

## Renewable Energy Technology R&D

**C**anada's renewable energy industry has flourished over the past 10 years. Ten years ago Canada's domestic renewable energy market was very small. Bioenergy played a noticeable role, followed by small hydro. Wind and solar energy were still considered too costly for practical use. Whereas today, the Canadian renewable industry contributes over 6% of Canada's energy needs – displacing 36 million tonnes of CO<sub>2</sub> annually. Canada's renewable equipment and service industry has grown to over 250 companies, 3,700 jobs and \$1.4 B goods & services (including \$400 M exports).



*Iogen Corporation's Biomass Ethanol Plant*

The Renewable Energy Technologies Program (RETP) has helped facilitate this growth by supporting the Canadian renewable energy industry in their R&D efforts to develop and deploy renewable energy technologies. RETP helps industry to generate competitive and environmentally responsible alternatives to conventional energy generation. Technologies include small hydro, active solar, wind energy and bioenergy.

RETP provides cost-sharing and technical assistance in support of technology development and field trials to:

- advance technologies in the Canadian marketplace; and
- identify and exploit international opportunities.

In addition to domestic and international private sector companies, program partners include: universities; utilities; trade associations; other federal and provincial departments; research institutes; and international organizations such as the International Energy Agency (IEA).

Directed by the CANMET Energy Technology Centre (CETC), RETP focuses on:

### ***Innovation***

- supports industry R&D to develop new technologies and processes as well as to improve the cost-performance and reliability of existing ones;

## **Renewable Energy Technologies Opportunities**

There is strong public support for RETs both domestically and worldwide.

*Fast growing Canadian equipment and service industry:*

- 250 companies & 3,700 jobs
- \$1.4 B goods & services (including \$400 M exports)

Helps meet Canada's clean energy needs:

- contributes 6% (bioenergy) and 11% (large hydro) to total energy mix
- is CO<sub>2</sub> neutral (bioenergy) or CO<sub>2</sub> free (wind, small hydro, solar) — displaces 36 million tonnes of CO<sub>2</sub> annually

Huge potential world market (2 billion + people without electricity and 2.5 billion people in the fast growing economies of China, India and the Pacific Rim):

- developing countries alone will need 5 million MW over the next 4 decades

**Current global RET market is several billion \$ annually**

- contributes to the development of technical and safety standards to eliminate barriers to technology uptake in the market place;
- helps industry establish R&D consortia to optimize the use of resources and broaden exposure of technologies to potential client groups; and
- helps Canadian companies create joint ventures with foreign partners and helps them access Canadian, foreign and international funding programs to deploy Canadian technology.

### **Environmental Impact**

- reduce greenhouse gases;
- lower acid gas emissions and ozone precursors; and
- turn wastes into valuable energy feedstocks.

### **Society**

- generate high-tech employment, export opportunities and wealth; and
- promote technologies that improve the living standard and the quality of life – especially in developing countries.

### **RETP Highlights**

RETP is carrying on the R&D effort in renewable energy that began almost three decades ago with the oil crisis. Since then, with its assistance, a number of technologies have evolved.

Some, like the Solarwall™, a solar-heating system for industrial ventilation developed by Conservall Engineering Ltd., have developed substantial global markets. Others, such as Iogen Corporation's demonstration plant — the first of its kind in the world to produce ethanol from agriculturally generated cellulosic biomass — are at the brink of commercialization.

R&D priorities are set in close consultation with industry to meet their needs. Most research falls within the short-to-medium term and is conducted through cost-shared agreements in four areas:

### **Bioenergy**

Bioenergy, supplied from the combustion of biomass, provides 6% of Canada's primary energy demand.

Biomass may be converted into solid, liquid or gaseous energy sources. This allows a wide range of applications; for example, wood can be burned directly to produce heat and/or electricity, converted biochemically to produce liquid fuel; and finally, pyrolyzed to produce oils and high value chemicals. While combustion technology is highly evolved, biochemical and thermo chemical conversion technologies are beginning to show potential.

Pioneered by Ensyn Technologies Inc., with assistance from RETP, the Rapid Thermal Processing system is a heat-intensive process that converts biomass to a liquid fuel and value-added chemicals. Units have been sold in the U.S. and Europe.

In cooperation with the Canadian company KMW® Group, RETP is developing a small, biomass-fired industrial cogeneration system (300 kW), that will be used to provide remote communities with heat and electricity.

With assistance from CETC, the ADEPT Group Inc. is in the process of demonstrating that waste frying oils and greases can be converted to a high cetane specification diesel fuel using conventional petroleum refining technology.

