

Background Document for the Green Power Workshop Series

Workshop #3 – December 8 and 9, 2003



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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.

Table of Contents

Introduction

Discussion Guide

Background — Green Power

- An Overview by Technology
- Federal and Regional Perspectives

Benefits of Green Power in Canada

- Energy Security
- Reducing Environmental Impacts of Energy Production
- Health Benefits
- Creating Employment and a New Industry
- Price Hedging and Easing Natural Gas Shortages
- Shorter Development Times
- Internalizing Energy Production Costs and Benefits

Barriers to Green Power Development in Canada

- Pricing
- Market Access
- Investment in Green Power
- Access to Wind Power Production Incentive
- Market Acceptance and Demand
- Permitting and the Not-In-My-Backyard (NIMBY) Syndrome
- Intermittency and Location
- Grid and Transmission Access
- Lack of Standards and National Technical Rulemaking
- Resource Mapping
- Regulatory and Structural Barriers
- Limited Financial Support from Government

Results of the Montreal Workshop

- Tackling Technical Problems
- Creating a Domestic Renewable Energy Industry

A Portfolio of Possible Solutions

References

Appendices

- Appendix 1: Overview of Federal, Provincial and Private Measures to Further Green Power Development
- Appendix 2: Alternative Capacity Data
- Appendix 3: Details on Green Power Definitions
- Appendix 4: Results of the Halifax Workshop

Introduction

The development and diversification of a nation's green power/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 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 more than 60 per cent of electricity supply provided through such facilities, Canada lags behind most OECD countries in its development of green power/low-impact renewable energy technologies. Approximately 1.2 per cent of the nation's electricity sources is currently derived from non-large hydro renewable 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. Hilken 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. Along with related documents and further workshop details, it is available for review and downloading at:

www.pollutionprobe.org/Happening/Index.htm

Note to Readers: At this time, the paper offers an initial background 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 #3. 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. Broadly, what do you see as the main barriers to and the main opportunities for green power development in Canada?
4. What do you see as the main challenges and opportunities for investment in green power in Canada?
5. What do you see as the main challenges and opportunities for marketing green power in Canada?
6. How would you propose to define “green power”?
7. What is your vision for green power development in Canada?

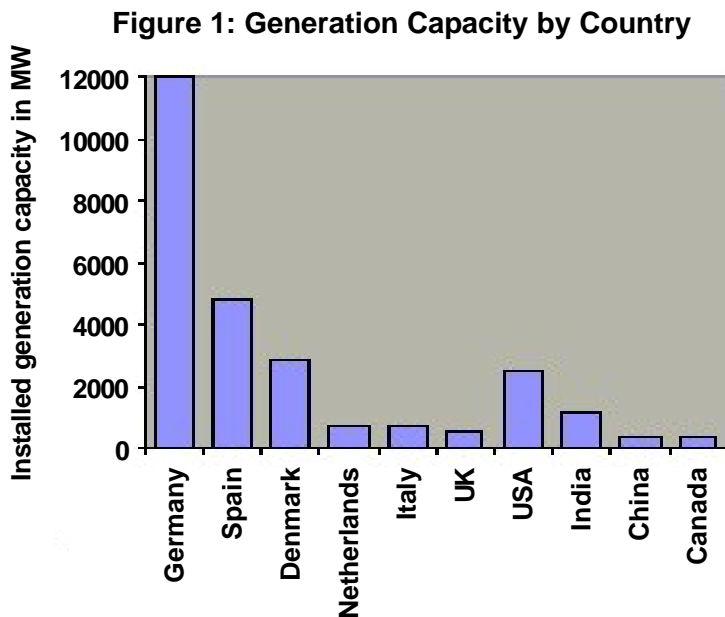
Background – Green Power

Canada has excellent low-impact renewable energy resources, the increased development of which could lead to major reductions in both greenhouse gas and other pollutant emissions, as well as diversify and strengthen the energy economy. Until recently, conditions in Canada have not been favourable enough to create flourishing and thriving markets for renewable energy, as opposed 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).

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.



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 in British Columbia.
- Biomass has been primarily 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 Quebec.

Figure 2: Current Electricity Generation Mix in Canada (CAREC, 2003)

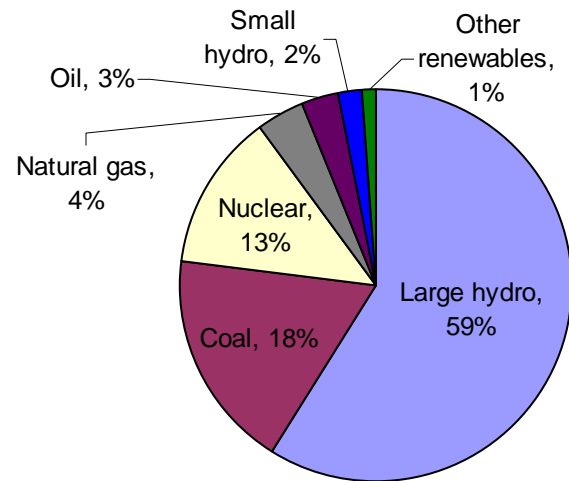


Table 1: Installed Renewable Energy Capacity in Canada
(PP, 2002 — solar and wind data updated)

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

- 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.
- Wave and tidal energy could be developed in Canada's coastal areas.

According to Natural Resources publication *Energy in Canada 2000*, Canada's total electricity generating capacity was 112,606 MW in 1997. The total installed renewable energy capacity listed in Canada 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 owned by TransAlta and is currently Canada's largest wind developer.

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 Quebec and Alberta (102 MW and 171.5 MW, respectively).

Canada's on-shore wind potential is best along its coastal areas and Hudson Bay. However, some inland areas, such as Pincher Creek in Alberta, Sudbury in Ontario, and the Maritimes, also have very good resources with annual average 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 throughout Canada.⁵ Due to significant improvements in wind turbine technology and the potential for off-shore wind farms, the Canadian Wind Energy Association (CanWEA) has estimated 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 offshore projects. Offshore wind plants can be easily installed in the shallow waters of Western Canada, 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 (CanWEA, 2003)

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

Offshore Wind Plants in the UK

October 2003: 4 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 biggest 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. Quebec 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 technically feasible potential assessed at about 9,000 MW.

According to Innergex:⁸

- 4,000 MW of large and small hydro potential has been identified in Ontario; 1,000 MW of which was 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

⁷ NRCan. 2002. p. 9.

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.

- Likewise, a memo by the Quebec 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 hydro potentials.

Solar Photovoltaic (PV)

In Canada, the installed capacity solar PV panels amounted to approximately ten 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 best resources could be found in the southern Prairies, including the more northern areas of Saskatchewan and the southern tip of Ontario. Solar resource varies with season, and also with weather conditions, latitude and time of day.¹¹

An assessment of solar resources in the similarly situated United Kingdom indicated that solar power could produce power equivalent to the UK's present generation utilizing only two per cent of land area.¹² This estimated output was achieved through scenarios integrating PV panels into existing building infrastructure. By capturing only eight per cent of the radiation reaching the roof, a house can cover all of its energy needs.

