Renewable Energy Financing Case Studies: Lessons to be Learned from Successful Initiatives

A report for the
Commission for Environmental Cooperation
Montreal, QC, Canada

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1 Background

The 2004 Puebla Declaration directed the Article 10(6) Working Group to develop a Strategic Plan on Trade and the Environment. In October 2005, the Article 10(6) Working Group agreed to include in the Strategic Plan a priority area related to renewable energy.

In the program plan for 2005, it was envisaged that CEC would prepare a document describing best practices in financing small-scale renewable energy projects. The CEC conducted a literature review of existing documents on the topic that was presented to the REEC at the first annual meeting on November 21 in Washington, DC. It was then decided that the existing information was not sufficient to provide stakeholders with how to best finance these small projects in North America. It was also realized that best practices would vary from site to site, from technology to technology, and the stage of development at which the investment is sought.

This present report, therefore, pulls together information on policies and programs, and will describe some case studies that can provide guidance for Canada, Mexico and the United States. Based on the report, the CEC will create a clearinghouse web site where information on renewable energy policies can be found. At the first stage, this report will focus on both small-scale and utility-scale renewable energy programs. It will concentrate on those financial initiatives that bring technologies on the ground, i.e., that support market entry of commercial technologies.

The technologies covered in this report include

- Solar photovoltaic (PV)
- Solar hot water systems
- Solar space heating, such as Solarwall
- Large and small wind turbines
- Small, mini- or micro-hydro systems
- Geothermal heat pumps
- Large and small-scale biomass-based systems, such as wood pellet stoves.

The first part of the report briefly describes successful programs for each technology, providing Internet links for more information, as well as contact information. The second part describes selected case studies in more detail, providing information on key features of these initiatives and the main reasons why they have been successful.

The report includes initiatives from governments, the business sector, utilities and nongovernmental organizations. It is meant to become a clearinghouse web site on renewable energy financing, and many Internet links were included that are intended for subsequent incorporation in a web site. Especially the tables in **Section 4** and the case studies in **Section 5** are organized in such a way that a cover page can be used to link to each section included in this report, as well as other case studies that are on external web sites.

2 Financing Renewable Energy

Most renewable energy systems differ from conventional energy in terms of their cost structure: while energy systems based on fossil fuel generally have moderate or low up-front capital costs, but high operating costs due to their fuel consumption, renewables generally have no fuel costs (sunlight, wind, geothermal heat etc.), but require a fairly high initial investment.

Being risk-adverse, the financial community has initially been reluctant to invest in emerging renewable energy technologies. Yet, policies in the leading countries in Europe, Japan, the United States and India, to name a few, have led to wind and solar emerging as the leading types in new electricity generation capacity in recent years, with double-digit annual growth of the industry. According to the Worldwatch Institute,[1] global investment in renewable energy hit a record $30 billion in 2004, accounting for 20–25 percent of all investment in the power industry.

This success is based on some countries favoring the advantages of renewable energy through clear, directed policies and support programs. These advantages include reduced air emissions, employment creation, and grid stability. Energy independence is also moving up on the agenda as terrorist attacks and natural disasters, as well as political instability threaten the functioning of the oil-based economy. And as renewable energy technologies mature, many utilities and large energy companies use them as tools to hedge against increasing and fluctuating prices in fossil fuel markets.

Still, mainly countries with effective public policies benefit most from the renewable energy boom. Renewable energy portfolio standards and feed-in tariffs have emerged as the main tool to support large-scale renewables. Stable policies that create long-term viability of large renewable power projects will then attract private investment. Some environmental groups, such as the World Resources Institute, also have successful voluntary green power programs that can support substantial amounts of green power generation. Revolving loans, buy-back programs and feed-in tariffs are being used for smaller-scale, distributed energy systems. With banks still reluctant to enter a small loan market they see as risky, small-scale renewables are still waiting to breakthrough in many jurisdictions that could benefit greatly from their implementation, reducing the need for the construction of new, large-scale power plants through distributed generation. Some private energy service companies are trying to enter this niche market by offering renewable energy services, such as space heating using geothermal heat pumps, at a fixed price, without actually selling the equipment to the user.

Financing renewable energy systems can therefore be seen as the most important tool to overcome market barriers, combined with other measures, such as public awareness campaigns, training of the workforce, and the creation of rules and standards for the installation and interconnection of renewable energy systems. Especially small-scale renewables require three types of mechanisms at the same time: legislation, incentives, and education. To illustrate how these work together, some of the case studies discussed here include details on a variety of policy mechanisms and how they, as a whole, constitute a successful renewable energy support system.

[1] See <http://www.worldwatch.org/press/news/2005/11/06/>.

3 An Introduction to the Types of Financial Support Policies for Renewable Energy

One of the instruments used successfully to further renewable energy is the **renewable portfolio standard** (RPS, also called renewable energy standard)—a policy that has become very popular among state governments in the United States. This type of policy indirectly creates a market for renewables by obliging power retailers to source a certain percentage of their electricity from renewable energy facilities. A RPS usually targets an increasing share of renewable energy as a percentage of annual energy sales in a jurisdiction. For example, it could require that 2 percent of all electricity in 2006 must be renewable, and that this share must increase steadily until 2020 until it reaches 15 percent.[2]

There are various differences in RPS legislation with respect to the percentages of renewables required, whether this electricity can be generated inside or also outside the jurisdiction, and whether certain technologies are preferred. **Figure 1** shows the overall expected impact of existing RPS legislation in the United States on the future amount of power generation from renewable energy sources. Some of Canada's provinces have also implemented similar policies, setting voluntary and mandatory targets for renewable energy production.

