power Programs in Canada – 2002

An overview of government green power policies, utility green power development programs, green power and certificate marketing initiatives, and their benefits, in Canada, compiled by the Pembina Institute (November 2003).
www.pembina.org/pdf/publications/Reportfinal.pdf

Green Power Marketing in Canada: The State of the Industry

This report by the Pembina Institute provides a quantitative assessment of the environmental impacts of "Green Power Marketing" programs in Canada. It provides a detailed description of programs that were in place by early 2002, and indicates the quantities and sources of electricity for each program, the number of consumers participating, and the overall environmental benefits from each. The report also provides an overview of other policy mechanisms to support Green Power development in Canada and the role of Green Power certification programs.
www.pembina.org/pdf/publications/green_power_mktg.pdf

Vision for a Low-Impact Renewable Energy Future for Canada

This 12-page document (published in December 2003) from the Clean Air Renewable Energy Coalition lays out the advantages, potential and needs of low-impact renewable energy technologies in Canada and makes detailed recommendations for a national strategy.
www.cleanairrenewableenergycoalition.com/documents/FINAL%20-20CARE%20Vision%20Document.pdf

The Changing Face of Renewable Energy

A multi-client study carried out by Navigant Consulting for US and Canadian utilities, this document provides a good overview of policies, issues and developments with respect to renewable energy in North America (June 2003).
www.navigantconsulting.com/A559B1/navigant.nsf/vGNCNTByDocKey/PP522DD1693019/$FILE/NCI-RenewableEnergy Study-publicdoc-2003-v8.pdf

National Policy Instruments: Policy Lessons for the Advancement and Diffusion of Renewable Energy Technologies Around the World

This paper, written by Dr. Janet Sawin from the Worldwatch Institute, was published as a Thematic Background Paper for the upcoming Bonn Conference for Renewable Energies in June 2004. It provides an excellent overview of the pros and cons of RPS versus feed-in tariff policies to promote green power (December 2003).
www.renewables2004.de/pdf/tbp/TBP03-policies.pdf

Municipal Guide to Wind Power Development in Ontario

This report prepared by CIELPA provides further details on the current financial incentives as well as the case studies, interviews and environmental assessment and planning process requirements for wind development. The opportunities to address and solve several important public health and environmental issues are enormous by steadily developing new wind generation and other certified renewable energy sources (November 2003).
www.cielap.org/whatsnew.shtml

Appendix 5: Ontario Electricity Conservation and Supply Task Force Recommendations

The following are recommendations from the Task Force that seem most relevant to green power technologies:

Ensuring Adequate Supply

- The government should provide guidance to the IMO on the desirable composition of supply and demand in the Ontario electricity system, in terms of diversity of generation mix, environmental criteria, regional supply needs, the role of imports, and other matters.
- The IMO should develop a long-term integrated system plan within the context of government policy direction and in consultation with the government, the Ontario Energy Board, potential private investors, major load customers, transmitters and others, to guide development of the supply and demand resources needed to meet the power needs of Ontario consumers.
- The portfolio of contracts developed pursuant to the previous recommendation should reflect the short-term, medium-term and long term power needs of the market, as well as the Government's guidance on desired supply mix, and should be achieved through open and accountable processes. These processes should encourage investors and generation developers to bring forward a wide range of proposals to address Ontario's power needs, including conservation measures and distributed generation initiatives.
- The siting and approvals processes for new generation and transmission projects should be streamlined and accelerated. Clear time limits should be built into approvals processes. A task force should be established to complete a review of Ontario regulatory and approvals processes, with a view to ensuring that processes in this province match best practices elsewhere.
- Ontario should move towards a market with rules that promote appropriate investment in distributed generation.
- The Ontario Energy Board should assess the public costs and benefits associated with distributed generation solutions and ensure that projects that reduce system costs benefit from these cost savings.
- Distributed generation facilities should be able to compete on a level playing field with other supply and demand side initiatives. The level playing field should include consideration of system benefits including security of local supply, energy efficiency and emission reductions, and local commercial and industrial competitiveness.
- The IMO's market rules should be amended to encourage load serving entities, when created, to purchase electricity produced by DG plants connected to local distribution systems.
- Ontario should expand its comprehensive tax incentive program to include a broader definition of distributed generation investment.
- Renewable power technologies such as water, wind and biomass can provide a significant amount of new supply. In order to achieve the 2007 target of an additional five per cent of the province's power from renewable resources (1350 MW), and its 10 per cent target for 2010 (2700 MW), the Government should move quickly to implement its Renewable Portfolio Standard.

Enhancing the Responsiveness and Reliability of the Grid

- Within the context of the integrated system plan, Hydro One should develop a comprehensive long-term transmission development plan. In developing this plan, it should consult with generation developers, load customers, the IMO, local transmitters and other interested parties. The plan should extend out at least 10 years and should be updated annually. It should anticipate system expansion needs and address them in a proactive fashion.
- In light of the urgent need to develop new provincial power supply, transmission should be a facilitator of new generation, not a barrier to it. Costs for transmission enhancements to incorporate new generation should be recovered through markets or through rates, to the extent justified by public interest benefit as determined by the OEB.
- The OEB should issue guidelines that encourage the timely and economic connection of distributed generation facilities. Any resulting stranded transmission and distribution costs should be recovered from ratepayers.

More Effective Institutions

- Research and innovation are important aspects of building a leading-edge electricity sector in Ontario capable of developing creative supply and demand solutions to the Province's power needs. Government should work with industry and universities to support research and innovation in the electricity industry through Centres of Excellence for Electricity and Alternative Energy Technology and other mechanisms.
- Governments, corporations, educational institutions and employees and their associations should work together to ensure that Ontario continues to have the skilled workers needed as the electricity sector goes through both major demographic change and the rebuilding of the province’s electricity system over the next 15 years. The electricity industry needs to become a career path of choice for Ontario’s youth.
- The government should adopt internal procedures to ensure that the importance of bringing on new generation and transmission, and of promoting conservation, are given adequate recognition by all ministries and agencies.