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.¹³ 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 producer sector was reported as 6,393 GWh.¹⁴ Municipal waste is also considered to be biomass in terms of its organic fraction. Current electricity production from municipal waste incineration (so far only in Ontario) is about 747 GWh/a.¹⁵

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.¹⁶ More 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 biomass.

- 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 over 700 MW of generation capacity (see Appendix 2).

¹⁰ NRCan. 2002. p. 25.

¹¹ Morris. 2003.

¹² Royal Commission on Environmental Pollution, Study on Energy and the Environment.

¹³ NRCan. 2002. p. 7.

¹⁴ Ibid. p. 13.

¹⁵ Ibid. p. 16.

¹⁶ PP. 2002. p. 117.

- Quebec 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 that amount 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 Quebec) 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 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.¹⁷

Geothermal Energy

Geothermal energy is available throughout North America, but is only commercially viable where hot and abundant geothermal fields are available. 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.¹⁸

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), other sites in the US produce for 3.3 to 3.9 cents/kWh — cheaper than most wind and biomass sources. At Meager Creek in British Columbia, costs of between 3.9 and 4.1 cents/kWh are expected (5.9 Canadian cents/kWh), with further price reductions to 5 cents/kWh in the future. The cost for geothermal energy has declined by 25 per cent over the past years, and another reduction of 25 per cent between now and 2020 is expected.¹⁹

¹⁷ Layzell. 2003.

¹⁸ McLeod. 2003.

¹⁹ McLeod. 2003.

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 very seriously at the international level, Canada, although in possession of some of the most significant resources in this area, has neglected these promising technologies. Ocean technologies are about five to ten years behind wind technology today, but could be developed rapidly if a similar level of support was given to them as for wind and turbines and other technologies. World resources of wave power are estimated to be between one and ten TW of installed capacity. To illustrate, 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 to be between four and ten GW.²⁰ 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.²¹ 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.

²⁰ Triton, 2003.

²¹ PP. 2002. p. 118.

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.²² BC Hydro commissioned an analysis of British Columbia's coast tidal stream energy potential in 2002. The results of this analysis are posted on BC Hydro's website.²³ 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. However, there are now concerns about the environmental impacts of these types of generating stations on fish and other ocean shore fauna. The industry has since developed a different concept, called tidal stream. This technology does not block the tidal waterflow, but extracts energy using underwater devices that can be 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.

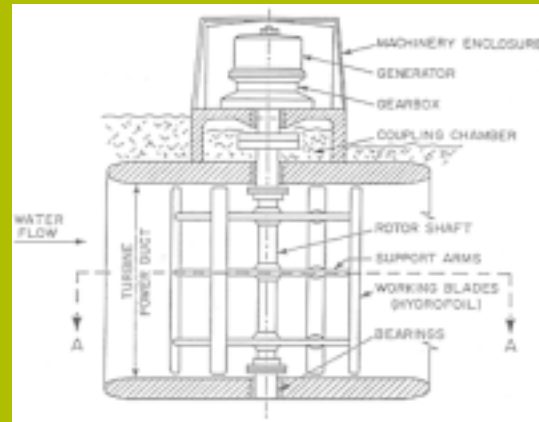
²² Triton, 2003.

²³ See www.bchydro.com/rx_files/environment/environment3928.pdf

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 the 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.

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 cent/kWh **Wind Power Production Incentive (WPPI)** was established 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 is currently valued at 1.0 cents/kWh (summer 2003) and will drop to 0.8 cents in 2006. The WPPI has incented more than 90 MW of wind capacity after one year of operation, especially in areas with very high capacity factors, or on farms where leasing land for wind turbines offers another source of income.

The **Market Incentive Program** is another federal program that provides funds to power retailers that are 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, ending in 2007.

Other federal measures include the following:

- CANMET is a Natural Resources Canada program that assists the development of green power technologies in Canada.
- The Renewable Energy Deployment Initiative (REDI) targets distributed generation, such as solar thermal technology.
- The Industrial Research Assistance Program and Sustainable Development Technology Canada support the development of renewable energy technologies.
- A 20 per cent green power procurement target (by 2005) has also been put in place, which extends to all government departments. This latter program has led to 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 generation cost 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 tangible capital cost, but at a lower depreciation rate. The Canadian Electricity Association has therefore asked the government to expand the application of Class 43.1 to allow a wider range of emerging renewable technologies to qualify for the 30 per cent incentive rate.²⁵

Provincial Measures

Provincial renewable portfolio standards are being discussed in Alberta, New Brunswick, PEI and Nova Scotia, and has been announced recently by the Ontario government. Other specific measures underway 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, which is 3.5 per cent of total generation by 2008. The Alberta government, as with other provinces, has committed to a green power procurement target (25 per cent).
- Quebec has stipulated that 1,000 MW of wind and 100 MW of biomass-based generation to come on-line by 2012.²⁶
- The former Ontario government has announced a support package for renewable energy, including a 20 per cent procurement target and property, income and sales tax incentives (see Appendix 1).
- Nova Scotia, New Brunswick and PEI are all discussing 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 resell their generation back into the grid.

In many parts of Canada, there is interest in strengthening regional cooperation between governments and with other 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.

²⁴ CEA. 2002. p. 6.

²⁵ CARE. 2003(1).

²⁶ QC. 2003.

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 the following examples:

- Suncor 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 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 capacity of nearly 120 MW.

- Canadian Hydro Developers 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 capacity of 104 MW.
- Shell and Manitoba Hydro have partnered to explore windpower opportunities, having entered into an agreement to jointly explore development, construction, ownership and operation of wind power generation opportunities in Manitoba.
- JD Irving 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 per the Natural Resources Canada website.²⁷ There are a number of private developers in other areas, such as biomass or geothermal energy, and Canada also has a small manufacturing industry for PV, wind and water turbines, as well as tidal power technologies.

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

²⁷ See www.canren.gc.ca/programs.

Benefits of Green Power in Canada

If green power becomes more mainstream in Canada, a large number of positive results would follow. This section briefly describes the beneficial effects the development of the 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 become 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 or 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 has 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 the local grid, or at least closer to the consumer, reducing both transmission losses and the need for increased long-haul transmission capacity.

The text box on the next page shows some of the potential advantages of distributed electricity generation.

Reducing Environmental Impacts of Energy Production

Criteria air pollutants, such as SO₂ and NO_x, have influenced energy policies throughout the latter end of the 20th century. With greenhouse gas emissions at the forefront of public interest at the beginning of the 21st century, renewable energy is emerging as part of the 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;
- Preservation of non-renewable energy resources;
- Elimination of hazardous waste, such as nuclear and fluegas 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, and even more so as most units are small. This means that many more single generation plants are needed to respond to energy needs than is the case with conventional large central conventional power plants.