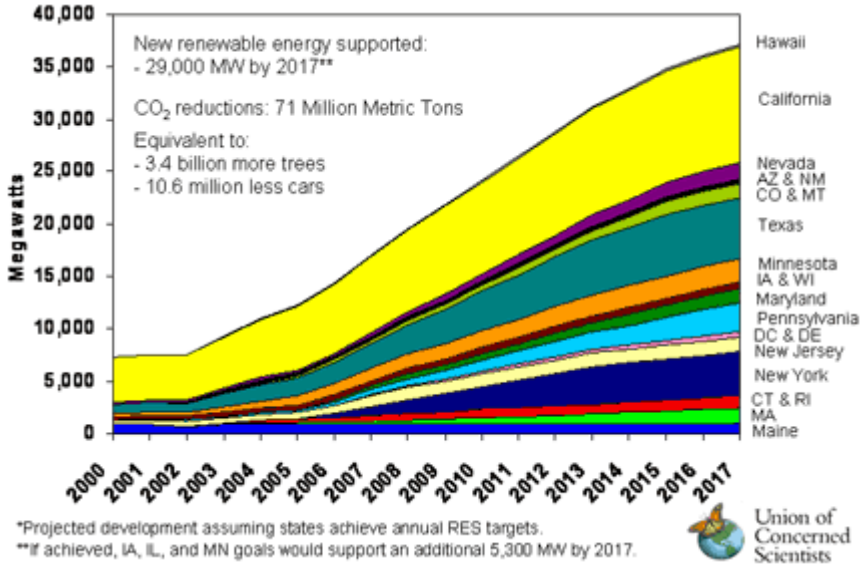

Figure 1
Expected Impact of RPS Legislation in the US—New Generation Capacity Added Until 2017

Source: Union of Concerned Scientists

The Public Utility Regulatory Policy Act (PURPA), enacted in 1978, requires utilities to buy green power if it can be obtained more cheaply than their "avoided cost", i.e., the cost of investing in conventional power generating capacity. PURPA has benefited both renewable energy and cogeneration in the United States. A step up from PURPA, **feed-in tariffs** (also called, advanced renewable tariffs) require utilities to pay more than their avoided cost for renewables. These tariffs have become very popular in Europe, making Germany, Spain and Denmark world leaders in wind power development. For example, power from eligible forms of renewable generation under Germany's feed-in law more than doubled between 2000 and 2004, from 14 to 37 terawatt-hours (TWh). More recently, they are also being used in some Canadian provinces and in Washington State, but also in Thailand, Nicaragua, Brazil, India and Sri Lanka. A feed-in tariff is like an open call for proposals in that it sets a fixed price for electricity from renewable energy sources. Power utilities are obliged to buy electricity at this government-set tariff from

[2] See <http://www.cec.org/databases/certifications/Cecdata/index.cfm?web siteID=3> for a detailed description by state, and CEC (2003) for their comparison.

any power developer in their service area. The tariff generally varies from one technology to the other, and also decreases over time, i.e., a developer may be paid a fixed tariff over 20 years, but the tariff will be slightly lower if the new electricity generation units start producing in 2007 than if they would be operational as of 2006. Tariffs can also differ according to the size of development, i.e., a small wind turbine on a city rooftop may get a higher tariff than a large wind farm near the ocean. **Figure 2** illustrates the success of feed-in tariffs in Europe: Denmark, Spain and Germany have used feed-in tariffs and contributed the most to Europe's (EU-15) increase in wind power capacity since 1990.

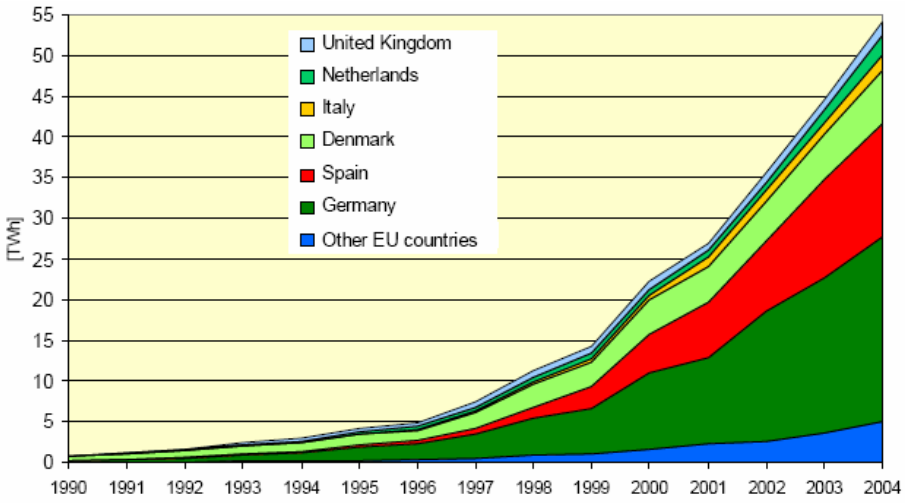

Figure 2
Electricity Generation from Wind Turbines in the European Union

Source: German Environment Ministry

Apart from these requirements to purchase increasing amounts of green power, many states also provide **tax exemptions, incentives** or **rebates** (buy-downs) to renewable energy projects. A very successful example is the US Production Tax Credit, which provides a tax credit of 1.9¢/kWh to wind power producers. Many jurisdictions also provide other tax credits, such as sales tax exemptions for renewable energy equipment, or **accelerated depreciation** schemes. Incentives include production incentives paid on a per-kWh basis, research and development funding, buy-downs for home-based installations, and project-based funding. Incentives are sometimes financed through so-called **System Benefits Charges**, which are collected from electricity consumers through a small charge raised per kWh. These charges are collected into Renewable Energy and Energy Efficiency Funds, which are then used to support these technologies. **Figure 3**