### **Small Hydro**

Hydroelectric energy is CO<sub>2</sub> free — relying solely on the gravitational flow of water. Canada has abundant water resources and a geography that provides many opportunities to produce low-cost hydro energy. There are more than 500 small hydropower stations in Canada.

A recent trend in the hydroelectric energy industry has been the development of small-scale projects, usually less than 50 MW, which help utilities match their growth in demand with small increments



*Riviere du Loup Small Hydro Plant*

in capacity. Small hydroelectric plants can be developed at existing dams that are scattered throughout the country. Dams can also be developed in connection with river and lake water-level control and irrigation schemes.

Natural Resources Canada has developed a Geographical Information System — based database ([www.small-hydro.com](http://www.small-hydro.com)) to provide information on existing and potential sites and is developing remote sensing-based hydro potential assessment software.

Powerbase Automation Systems Inc. has developed an automated control system for small hydro power plants. The technology is being marketed in China and in other developing countries.

Swiderski Engineering has produced a novel ultra low-head (less than 3 meter head) “rim-drive” hydro turbine.

Numerous Canadian engineering firms have become world experts in the refurbishment of existing hydro power plants.

### **Wind**

Wind is one of the world’s cleanest sources of energy and has the potential to supply a significant amount of global electricity demand. In an “ecologically driven scenario”, wind energy systems could supply 6.5% to 10% of world electricity needs in the year 2020. Worldwide, 16,500 MW of wind



*Wind Energy in Canada*

energy installed at the end of 2000 generated some 33,000 GWh of power per year, equivalent to about 6% of Canada’s electricity use. Wind power can provide about 17% of Canada’s electricity needs, and this percentage could be maintained even as future demand for power grows.

Through companies like Polymarin Bolwell Composites (PBC), Canada can provide blades for wind turbines ranging from 10 kW to 1.5 MW. Since its establishment in 1994 with support from RETP, PBC has exported more than \$25 million worth of state-of-the-art fibreglass blades to the rapidly growing wind energy market. Soon Canada will be manufacturing wind turbines suitable for agri-business, small remote communities and stand-alone applications in Canada and abroad.

A new high penetration, no-storage wind/diesel system that could triple the wind turbine market in remote communities has been developed at the Atlantic Wind Test Site, in cooperation with the Institut de recherche en électricité du Québec.

### **Active Solar Energy**

Canada’s energy costs are among the lowest in the world, a factor that continues to be a major impediment to the development and deployment of alternative energy sources, including solar energy. Nevertheless, active solar energy technologies hold great promise in Canada, particularly for low-temperature (< 60°C) heating applications.

Areas of particular focus include industrial ventilation air heating, domestic hot water heating, residential outdoor pool heating, and certain niche markets such as process water heating for aquaculture and car wash applications.

Conserval's Solarwall™ has established itself as a leader in commercial/industrial air heating in Canada (Canadair, Ford, GM) and is opening new markets for crop drying in China, India and Latin America.

A Canadian firm is on the verge of commercializing a 3,000 kWh, high-efficiency solar water heating appliance based on a low-flow concept pioneered in Canada.

We have witnessed the first use of unglazed plastic solar panels for commercial solar heating projects for salmon and trout aquaculture and car wash facilities.



*Conserval's Solarwall*

NRCan's three-year, \$12 million-Renewable Energy Deployment Initiative (REDI) program, promotes renewable energy technologies for the heating and cooling of new or existing commercial and institutional buildings.

Solar photovoltaic (PV) electricity production and remote communities applications are handled by the CANMET Energy Diversification Research Laboratory (CEDRL) in Varennes, Quebec at <http://cedrl.mets.nrcan.gc.ca>.

### **Testing and Laboratory Services**

RETP provides funding for laboratories and test facilities to ensure their continued availability to industry.

### **National Solar Test Facility**

Located at Bodycote Materials Testing Canada Inc. in Mississauga, Ontario, the world's largest indoor solar simulator at Canada's National Solar Test Facility provides world class research and testing infrastructure for product development.

### **Atlantic Wind Test Site**

This world class facility is dedicated to the testing, evaluation and certification of wind energy conversion systems for electricity production.

### **Hydro Turbine Testing and Simulation Centre**

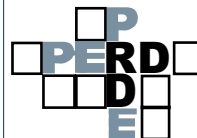
Laval University's Small Hydro Turbine Test Facility couple computer simulation and modeling of hydro turbine flow with testing and research services.

### **Where to find us:**

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