Benefits of Distributed Generation

In general, given reasonably reliable units, a large number of small units will have greater collective reliability than a small number of large units, thus favouring distributed resources. In addition,

- Most distributed resources, especially renewables, tend not only to fail less than centralized plants, but also to be easier and faster to fix when they do fail. Thus, the consequences of failure are far smaller for a small than for a large unit.
 - Distributed resources tend to avoid the high voltages and currents and the complex delivery systems that 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 or widespread outages.
 - Distributed resources can improve utility system reliability by powering vital protective functions of the grid even if its own 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 structure that is more web-like, learns faster and is more adaptive, making the inevitable mistakes less likely, consequential and lasting.
- Source: SolarAccess.com. August 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. 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. These numbers also include the cost of pollution from other sources, such as vehicle exhaust.

Stanford researchers have tried to quantify the societal costs per unit of electricity made from coal — 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 asthma, respiratory and cardiovascular diseases and deaths caused by emissions from coal-fired power stations, an external cost of between 5.5 and 8.3 cents/kWh (US) was determined.

²⁸ SCIENCE. 2001.

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.

Creating Employment and a New Industry

Important job creation benefits can be obtained from a strategy to promote renewable energy technologies. Employment is created at different levels, from research and manufacturing to services, such as installers and distributors. In Germany, 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.

²⁹ PP. 2002. p. 39.

³⁰ EE. 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 ten 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, via 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 fuel — 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 provisions 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

Talisman Energy Preparing for Stake in Giant Scottish Offshore Windfarm

BANFF, Alberta (CP) — Talisman Energy, one of Canada's most international oil and gas companies, will be a partner in a billion-dollar windfarm that is to be built soon off the Scottish coast and will be more than ten 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 ten 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.

US\$5.20 per MWh.³¹ If this would be accounted for in energy planning, green power would immediately become more competitive with conventional power sources. Renewable energy resources may thus 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 electricity. In the US, customers are facing electricity and natural gas rate hikes due to a natural

³¹ PLATTS. 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. finds that aggressive programs to encourage energy efficiency and renewable energy could reduce the demand for natural gas sufficiently to cause a ten 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 Web site at: www.aceee.org/energy/efnatgas-study.htm.

Source: EERE Network News.

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.

Shorter Development Times

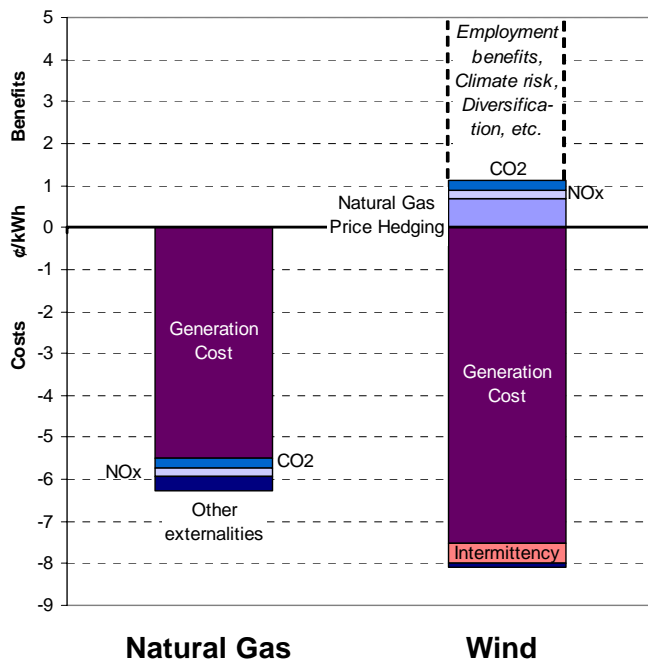
Renewable energy projects can be developed more quickly than traditional generating stations. Large power projects require a lengthy, expensive and detailed permitting process that can take several years. For example, this process would take five to ten years on average for a large hydro project, while a small hydro project would typically take only half the time to develop. In Quebec, for example, small hydro projects with less than five MW capacity do not have to go through a public hearing process. 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 done over the past few years to quantify the external benefits and costs of power generation. Figure 3 shows that if the external benefits and costs were reflected in the price of energy, wind power could compete with the prices for natural gas, especially as the disadvantage of intermittency only comes into play when intermittent power generation sources amount to at least ten 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 is projected at 5.5 cents/kWh — the current avoided cost used by BC Hydro in its renewable energy RFPs. 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 CO₂ per MWh.

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



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 CO₂, which is a value for emissions credits that might reasonably be expected once mandatory 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 consultancy for renewable energy, has assessed the extra value of renewable power generation in terms of reduced natural gas consumption as being at least US\$5.20 per MWh.³² 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.³³

The value of avoided grid modernization costs through distributed generation varies greatly by location. It moves between 0–20 cents/kWh (US),³⁴ or even more in Canada's remote areas. This benefit was not included in Figure 3 as it only applies in special cases.

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 also not included in Figure 3. If all the benefits of renewable energy had been quantified, and were valued in its price, their combined market impact would be significant.

³² REF. 2003.

³³ EU. 2003.

³⁴ EERE. 2001.

Barriers to Green Power Development in Canada

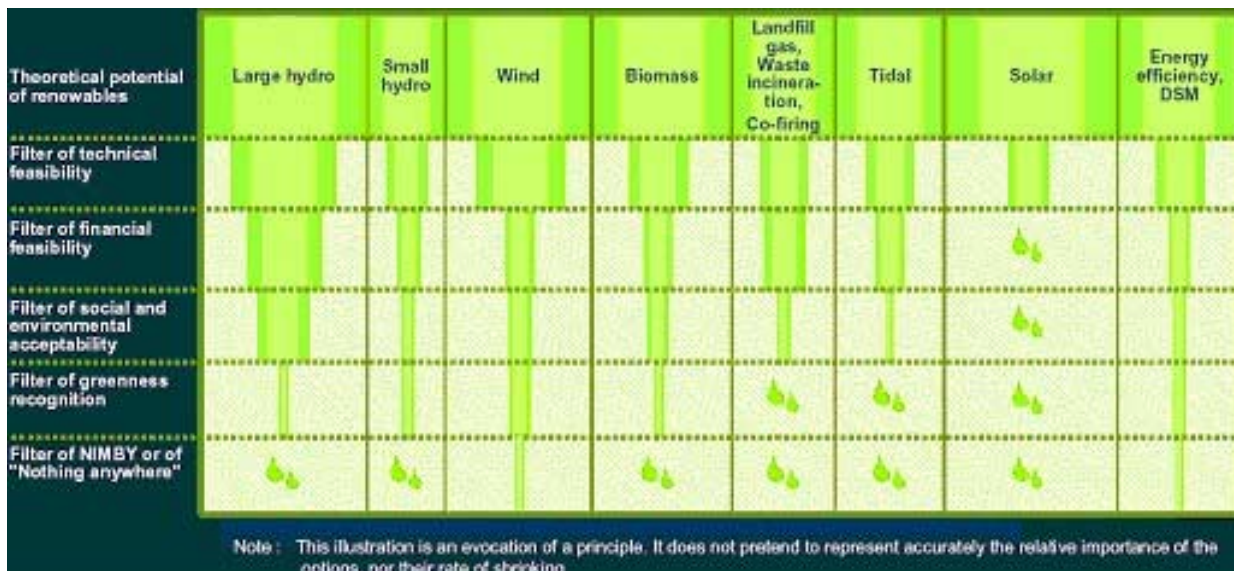
The following section identifies barriers to green power development specifically pertaining to Canada. Pricing, market access, acceptance and demand, problems with obtaining construction permits/suitable sites, access to existing incentives, intermittency and location of renewable energy projects, as 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 these 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