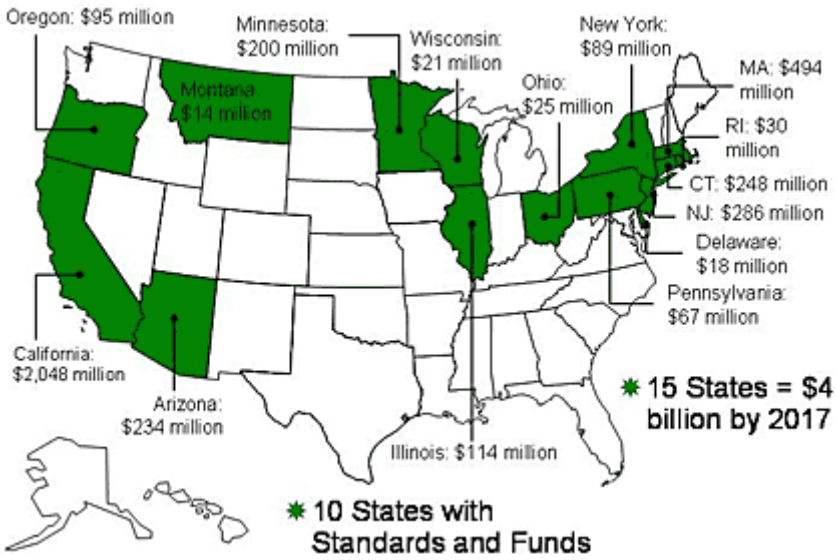

Figure 3 Renewable Energy Funds in the United States

shows US states with such systems in place. **Figure 4** compares the success Japan has had in the solar photovoltaic (PV) sector through its rebate program with that of Germany (introduced feed-in tariffs in 2000) and the US (mainly determined through rebates in California).

Instead of tax exemptions for renewables, some governments have implemented **energy taxes** on fossil fuels. These taxes are similar to, but usually much higher, than the System Benefits Charges mentioned above. Similar taxes are emission-related taxes, such as CO_2 or SO_2 taxes. These taxes are meant to correct a market failure that does not incorporate the external costs of fossil energy sources in the heat and electricity sectors. Such taxes (for example, implemented in Austria, Denmark, Finland, Italy, the Netherlands, Germany and Sweden) make it easier for (usually somewhat more expensive) energy from renewables to compete in the marketplace, and tax revenues are sometimes also used to support renewable energy technologies (for example, Austria, Italy, or Denmark in the 1990s).

Net metering is another policy that helps the renewable energy industry. Similar to feed-in tariffs, it lets on-site producers of electricity feed excess electricity into the public grid at the retail price, and participants only pay the utility whatever electricity they consume above their own production. Net metering is mostly used to support smaller, distributed energy systems that are installed on or near buildings. Thirty-nine US states have net metering rules. Net metering is available in Mexico, and is also becoming popular in Canada—now being available in British Columbia, Ontario, and Manitoba.

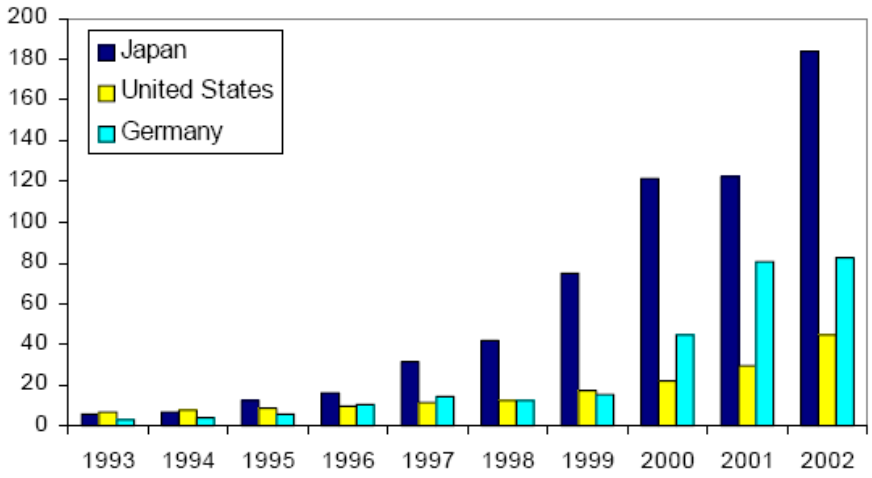

Figure 4
Solar PV Capacities Installed in Japan, Germany and the United States
[in peak megawatts (MWp)]

Source: International Energy Agency

Another way of financing renewable energy projects is leveraging a premium for renewables through so-called **green power marketing** or **green pricing** programs. Under these voluntary programs, power retailers offer green power to their customers under specific contracts, often at a small price premium over the usual cost of electricity. The money raised this way then flows back to the developers of renewable energy projects. **Table 1** shows the most successful green pricing programs in the United States and the new generation capacity they have helped to develop. Such programs are also available in several Canadian provinces. The World Resources Institute runs a successful program to commit the private sector to voluntary green power purchasing in the United States.

Table 1 Green Pricing Programs and New Power Generation Capacity They Supported (as of December 2004)

Rank	Utility	Resources Installed	New Capacity
1	Austin Energy	Wind, landfill gas, small hydro	38.2 MW
2	Portland General Electric	Existing geothermal, wind, small hydro	29.9 MW
3	PacifiCorp	Wind, biomass, solar	21.9 MW
4	Sacramento Municipal Utility District	Landfill gas, wind, small hydro, solar	20.2 MW
5	Xcel Energy	Wind	15.7 MW
6	National Grid	Biomass, wind, small hydro, solar	10.1 MW
7	Los Angeles Department of Power & Water	Wind and landfill gas	8.6 MW
8	OG&E Electric Services	Wind	6.5 MW
9	Puget Sound Energy	Wind, solar, biogas	5.3 MW
10	We Energies	Landfill gas, wind, small hydro	4.7 MW

There are also **private initiatives** to finance renewable energy systems. For example, Earth Energy Utility in Ontario (Canada) is an energy services company that finances geothermal heat pumps in large residential and commercial developments and sells the heat to residents at a fixed price for 50 years (see on the discussion on heat pumps in **Section 4**, below). This offers long-term profits fro the company and energy price security for the customers: a true win-win situation. In the United States, the home mortgage company, Fannie Mae, offers its customers an increased mortgage if they can show that their energy bills are reduced through renewable energy and energy efficiency measures. This leverages extra financing for those that could otherwise not afford to implement these measures in their homes. Likewise, many green investment funds and major energy producers have started investing in large-scale renewable energy projects. Lately, the flexible carbon trading mechanisms under the Kyoto Protocol have leveraged new capital for renewable energy projects in developing countries that have ratified the Protocol, and both governments and corporations provide capital to buy carbon credits from such projects.

Finally, some countries are having major successes **without any financial incentives**. Many renewable energy systems can amortize themselves over less than a decade, and whenever market conditions are favorable and the public is informed about these advantages, markets develop by themselves. For example, China is the biggest market for solar heat systems, which are all domestically manufactured. Sweden is seeing a surge in geothermal heat pump installations, a technology that has established itself as the natural choice for new construction and refurbishments in the residential sector. Increasing prices for oil and gas have favored such developments without government subsidies, and often only small or no incentives (only promotion by governments or electric utilities) are necessary to enhance market growth for these technologies. Yet another means of supporting renewable energy is **mandating** it—which is done through mechanisms such as feed-in tariffs and renewable portfolio standards discussed above, but also by prescribing technologies for new construction, as is done in Israel with solar thermal systems.

Table 2 summarizes the various approaches and classifies them as “direct” and “indirect” policies. Direct policies support technologies by tax exemptions or subsidies, whereas indirect policies relate to the creation of markets and education.

Table 2 Summary of Direct and Indirect Renewable Energy Policies

Direct Policies	
US PURPA policy, feed-in tariffs	Power purchase contracts are needed over a sufficient time period to guarantee revenues to make capital payments
Green power marketing	Helps create a market, but is usually not enough to cause large-scale investment
Financing at favorable terms	Lowers capital recovery requirements
Buy-downs, rebates, grants	Lower the initial investment costs
Tax exemptions, credits or other incentives (e.g., accelerated depreciation)	Accelerate capital recovery
Indirect Policies	
Renewable portfolio standards (RPS)	Creates a purchasing mandate but does not necessarily specify contracting terms, e.g., pricing, length of agreement, etc.
Green purchasing targets	Governments can create a market pull by committing to buy green power for their operations
Green building mandates	Mandating that new buildings include renewable energy systems helps to create a market
Net metering	Improves the return for the project owner by valuing the electricity generated at the retail rate rather than at the utility's avoided cost, but only assists with financing if the project owner can convince the lender to factor these savings into the financing decision and terms
Education and awareness building	Broadens the potential market for renewable energy systems, particularly small-scale, but does not necessarily improve financing
System benefits charges (SBC)	Collects funds that can be used to provide specific incentives

4 Successful Programs by Technology

The following programs are also listed in **Table 3** at the end of this section.

4.1 Solar PV

<table>
<tr><td colspan="2">Germany: Renewable Energy Sources Act (EEG)

The objective of the Renewable Energy Sources Act is to increase the share of total power supply derived from renewables to at least 12.5 percent by 2010 and at least 20 percent by 2020. Additional aims are the creation of jobs, the strengthening of small and medium size enterprises, and reduction of production costs for electricity from renewable energy.

The EEG replaced the Electricity Feed-in Law (1991–2000) in 2000. The original feed-in law made the purchase of electricity from renewable sources mandatory and set a fixed price, which is generally guaranteed for 20 years. The main difference was that before 2000, grid operators did not have to comply with these obligations after they had met a limit of 5 percent renewable electricity. This condition was meant to ease the burden of the operators in region with high rates of renewables but was found obsolete when a number of regions exceeded the limit. This 5 percent cap was then abolished when the EEG replaced the old Feed-In Law in 2000.