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

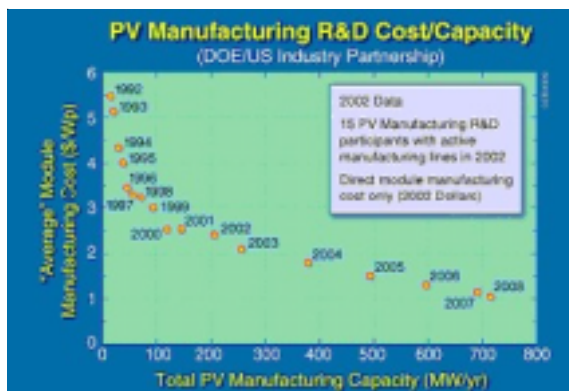


Source: Y. Guerard. Hydro-Québec. Presentation from the Nov. 3–4 Green Power Workshop in Montreal.

development. Great progress 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.³⁵ 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.

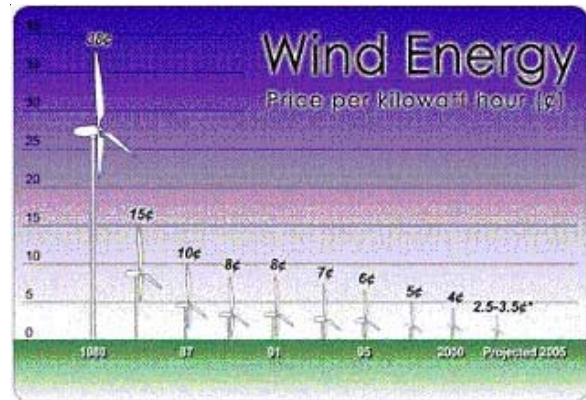
Figure 5: Price Evolution of Solar PV Modules (NREL, 2002)



Data for the period of 2002 and earlier are “historical,” whereas data for years beyond 2002 are “best projections.”

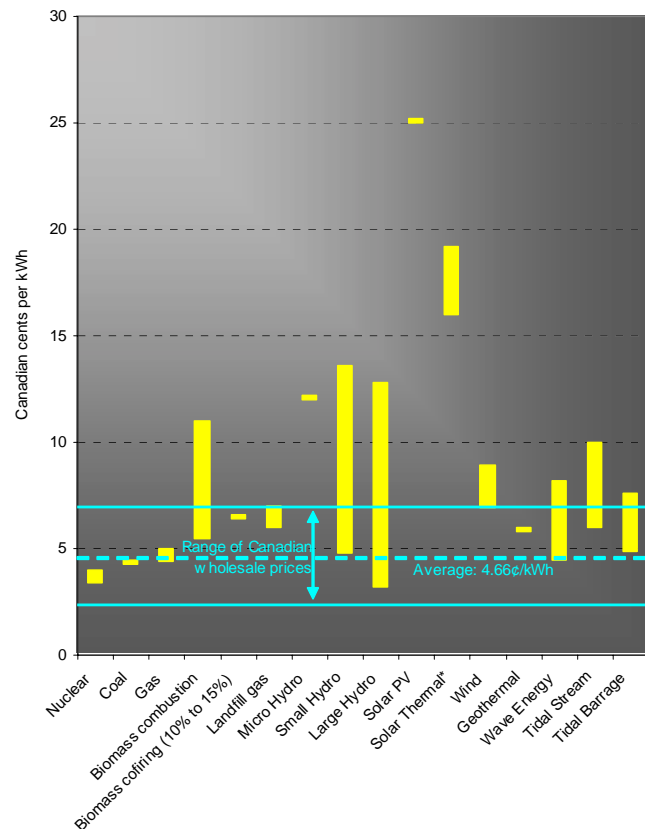
³⁵ NAV. 2003. p. 5.

Figure 6: Price Evolution of Wind Power (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 (PP, 2002, p. 105)



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 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 is not applicable when a customer changes electricity providers, the green power market has been severely impaired by this decision.

Alternatively, 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 provide 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 customers in green pricing programs. In Alberta, both ENMAX and EPCOR have offered green power products since 1998–99. Deregulation in 2001 has 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 and limited 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, the Sustainable Development Technology Canada and the Green Municipal Investment Fund, are trying to address some of the 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 government (in terms of which share of the WPPI can go to a given province) have led to increased uncertainty among investors as to

whether a project to be financed will or will not be among the ones qualifying for the incentive. These caps are currently under review by the government.

Existing incentives in Canada have been criticized as being too small to incent significant amounts of new renewable energy generation. For example, the WPPI (1 cent/kWh) only amounts to 40 per cent of the US production tax credit (2.7 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 achieved by similar Canadian initiatives.³⁶

It is also important to note that currently most of Canada's 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.

Market Acceptance and Demand

Another factor in developing the renewable energy sector is the degree of market demand exhibited from 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 demand for green power, which helps to kick-start green power markets.

A recent Environics survey reconfirmed that Canadian citizens prefer environmentally benign power sources (see Table 3), but so far, not all Canadians are given options to choose green power to supply their electricity needs.

In Canada, only Alberta and Ontario have opened their markets to competition, allowing customers to choose their providers. BC Hydro is making green tags available to industrial clients and plans have been made to open the large industrial customer market to full retail competition in British Columbia, which would allow all power providers to engage in direct power delivery contracts with large electricity consumers.

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, RPS 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 efforts 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

³⁶ NAV. 2003. p. 5.

Table 3: Canadian Power Preferences (CAN, 2003)

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

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 between 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 for renewable energy. Tax exemptions, production incentives and other mechanisms, such as favourable loan conditions or rebates for green power customers or equipment purchasers, are needed to attract renewable 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 to promote 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

Some companies, such as SeaBreeze Energy in British Columbia, are facing significant local resistance to the development of renewable energy projects. SeaBreeze is 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.

JD Irving Ltd. in Nova Scotia is trying to develop a wind power project in PEI. The company encountered NIMBY resistance with local real estate owners, but managed to show that environmental impacts are not a major concern. However, the project is still delayed due to difficulties with planning details.

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 provincial and municipal levels, according to *Canadian Press*. Opposition to proposed turbines from residents of Prince Edward County have delayed permit approval, while the province has “a whole bunch of complications,” the news agency quotes 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 Energies. May 2, 2003.

Many small hydro projects in British Columbia and Quebec 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.

Environmental Impact Assessments (EIAs) for renewable energy projects, such as biomass-based generation, have been identified by proponents as oftentimes being too demanding. Such proponents have argued that EIAs should take into account the positive environmental aspects of these technologies.

JD Irving PEI Wind Project

JD Irving Ltd., a forest product 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 for this project:

1. Many locals were against the wind farm, fearing problems with noise, bird kills, flicker or ice throw. JD Irving Ltd. was able to show these concerns were, for the most part, unfounded; however, viewscape issues still persisted as a major obstacle to the development of the wind farm; and,
2. Due to these concerns, the project technicalities had to be modified repeatedly — both with respect to scale and location. JD Irving Ltd. is now seeking permission to set up two turbines and has changed the proposed siting arrangements several times, even as recently as October 2003. There are unresolved questions with respect to possible exports of green energy to neighbouring provinces using Maritime Electric's transmission network. There are also questions concerning the ownership of emission credits and how the project will fit into the Province's RPS plans.

Internationally, the refusal of construction permits has hampered the deployment of renewable energy in the UK and the Netherlands for some time. 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 in 2002. A 2000 survey in Scotland showed that local public opinion became more favourable to wind farms after construction, which suggests that initial public concerns were not born out in practice.

Denmark and Germany have standardized national permitting procedures for wind, and have required municipalities to set aside areas

Renewable Energy Myths

Misinformation is a major problem with renewable energy deployment. There are a number of perceptions among the general public that can act to hamper the deployment of renewable energy. Specific examples that were mentioned at the Halifax workshop include:

“Wind turbines are noisy” — Although it was cited that one can stand under a modern turbine and have a normal conversation without any problem.

“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 yet unproven” — Solar PV is in use worldwide and is a very reliable and mature technology.

“Solar energy is too costly” — Payback periods for solar energy systems are often under ten 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 based 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 ten 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 could be developed within five to ten years to the same level as wind power has reached today, 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 its electrical power needs.

“Renewable technologies are expensive” — Taking into account the external costs of conventional power generation, and putting a value on the environmental and other benefits of low-impact renewable power, most technologies can already compete with conventional energy generation today.

where wind development is encouraged. The Dutch federal government works together 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 both opportunities for local involvement in the planning process, as well as economic benefits for locals that invest in the technology. In Scotland, it has now been proposed that electricity prices be reduced for homes closest to wind power developments in order to increase their acceptance among the population.

In Canada, one of the best examples of the benefits of less restrictive regulations is the wind power project by Breton Windworks, which works with First Nations. As a wind project on First Nations land is not subjected to the same legislative restrictions as on public land. Three turbines will soon be installed soon to meet 75 per cent of power needs. Developing wind projects with First Nations can offer attractive opportunities for the renewable energy sector.

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. Tidal energy varies according to moon phases. 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 like 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

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

demand. Combining several renewable energy sources, or linking them with spinning reserves³⁷ 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. Required grid extensions, or the strengthening of 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 for renewable energy.

³⁷ 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.

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.

For example, in Alberta, obtaining grid access can be a costly undertaking for renewable energy providers. A plant larger than 25 MW could be required to pay up to \$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 through 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 upon renewable energy producers. Discussions are underway now 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.

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:

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 for 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 for connecting distributed generation to the local distribution system.

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 in regards to whether or not their turbines have sufficient strength to withstand local wind loads. Wind loads were 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 has identified this as a problem and is currently working on a number of technology standards for the renewable energy industry.

No standard connection and approval standards for distributed generation, such as solar PV or manure digesters on farms currently exist in Canada, 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 — it is called 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. Adoption of the guidelines throughout Canada is anticipated for the end of 2003, which would 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 green power.

The Commission for Environmental Cooperation and Renewable Energy

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

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

One of the foci of the CEC is green power certificate trading (www.cec.org/electricity). The CEC is currently developing a methodology to quantify environmental benefits from renewable energy generation, databases and standards for renewable energy, as well as working on the creation of issuing bodies and a tracking system for green power certificates.

Resource Mapping

Renewable resource assessments are crucial for both policy-making and for facilitating the deployment of renewable energy technologies. At the moment, the federal government is 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 other resources than wind are so far limited to British Columbia, and some uncoordinated studies on the availability of biomass in Canada have also been done.

Geothermal Resource Mapping in the US

The US Department of Energy (DOE) announced the availability of new, first-of-their-kind geothermal resource maps that show low- to moderate- and high-temperature geothermal energy resource locations in 13 Western states. These maps reveal a world of geothermal development opportunities that exist just beneath our feet.

The Idaho National Engineering and Environmental Laboratory (INEEL), with its 30-year history of geothermal research leadership and program management, produced the maps as part of 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 2003.

Wind Mapping in Canada

Environment Canada and Natural Resources Canada are trying to make better wind resource data available to the 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.

The originally Linux-based tool will be available on Windows XP Professional soon 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 (input and output could be in GIS format). Licensing of WEST will be made through the EnSim system and will commence March 31, 2004.

The Wind Atlas project is another tool under development for the industry and Canadians in general. The Atlas project is seen as a multi-stakeholder project involving both the government and the private sector. The project is being considered for inclusion in the suite of 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 prototype Atlas has been almost completed by the Montreal Engineering School (Polytechnique). The target date for the transfer of the Atlas to Geomatics Canada for inclusion in the National Atlas for Canada is early 2004.

Regulatory and Structural Barriers

Many problems associated with the furtherance of renewable energy projects have to do with regulations and structures in place before renewables became mature technologies. These need to be reconsidered and adapted in order to accommodate the new reality of other forms of energy entering the marketplace.

Some examples of these barriers include:

- Subsidies for diesel in remote communities that lower the price of energy below that of wind power, although wind power *per se* is far cheaper than diesel-based electricity.
- There are no requirements for the inclusion of renewable energy features in new buildings (although, in some areas, such criteria exist for the inclusion of art). For example, in some areas in Quebec new public buildings require that a specific percentage of the budget be spent on art. Also, in planning new buildings, there are often no requirements to consult with qualified experts on renewable energy.
- The tipping fees for municipal sludge in Canada are low, as opposed to California, where fees of \$40–60 per ton have led to the development of alternative treatment concepts.
- The transmission of green power across the border for export has yet to be created in Canada. So far, only Manitoba and Quebec allow wheeling to the US.
- Renewable energy producers are currently excluded from Canada's greenhouse gas offset system.
- In Ontario, the lack of a cohesive policy with respect to allocating Crown Land is holding up the development of small hydro sites.
- Requirements to conduct full-scale environmental assessments can make smaller renewable energy projects uneconomic.

In order to foster new renewable energy, it is imperative that Market Rules reflect the realities of small power generation units, for example through a distinct new class of compliance that can reduce administrative burden.

Limited Financial Support from Government

While there are several programs in support of renewable energy in Canada, such as CANMET's research or the REDI initiative, overall funding is rather insignificant both in comparison to other energy technologies, as well as compared to other countries' renewable energy budgets. As Table 4 below shows, 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.