The EEG has been very effective from the beginning: from 2000 to 2004, the volume of electricity generated from renewable energies supported by this Act increased from around 13.6 TWh to 34.9 TWh. During this period, the share of wind and biomass more than doubled and photovoltaic systems saw a nine-fold increase.</td></tr>
<tr><td>System size:
Landfill gas, wind, solar, geothermal: unrestricted
Hydropower: up to 5 MW (up to 150 MW for capacity increases etc.)
Biomass: up to 20 MW</td><td>Main instrument: Pays a fixed rate per kWh to grid connected renewable electricity producers for 20 years. The rate of payment for a particular facility depends on the year of installation, as it will be reduced each year. However, the rate obtained in the first year remains the same for 20 years.</td></tr>
<tr><td>Program start date: 29 May 2000</td><td>MW installed since start: enabled the installation of more than 300 MW of solar PV and nearly 14,000 MW of wind power.</td></tr>
<tr><td colspan="2">Link:
Renewable Energy Sources Act</td></tr>
<tr><td>Contact: German Environment Ministry
+(49) 1888 305-0</td><td>Program administrator: utilities</td></tr>
<tr><td colspan="2">Similar initiatives: Several other countries have also implemented feed-in tariffs for solar PV and other renewable energy systems.</td></tr>
</table>

California: LADWP – Solar Buy-Down Program

In June 2000, the Los Angeles Department of Water and Power (LADWP) Board of Commissioners approved a solar buy-down program designed to encourage the use of renewable energy through the installation of photovoltaic systems by residents and businesses in Los Angeles. The Board has approved a total of $150 million through June of 2011 toward developing solar power in Los Angeles. Annual funding for the solar program varies within a range from $8 million to $16 million. The programs are funded under LADWP's public benefits program authorized by AB 1890, California's electric utility restructuring law. The program seeks to encourage PV manufacturers to locate manufacturing in Los Angeles by offering a higher per watt rebate and access to economic development programs, including multi-year discounted electric rates up to 30 percent, wage subsidies, and other business attractors. LADWP's goal is to have 100 MW of solar power developed in the City of Los Angeles by the year 2011 through the buy-down program and through LADWP-constructed solar power plants. Los Angeles supports net metering up to a one-megawatt system capacity through a Net Metering Ordinance. The current ordinance is effective through 31 December 2005, for commercial systems and systems over 10 kilowatts. Net metering for residential systems up to 10 kilowatts in capacity does not expire.

System size: At least 300 W. PTC rating not more than 100 percent of the annual power needs. (The PTC rating is a capacity rating for solar panels, which equals about 88 percent of the nameplate capacity of solar panels)	**Main instrument:** Rebate <30 kW: $3.50/W (PTC rating) for systems manufactured outside Los Angeles, and $4.50/W (PTC rating) for systems manufactured in the City of Los Angeles. There is a maximum rebate cap of 75 percent of eligible costs. >30 kW: $2.75/W (PTC rating) for systems manufactured outside Los Angeles and $3.50/W (PTC rating) for systems manufactured in the City of Los Angeles. There is a maximum rebate cap of 50 percent of eligible costs.
Program start date: 1 September 2000	**MW installed since start:** Between September 1,2000 and June 2004, the program had completed over 8.5 megawatts of customer-installed solar power systems. In addition to the customer-installed systems, LADWP has installed 756 kilowatts of solar photovoltaics on city-owned buildings, for a total solar installation in Los Angeles of 9.3 megawatts.

Link: LADWP web site

Contact: **Josephine Gonzalez** **Los Angeles Department of Water & Power** Los Angeles, CA Phone: (213) 367-0414 Fax: (213) 367-2591 E-Mail: josephine.gonzalez@ladwp.com	**Program administrator:** **Los Angeles Department of Water & Power** Los Angeles, CA Phone: (800) 473-3652 Phone 2: (213) 367-4122 E-Mail: solar@ladwp.com

Similar initiatives: Solar rebates also exist at the state level in California, and many other states and countries. In the UK, community groups and homeowners can apply for funding through the £20m Major Photovoltaics Demonstration Programme. This should see PV systems installed on 2,500 homes and 70 medium and large non-domestic buildings—a total of 9MWp-installed capacity.

Japan: Solar PV Low-Interest Loans and Rebates

Japan established net metering for photovoltaic (PV) power in 1992, requiring utilities to purchase excess power at the retail rate. In 1994, Japan launched the "Solar Roofs" program to promote solar PV through low-interest loans, a comprehensive education and awareness program, and rebates for grid-connected residential systems that were provided in return for data about systems operations through the "Residential PV System Dissemination Program." Government promotion of PV has included publicity on television and in print media. The rebates declined gradually over time, from 50 percent of installed costs in 1994 to 12 percent in 2002, the year the program ended. In 1997, the rebates were opened to owners and developers of housing complexes as well, and Japan became the world's largest supporter of PVs, with a seven-fold increase in funding for the expanded "70,000 Roofs Program." After the expiry of the Solar Roofs program, the Ministry of Economy, Trade and Industry enforced "the Law Concerning the Use of New Energy by Electric Utilities (Renewables Portfolio Standard (RPS) Law)" in April 2003, as a measure to promote further dissemination of new and renewable energy. The RPS Law obliges electric power companies to expansion of use of electricity generated from new energy. The target minimum ration of renewable energy usage in 2010 is 12,200 GWh, which accounts for 1.35 percent of net sales energy demand.

System size: small distributed systems, about 4kWp (average)	**Main instrument:** 50 percent cost rebate (decreasing from year to year) and net metering
Program start date: 1994	**MW installed since start:** 420 MW (from 1994 to 2002)
Link: National Status Report 2002	
Contact: Ministry of Land, Infrastructure and Transport (METI)	**Program administrator:** Government, "Residential PV System Dissemination Program"
Similar initiatives: Rebates and net metering are also used in California and several other jurisdictions.	

4.2 Solar Hot Water Systems

<table>
<tr><td colspan="2">Austria: Residential Energy Retrofit Grants

Several Austrian state governments support the installation of energy efficient energy systems in homes. For example, the government of Lower Austria supports both solar thermal installations for hot water and geothermal heat pumps with a buy-down program. The buy-downs cover between 20 percent (hot water) and 30 percent (hot water and space heating) of the system investment cost. Austria, as a whole, added between seven and eight thousand new heat pump systems per year in 2003 and 2004, which represents two-digit growth rates. At the end of 2005, Austria had installed three million square meters (m^2) of solar thermal collectors (2,100 MW). With 270 m² of installed solar thermal panels per 1,000 inhabitants, Austria (with Greece) has one of the highest per-capita solar use rates in the world.</td></tr>
<tr><td>System size: residential
Solar thermal: min size of 4 m² and 300 liters of hot water storage</td><td>Main instrument: Buy-downs.
Solar thermal (hot water): €1,500
Solar thermal (water and space heating): €2,200
Heat pumps (hot water): €1,100
Heat pumps (water and space heating): €2,200</td></tr>
<tr><td>Program start date: 5 October 1993</td><td>MW installed since start: By the end of 2005, 19,836 solar hot water systems had been supported, plus another 5,562 systems that heat both warm water and living spaces.</td></tr>
<tr><td colspan="2">Link (German): Program document</td></tr>
<tr><td>Contact:
Phone: +(43) 2742 9005 14036
Fax: +(43) 2742 9005 14065
Email: post.f2auskunft@noel.gv.at</td><td>Program administrator (sub-federal/state level):
Amt der Niederösterreichischen Landesregierung
Abteilung F2A,B – Wohnungsförderung
St. Pölten, Austria</td></tr>
<tr><td colspan="2">Similar initiatives: Other Austrian states have similar programs. The UK's Clear Skies program provides grants of £400 per system installed. Victoria (Australia) offers A$1,500 per system, and California up to US$750 per system, to name a few.</td></tr>
</table>

United Kingdom: Solar Clubs

Solar Clubs are community clubs designed to make it easier and cheaper for householders to install an active solar water-heating system. They were developed by the Bristol Centre for Sustainable Energy, an environmental organization. Solar Clubs operate by training householders to install pre-manufactured solar collectors themselves. This enables the cost of installing a system to be reduced. In addition, by joining a Solar Club, members can take advantage of discounts from manufacturers and suppliers that the club has negotiated. This provides further reductions in the investment required to take advantage of solar water heating.

Joining a Solar Club does not cost anything, although there is a charge for attending the relevant training course. A self-installation solar system will cost in the range of £800 to £2000. The precise amount will, naturally, depend on the type of system selected, the type and size of solar panel employed, and the control and storage system required.

A key development occurred in 1998, when the BOC Foundation contributed extra funding to expand the project and to support the launch of ten new Solar Clubs around the UK. To this end, seminars were held in Bristol and Leicester in February 1999 to disseminate the findings of the pilot project, and to invite applications to set up clubs as part of the network. There were 13 solar clubs in the UK today in 1999, 7 of which were still operating in 2004. Financing for the initiative comes from the Department of the Environment (DETR) and from a number of charitable trusts and foundations.

The Solar Clubs have reduced their activity because the Department of Trade and Industry's Clear Skies grant program. This program provides substantial grants but requires professional installation, which means that the saving associated with a do-it-yourself installation has been significantly reduced. Furthermore, the reduced VAT charged on a professional installation of 5 percent compares unfavorably with the 17.5 percent VAT for do-it-yourself installations.

System size: Residential	**Main instrument:** Training and providing solar panels at a discount (can be 20–30 percent below regular price)
Program start date: 1997	**MW installed since start:** at least 12 systems (1993 to 2003, 1 club)
Link: Centre for Sustainable Energy Community Projects web site	
Contact: Ian Preston, Centre for Sustainable Energy **Tel:** +(44) 117 934-0945 ian.preston@cse.org.uk	**Program administrator:** Solar Clubs Local Contacts
Similar initiatives: Solar clubs are based on an idea that has revolutionized the market for solar energy in Austria, increasing demand for solar panels by over 900 percent in the last ten years.	

India: Solar Water Soft Loans

Solar water heaters in India are now being installed in thousands of homes, thanks to the low-cost financing provided by many of the commercial banks in the urban and rural parts of the country. The regular interest rates are being subsidized by the Ministry of Nonconventional Energy Sources (MNES), Government of India. For example, Canara Bank, headquartered in Bangalore, offers loans for solar water heaters at 2 percent for individuals, 3 percent for institutions and 5 percent to commercial entities. Typically the bank finances 85 percent of the project cost for a loan period of five years. On top of the reduced interest rates, private enterprises can gain a benefit of accelerated depreciation of 80 percent.

Until the early 1990s there was a capital subsidy on the solar water heaters. These subsidies were monitored by the nodal agencies of MNES in the different states of the country. The bureaucracies of the processes of availing capital subsidies, with the lack of appropriate financing deterred the growth of the market. For example, in the State of Karnataka, India, there were less than six manufacturers of solar waters in the early 1990s. Even a 30 percent capital subsidy on the solar water heaters did not entice either new manufacturers or potential clients. The policy change in the mid-nineties, from capital subsidy to interest subsidy completely changed the scenario.

The interest subsidy enticed the numerous banks to finance solar water heating systems and that in turn led to the growth of a number of manufacturers from less than six to more than 60 in 2005 in the State of Karnataka alone. The financing program has led to installations of solar water heaters in households, hotels, hospitals, small scale businesses, medium enterprises, sugar mills, milk processing plants, food processing units; all places where there is a requirement for hot water.

System size: not specified	**Main instrument:** Interest buy-down
Program start date: mid-1990s	**MW installed since start:** unknown
Link: India soft loan program for solar thermal technologies (Solar Energy/Solar Thermal)	
Contact: Ministry of Nonconventional Energy Resources India	**Program administrator:** Private banks
Similar initiatives: The German Credit Agency for Reconstruction (KfW) provides low-interest loans for a range of energy efficiency measures in residential buildings, as well as solar PV systems.	