Government and private businesses invest about \$220 billion in research and development in Canada every year. On top of that, annual venture capital funding amounts to \$3.58 billion. Many technologies do not make it to market because of gaps before commercialization and before market readiness. The situation for clean technologies is even worse — only about 100 projects received venture capital in 2002.³⁸

To succeed, renewable energy technologies need to be supported from research and development during the venture capital and pilot project stages prior to commercialization. As electricity in Canada is very cheap compared to other OECD countries, renewable energy needs further support to be able to compete in the market, as 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 addressed this issue in several ways.³⁹

³⁸ Sustainable Development Technology Canada. 2003.

³⁹ PP. 2002. p. 93.

Table 4: Gaps in 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 Procurement Targets	-	-	REDI	-	-	-
Marketing	MIP						

* several provincial initiatives also support the deployment of renewable energy (e.g., green power procurement, renewable energy targets in BC, QC); 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; IRAP: Industrial Research Assistance Program; CFI: Canada Foundation for Innovation; TPC: Technology Partnerships Canada; MIP: Market Incentive Program

- In Finland, new renewable 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 with 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).
- The UK, which did not have a grant program for renewable power under the NFFO, 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.
- All 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

took 29 per cent, fossil fuels got 24 per cent and conservation received 25 per cent.⁴⁰

Canadian programs are poorly funded in comparison to those in 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.⁴¹ European

governments, in particular, have shown great leadership in bringing about a change in energy production — Germany calls its policy the “Energy Turn” (Energiewende). The Canadian renewable energy industry is now calling for the same support for renewables as was given to traditional energy technologies in the past (see the text box — “If I Had a Billion Dollars...”).

“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 2010.⁴²

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.⁴³

⁴⁰ CARE. 2003(4).

⁴¹ PP. 2002. p. 95.

⁴² DoF. 2001.

⁴³ CNEWS. 2003.

**“If I Had a Billion Dollars ...”
continued**

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 1952.⁴⁴

3. Ontario Retail Price Cap: The \$293 million spent to finance the Ontario 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 online,” according to the provincial engineers’ society.⁴⁵ The price cap cost the province \$700 million since its inception.

**Sustainable Development
Technology Canada (SDTC)**

Sustainable Development Technology Canada (www.sdtc.ca) is a government venture capital fund that targets Canadian climate change technologies. Equipped with \$350 million in funding from the government of Canada, the SDTC has completed three rounds of submissions so far, with the fourth round being evaluated in November 2003. For this last round, about 100 submissions were received, 30 per cent of which are related to biomass. Energy exploration and production has been a major SDTC funding sector.

SDTC favours consortia, not single companies, in its funding decisions. The fund tries 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 incent private investment in areas in which Canada can excel.

Currently, about 9 per cent of project submissions get approved: for example, 10 out of 117 projects were approved in Round Three. Total SDTC funding in Round Three was \$20 million.

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

⁴⁴ OC. 2001.

⁴⁵ 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, Quebec 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 — Is 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 and renewable energy systems other than solar PV.

Results of the Montreal Workshop

The second workshop of the series was convened in Montreal and focused on green power technology development and the resource potential existing in Canada. The following sections offer a broad overview of the discussion. Many of the comments presented have already been incorporated into previous pages of this background.

Tackling Technical Problems

In Montreal, stakeholders identified the following technical “shortlist” of recommendations to be considered in the development of emerging renewable energy resources in Canada.

- **Synergies between different resources and technologies should be emphasized.**
 - A possible symbiosis between on- or offshore wind and tidal systems exists as the same foundations can be used for both technologies at the same time, drastically reducing the costs of each.
 - In remote communities without good hydro resources, wind power can displace diesel-fuelled electricity generation, and use existing diesel generators to provide back-up power sources.
 - While hydro reservoirs can present a number of environmental concerns, there are also positive attributes to consider. They can serve as a complementary source of power for intermittent renewable energy resources, such as wind power. Reservoirs can store energy when precipitation is high and release it when it is low. Peak supply, which can thus be provided from hydro reservoirs, cannot be delivered, for example, with the same degree of flexibility from biomass power plants. Wind energy can also be “stored” in hydro reservoirs, to be released when the wind resource is low. This mechanism also allows for intermittent “green” wind power to be sold into foreign markets as firm generation.
- 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 development of the project. There are great opportunities for improvement in this respect, especially with native communities.
- **Wind power** is expected to become cheaper over time. In the long term, the law of decreasing returns will temper this advantage because less advantageous sites will have to be developed, which will lead to an increase in prices over time. However, as very few sites have been developed in Canada, this concern is not expected to become problematic for some time. To illustrate this, Germany has installed 10,000 MW of onshore wind generation capacity with, oftentimes, poorer quality wind resources than those available in Canada. There is also considerable potential in Canada for small wind turbines located at decentralized sites or on the rooftops of high rises. The federal government has recognized this potential and has recently commissioned

a report on the marketing of such turbines in Canada.⁴⁶

- The **intermittency** of wind can be reduced when wind farms are spread over a large area. The overall fluctuation in the whole power grid can be very much reduced as wind patterns change. It is of note that changes in wind intensity can also coincide with changes in demand (e.g., there can be stronger winds at the beginning of the heating season).
- Building **zero-energy buildings** using high-insulating glazing, daylighting, solar hot water and solar PV systems is already possible in Canada. For example, the surface of advanced and well-positioned windows can deliver enough energy to heat a home in Montreal in March. A roof-mounted four kW photovoltaic panel can produce 4,000 kWh of electricity per year. This amount is not enough for heating, but produces energy equivalent to the requirement of home appliances. A heat pump driven by PV can be used to deliver auxiliary heating on top of solar heating. The cost of solar PV systems is still high (\$4.15 per peak-Watt), but the prognosis is that costs will fall to 14 cents/kWh (US) in 2010, and to eight cents by 2020. One of the main challenges cited for solar PV systems is their integration into the building to achieve architectural beauty.
- Waste **biomass** resources can be scarce in some locations, and a certain share of forest or agricultural biomass has to be left behind for sustainability reasons. Sweden, for example, attains 20 per cent of its energy needs through the use of biomass resources, but is now considering looking at carrying back cinder to the forest to address soil depletion. Using energy crops to amplify biomass resources is another alternative. However, such crops require large energy inputs in terms of fertilizer, transport, etc., so that the overall energy payback is very small.
- It is nearly impossible to build new waste incineration facilities in Canada to utilize the energy in the biomass and plastics fraction of municipal waste, due to public resistance. A Montreal incinerator has recently been closed without replacement because there was too much resistance to it, even though it would have been equipped with high-performing flue gas treatment. In Quebec there is also much resistance to new landfill projects.
- There is a need for clarity around **definitions**, and a need for **resource mapping** for all resources at a national level.
 - Germany and Spain are expanding their small hydro base. In Canada, stakeholders have indicated that these developments are moving ahead more slowly because of a lack of clear policy from governments and also because environmental guidelines for small hydro have not been concretely defined. Some regional assessments of small hydro resources have been conducted; however, the data is 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.
 - For ocean-based power technologies, a sound assessment of Canada’s resources is needed. So far, only the potential existing off the West Coast has been assessed in detail.
- To enhance development of emerging renewable technologies in Canada such as ocean power, technology transfer and information exchange with other countries

⁴⁶ CARE. 2003(5).

need to be increased. Also, testing and certification guidelines should be developed in order 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 different technologies should be explored in order to minimize intermittency (e.g., a combination of tidal 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.