4.3 Solar Space Heating

Ontario: Enbridge MultiCHOICE Program This program targets the commercial sector and provides incentives on energy savings measures that reduce natural gas consumption. Installing Solarwall is a qualifying measure and is supported with up to C$30,000. The incentive is available to Enbridge's Ontario (Canada) customers only.	
System size: Not specified, but maximum support is C$30,000.	**Main instrument:** Incentive of 5 or 10 cents per m^3 of natural gas saved in the first year, up to C$30,000.
Program start date: 1998	**MW installed since start: unknown**
Link: MultiCHOICE Program	
Contact: Enbridge Energy Services 1 866 844 9994 Email: energyservices@enbridge.com	**Program administrator:** Enbridge MultiChoice Program
Similar initiatives:	

Florida: Solar Energy Equipment Exemption (Sales tax credit) Solar energy systems have been exempt from Florida's sales and use tax since July 1, 1997. The term "solar energy system" means the equipment and requisite hardware that provide and are used for collecting, transferring, converting, storing or using incidental solar energy for water heating, space heating and cooling, or other applications that would otherwise require the use of a conventional source of energy such as petroleum products, natural gas, manufactured gas or electricity. Vendors of solar energy systems or components are required to document exempt sales.	
System size: not specified	**Main instrument:** Sales and use tax exemption
Program start date: 1 July 1997; the program is now permanent.	**MW installed since start:** unknown
Link: Florida solar tax exemption	
Contact: Colleen Kettles Florida Solar Energy Research and Education Foundation, Inc. (FlaSEREF) Longwood, FL Phone: (407) 786-1799 Fax: (407) 786-1772 E-Mail: cmkettles@cfl.rr.com	**Program administrator:** Florida Solar Energy Research and Education Foundation, Inc.
Similar initiatives: Massachusetts has a tax exemption for residential solar space heat applications. Minnesota, New Jersey and others exempt all solar systems from sales tax.	

<table>
<tr><td colspan="2">United States (federal): Business Energy Tax Credit (Corporate tax credit)

Businesses in the United States that install renewable energy systems are eligible for a corporate tax credit amounting to 30 percent of installed cost until 2007, and 10 percent after that. This credit is applicable to solar space heating, but also to solar water heat, solar thermal electric, solar thermal process heat, photovoltaics, geothermal electric, fuel cells, solar hybrid lighting, direct use geothermal (10 percent only), and microturbines (10 percent only).</td></tr>
<tr><td>System size: not specified</td><td>Main instrument: 30 percent of equipment cost corporate income tax reduction</td></tr>
<tr><td>Program start date: 8 August 2005</td><td>MW installed since start: unknown</td></tr>
<tr><td colspan="2">Link: DSIREUSA</td></tr>
<tr><td>Contact:
US Department of Energy</td><td>Program administrator:
Federal Department of Finance</td></tr>
<tr><td colspan="2">Similar initiatives:</td></tr>
</table>

4.4 Wind Turbines

US Renewable Electricity Production Tax Credit

The federal Renewable Electricity Production Tax Credit (PTC) is a per kilowatt-hour tax credit for electricity generated by qualified energy resources. Enacted as part of the Energy Policy Act of 1992, the credit expired at the end of 2001, and was subsequently extended under different Acts in 2002, 2004 and 2005 with some modifications in the process. It will expire again on 31 December 2007.

The PTC was the main contributor to the development of wind industry in the United States but it is generally accepted that the cycle of two-year extensions and then expirations of the program had a negative effect on its success. The PTC has mainly spurred wind energy development because (1) wind is much closer to cost competitiveness than other eligible renewable energy technologies and (2) wind projects can be installed with short lead times that can fit within the two-year policy window. However, the nature of the incentive limits its applicability to large companies with sufficient tax liabilities.

System size: no size limitations on wind power facilities. Consult the web site for information on other sources.	**Main instrument:** Production based Tax Credit (adjusted annually for inflation) 1.9¢/kWh for wind, solar, geothermal, closed-loop biomass; 0.9¢/kWh for others. Applies to first 10 years of operation.
Program start date: 31 December 31, 1992 Last extension in 8 August 2005.	**MW installed since start:** The PTC has supported most of the wind turbines installed in the United States since 1992.
Link: DSIREUSA Present law and background relating to tax credits for electricity production from renewable sources.	
Contact: **Information Specialist - IRS** **Internal Revenue Service** 1111 Constitution Avenue, N.W. Washington, DC 20224 Phone: (800) 829-1040 Web site	**Program administrator:** **Internal Revenue Service** 1111 Constitution Avenue, N.W. Washington, DC 20224 Phone: (800) 829-1040 Web site
Similar initiatives: none.	

Canadian WPPI Program

Since 2002, the federal Wind Power Production Incentive (WPPI) attempts to cover half of the current cost of the premium for 1,000 MW of wind energy systems in Canada. This incentive is available to electricity producers for the first ten years of a project. At the outset, the incentive amount was decreasing over time, but its extension to 4,000 MW, the incentive level will remain stable at 1 cent per kWh (before tax).

The first budget for this initiative provides C$260 million of financial support for 1,000 MW of new capacity until 2007. WPPI is expected to leverage approximately CAN$1.5 billion in capital investments across Canada. In the 2005 federal budget, the Government of Canada announced that it would invest an additional C$920 million over 15 years to increase the WPPI target to 4000 MW by 2010.