- 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 cheap and cost-effective, they are not being applied systematically in Canada. What is needed is good policy with a clear message that includes both energy efficiency and low-impact renewables so that it can be reinforced by the provinces. Canada needs an integrated approach, as not enough progress can be made by pushing projects one at a time.

The main challenges for renewable energy technologies that were identified during the breakout sessions in Montreal are summarized in Table 5. Common challenges that emerged in the discussions are combined in the table.

Table 5: Challenges to the Development of Renewable Energy Technologies in Canada

<p>Wind Power</p>	<ul style="list-style-type: none"> • Need weather predictions — real-time, seasonal and 0–72 hours. • Need to know 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 interconnectivity issues resolved.
<p>Solar</p>	<ul style="list-style-type: none"> • 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 demo 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 5 continued. . .

<p>Biomass</p>	<ul style="list-style-type: none"> • Need to reconsider the regulatory framework in terms of Kyoto and green power (for example, growing trees increases taxes since trees are not considered an agricultural activity). • A national roadmap towards small biopower is needed. • 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. • A focus on off-grid, local power use and using heat directly (industrial or community energy systems) is needed. • 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.
<p>Ocean Energy and Small Hydro</p>	<ul style="list-style-type: none"> • 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. • There needs to be a consistent framework developed 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 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 5 continued. . .

<p>Transmission and Grid Issues</p>	<ul style="list-style-type: none"> • 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). • Consistent interconnection rules and standards are needed. 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, model impact on intermittent systems on grid. • New technologies should be accepted on the grid. • Net metering and time of day billing should be introduced.
<p>Common Challenges</p>	<ul style="list-style-type: none"> • Government vision and leadership are crucial — a Sustainable Energy Program should be created. • Need for 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 the ten per cent increase, but on basis of life cycle assessment or full-cost accounting. • Consistent national and international standards are needed. • There is a need for a testing and assessment facility for renewable energy technologies in Canada. • Focused and clear communication on technology options and associated benefits — public education and campaigning against misinformation. • Need for better work 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

One of the main topics that participants of the Montreal Workshop discussed was the need to create domestic capacity to manufacture equipment for renewable energy systems. 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 with the result that much of the equipment has to be imported. The

following bullet points sum up the discussion and highlight some of the existing and emerging Canadian opportunities in the emerging renewable energy sector:

- Ontario has the capacity to make blades for **wind turbines**. In Quebec, the NEG Micon wind turbine plant in Boucherville was decommissioned after the first 100 MW was installed because government did not help sustain the demand for wind turbines that would have supported the continuing of production in Quebec (75 MW per year).

The Situation in Quebec

Between 1978 and 1998, the energy situation in Quebec changed drastically. Greenhouse gas emissions from both industrial sources and the residential sector were reduced through a switch to electricity, instead of oil, as a power source, as well as through energy efficiency improvements. Today, 45 per cent of Quebec’s overall energy consumption and 95 per cent of its electricity consumption is generated from renewable resources (mainly large hydro), and for electricity this number is as high as 95 per cent. However, Quebec still remains a net importer of energy, primarily due to fossil fuel use in the transportation sector.

The use of biomass resources in industry (mainly in the forestry sector) has doubled and currently amounts to 11 per cent of total energy consumption in the province. Some stakeholders suggest that sustainable biomass extraction rates may already have been reached, which would make it necessary to explore new sources of biomass, such as energy crops. Hydro Quebec’s recent RFP for 100 MW of

biomass-based generation resulted in only 86 MW of proposed capacity.

Quebec has 57 small hydro plants with a total capacity of 257 MW. Quebec also has 25 MW of landfill gas-based power generation at Gazmont, and about 100 MW of wind power capacity via the turbines located in the Gaspé peninsula. Hydro-Québec will be purchasing an additional 1000 MW of wind power and 100 MW of biomass-based generation over the coming seven to eight years. A previous program focusing on small hydro development in Quebec is now being revived in a different format under the new government (see the text box — Quebec’s Small Hydro Program).

There are also initiatives targeting the development of new large hydro reservoirs. However, the political, administrative and financial barriers to large hydro development in Quebec have grown. There is strong opposition to large hydro. Hydro-Québec has encountered increasing difficulties obtaining permits for the construction of new dams.

- 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 1–2 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 (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.
- 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 one 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 has been established in Waterloo, at Queen's University, as well as in British Columbia and Edmonton.
- 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 six to eight million dollars. In Nevada, 80 per cent of drilling costs are borne by the government, but Canada has no such program in place.
- **Ocean energy** technologies are thought to be some five to ten years behind wind technologies. Whereas the cost of wind energy has decreased from 55 to only four cents US per kWh today, tidal power technology costs could be reduced from ten to 3.5 cents in just five years, according to Blue Energy. However, there is currently very little research expenditure compared to wind (probably two orders of magnitude less). 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** technology 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 the very low electricity prices in Canada and the absence of targeted government support and policy. This would be a technology

Quebec's Small Hydro Program

In 2001, Quebec launched a renewable energy program to install 36 run-of-river small hydro plants with a combined capacity of 450 MW over a period of two years. This program was subsequently cancelled due to major problems in its implementation. One mistake that seriously impeded the success of the program was the proposed development of certain 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 and environmental groups. Grassroots groups started an "Adopt a River" initiative that worked to counter the development of private power projects on Quebec's rivers. The program was eventually stopped after only three of the proposed 36 projects had been developed. However, the program is now being continued at a smaller scale, with the Régie de l'Énergie recommending development of 150 MW of small hydro capacity.

that is particularly beneficial for rural areas, benefiting both the energy and the agricultural sector, 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 also be taken into account.

- Canada's Intersan has a **landfill gas** technology that does not simply capture methane, but enhances its production by achieving and maintaining optimum moisture contents 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 only 15 years, while gas production doubles. If this technology were applied more broadly, increased energy production and greenhouse gas emissions reductions would result, as well as reduced demand for natural gas. In Quebec, for example, landfill gas could cover 25 per cent of natural gas imported from Alberta.
- **Good policy** can make a big difference. Some RE policies mentioned were government incentives, renewable portfolio standards, feed-in tariffs and renewable energy certificate trading. With such policies in place, Germany added 20 TWh of green power production in only ten years (wind, waste, biomass). Denmark also added six TWh to its portfolio in ten years. The UK added five TWh in recent years and is increasing its renewable energy capacity rapidly.

Table 6: Readiness of Renewable Energy Technologies in Canada (Filion, 2003)

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

- As with Denmark, which is involving **local inventors** in the development of wave power technology, Canada should also encourage its inventors to contribute to the development of new energy developments. “New physics,” “free energy” and other concepts could have huge potentials to meet future energy needs. However, inertia, disinformation and vested interests often work to preserve the status quo, and some promising inventions can languish for more than a hundred years. Without support, the lead in developing such emerging technologies will shift to countries where such support is provided, and the benefits in terms of manufacturing and export capacity will be lost to Canada.

Table 6 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.

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 among 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 that ensuring proposed developments are communicated to the local community.
- 5. Increasing Electricity Prices** — Canada's retail prices are among the lowest of industrial countries, which increases the price gap between renewable and conventional energy sources. Increasing electricity prices in order to better reflect the environmental cost of conventional electricity would close this gap. There are socially responsible ways to achieve this, as per 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 the negative environmental impacts into 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** — The ministry has no person responsible for renewable energy sources, such as wind power.
- 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 very 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 ten 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.
- 16. Creation of RenewCanada —** Just as the government created PetroCanada to provide an alternative to Canadians, a “Renew Canada” corporation could enhance investment in renewable energy sources across the nation.
- 17. Coordination between Renewable Energy Associations —** The development of an integrated platform would do much to leverage association resources, in addition to taking advantage of common interests.
- 18. 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.
- 19. 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.
- 20. Have Mapping for all Renewable Energy Resources Available on a National Level.**

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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.
Newfoundland						Two private wind projects earmarked for St. John's.
PEI		Power from 5 MW wind farm	Maritime Electric Company Ltd.			
New Brunswick	RPS planned					NB Power Wind speed monitoring initiative.
Quebec	1000 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 — targets of 5 per cent by 2007 and 10 per cent by 2010 (3,000 MW by 2010); OPG: Voluntary purchase of 3 TWh of electricity supply from renewable energy by 2005 (this commitment is subject to market demand for Green Power).	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 ten-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.

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.
Saskatchewan	SaskPower: 45 MW of capacity to be solicited by 2005 (voluntary).	16 per cent	SaskPower			Up to 150 MW of wind through joint ventures by 2007.
Alberta	Renewable and alternative energy portion of total provincial energy capacity by 3.5 per cent by 2008.	25 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 (ten 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	9.87
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 Total
	Renewable Energy	Installed Capacity	
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 Energy Minister John Baird recently classified a natural gas cogeneration project as “alternative energy” within the provincial energy strategy.⁴⁷

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 “better,” 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.

⁴⁷ 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*.⁴⁸ These criteria refer to EcoLogo definitions, as well as minimizing land use, avoiding protected areas and requiring little new electricity infrastructure.

The US Green-e⁴⁹ 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 Directive⁵⁰ 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 standard⁵¹ was finalized in April 2002. It has been strongly

⁴⁸ SP. 2003.

⁴⁹ CRS. 2002.

⁵⁰ EU. 2001.

⁵¹ 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 facilitate 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: Results of the Halifax Workshop

The first workshop of the series was convened in Halifax and focused on the current status and challenges of green power development in Canada. Many of the comments presented have been incorporated into previous pages. The following offers a broad overview of the discussion.

Emerging Opportunities

In Canada, federal and provincial governments 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 sections overview emerging opportunities for renewable energy development on part of the federal government, and especially in Atlantic Canada, as voiced by participants at the Halifax workshop.

- The federal government has set targets for greenhouse gas emission reductions concomitant with an increase in the development of renewable energy. While most participants were aware of the funding opportunities available specifically for green power initiatives, attention was drawn to other funding programs that are now including renewable energy in their mandate.
- The Maritimes are expecting an electricity deficit by 2007. Natural gas seems questionable as an option due to price instability and criteria air pollutants. As New Brunswick is restructuring its power system, the opportunities that

renewable energy offers are being considered. However, there is some uncertainty around how much of future growth can be met by renewables, what kind of support they need, if any, how to define “green” power, and what the best policy measures are to support its development.

- Nova Scotia released an Energy Strategy in 2001 and also established an Electric Market Governance Committee to conduct a public consultation process on the province’s Energy Strategy. This process documented clear public support for green power. The Committee’s Interim Report, while focused on traditional fuel sources, made some recommendations related to green power. These included a target of 50 MW new renewable generation, allowing net metering for generators up to 100 kW and adopting an RPS by 2006.
- PEI has one of the highest electricity costs in Canada, in part due to a lack of hydropower and/or 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 ten per cent of electricity generation by 2010.

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

Limitations

There appears to be a great deal of hesitancy among utilities and governments regarding the shift to renewable energy. Renewable energy resources in general are thought of as emerging and unavailable technologies, or mere niche technologies that cannot be applied large-scale, although these same technologies are being applied successfully in Europe and the United States. While workshop participants expressed considerable need for new electricity options, there was a great deal 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 the Canadian energy associations (CanSIA, CanWEA, CanBIO, etc.) either have no offices, rely on voluntary contributions from their members, or have small offices with limited staff. This situation constrains 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.

An Assessment of Existing Federal Measures

Halifax workshop participants brought up some important concerns about the current federal-provincial approach to renewable energy. 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.

Some examples of this are:

- Renewable energy clearly provides greenhouse gas emission reductions. However, in the federal offset system, renewables are so far 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 ten-year period, which is necessary for renewable energy projects to obtain financing, the procurement program only provides contracts over five years, increasing financial insecurity for developers.
- 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 only less than half of the value of the American renewable energy tax credit.
- REDI is funded with \$25 million per year. Compared to programs in other countries, or subsidies to the fossil fuel or nuclear sector, this is a very small amount. Prince Edward Island for example has dedicated \$12 million to the development of its renewable resources.

- Federal green power procurement policies sometimes fail to incite emerging energy sources. In Québec, for example, government offices claim they do not need to purchase wind power as they already receive emission-free large hydropower.

This section and others will be further developed as the workshop series progresses.

Main Findings of the Halifax Workshop

Many of the points made at the workshop have been heard before. However, there is a sense that times have changed, in that there are new demands on our power systems and new commitments to improve air quality and address climate change. One jurisdiction after another is considering a role for renewables, suggesting that new opportunities will arise for renewables to become more mainstream within the Canadian electricity market.

It was suggested that the workshop proponents carefully consider the long list of solutions initially suggested and identify two or three of these as priorities — basically, to set out the approaches that will give the most “bang for our buck.” This would have several benefits, from helping decision makers assess how best to support renewable energy resources, to supporting the promotion of a cooperative approach among jurisdictions and utilities, private companies, ENGOs and other stakeholders.

In addition, the following points of view were put forth by various participants:

1. The deployment of renewable energy systems is not a technological issue, but a policy issue.
2. Coordination between 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 American market is crucial for Canada. Although we may not 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.

It is also important that the right people are reached, even by this workshop series. Often such meetings unite industry and ENGOs, but fail to reach the political decision makers that need to hear the message.