System size: at least 500 kW, or 20 kW in northern and remote locations.	**Main instrument:** Performance-based incentive of 1 cent per kWh produced, paid for the first ten years of a project:
Program start date: 1 April 2002, extended to 2009 with the 2005 budget.	**MW installed since start:** 562 MW installed since 2002, 276 MW scheduled in 2006 for a total of 839 MW installed and planned A list of projects can be found on the WPPI web site.
Link: Program web site	
Contact: **Wind Power Production Incentive (WPPI)** **Natural Resources Canada** Ottawa, Ontario Telephone: (613) 995-0947 Toll-free (information): (877) 722-6600 TTY (hearing impaired): (613) 996-4397 E-mail: wppi@nrcan.gc.ca	**Program administrator:** **Natural Resources Canada** General Enquiries: **(613) 995-0947**
Similar initiatives: California paid a similar incentive to renewable energy producers some years ago.	

United States: Austin Energy *GreenChoice* Program

In January 2000, Austin Energy, the municipally-owned utility of the City of Austin, Texas, launched *GreenChoice,* a program which allows its residential and business customers to purchase 100 percent of their electricity needs from renewable energy sources. A key feature of the program is that subscribers pay a "green rate," which replaces the utility's standard fuel charge and remains fixed for the 10-year term of the utility's renewable energy contracts. Thus, *GreenChoice* customers are able to lock in a predictable electricity rate and are protected from fluctuations in the price of the non-renewable fuels that the utility uses for the rest of its electricity generation mix. As of January 2006, because of fuel price increases that have occurred since the start of the program, all *GreenChoice* customers were paying a *lower* rate for electricity than customers on the standard utility service.

Austin Energy has procured its renewable energy supplies in "batches" to meet customer demand, with the electricity from each batch priced according to the power purchase contract prices. Through four successive batches, the utility has procured a total of 225 MW of renewable generating capacity for the program and the program ranks first in the nation among utilities in renewable energy sales.

System size: Batch 1 – 24 MW Batch 2 – 85 MW Batch 3 – 37 MW Batch 4 – 79 MW	**Main instrument:** Austin Energy substitutes a separate "green rate" for the utility's regular energy charge. The green rate is fixed for 10 years, which represents the contract term of the utility's renewable energy purchases.
Program start date: January 2000	**MW installed since start:** At the end of 2005, Austin Energy had contracted for a total of 225 MW of renewable energy generation to support the *GreenChoice* program. The capacity consists mostly of wind energy with smaller contributions from landfill gas and small hydropower projects.
Link: Austin Energy Green Choice Program	
Contact: Carol Harwell Austin Energy Phone: (512) 322-6562 carol.harwell@austinenergy.com	**Program administrator:** Austin Energy
Similar initiatives: More than 600 utilities across the United States offer "green pricing" programs to their customers but only a few provide fuel-price protection similar to the Austin Energy program. The popularity of these programs with customers varies widely depending on the "value proposition" offered by the utility.	

California: Emerging Renewables Program Rebate (small wind)

The Emerging Renewables Program (ERP) provides incentives for the purchase of four types of grid-connected renewable energy generating systems—photovoltaics, solar thermal electric systems, fuel cells using renewable fuels, and small wind turbines. Rebates for eligible renewable energy systems installed on affordable housing projects are available at 25 percent above the standard rebate level up to 75 percent of the system's installed cost.

Participants in the ERP program for photovoltaic systems may choose to receive the incentive as a capacity-based rebate in a lump sum as described above or as a performance-based incentive (PBI). The PBI is based on the amount of electricity generated by a system and is paid over a three year period. A total of $10M is allocated to this pilot performance-based incentive program for PV systems. The performance based incentive level will remain constant for duration of the pilot program.

System size: Less than 30kW for rebate option; no limit for performance-based option. Note that wind systems up to 50 kW in size may participate, but the rebates for such systems are limited to less than 30 kW.	**Main instrument:** Rebate or Production based incentive. • PV: $2.80/W • Wind: $1.70/W for first 7.5 kW and $0.70/W for increments above that limit • Solar thermal electric: $3.20/W • Fuel cells using renewable fuels: $3.20/W
Program start date: 1998	**MW installed since start:** As of October 2005, over 15,000 new systems have been installed since the rebate program began in 1998, of which 300 (1.6 MW) are small wind turbines.

Links:
Program web site

GUIDEBOOK For Emerging Renewables Program - Fifth Edition (July 2005)

Contact: California Energy Commission Emerging Renewables (Rebate) Program Sacramento, CA Phone: (800) 555-7794 Fax: (916) 654-4420 E-Mail: renewable@energy.state.ca.us	**Program administrator:** See Contact.

Similar initiatives: New Jersey, New York, Iowa and Minnesota have rebate or cheap loan programs for small wind applications. The UK's Clear Skies grants program provides grants for small-size wind power systems: £1000 per kilowatt, up to a maximum of £5,000, but limited in all cases to 30 percent of the total inclusive of VAT installed cost. Minimum size of 0.5 kWe. Installations larger than 5 kWe are allowable but capacity above that level will not incur a grant.

4.5 Hydropower

Large and small hydropower is already commercial in many applications. There are few financial initiatives targeting hydropower as a technology, but some of them target hydropower as part of a larger technology portfolio. For example, Germany has feed-in tariffs for small hydropower plants (below 5 MW) and plant modernizations. Canada's planned Renewable Power Production Incentive is expected to include hydropower as a qualifying technology. The US Production Tax Credit also supports hydropower. Hydropower (often with a size restriction or defined as run-of-river hydropower) also qualifies under many Renewable Portfolio Standards. Small hydro is also included in many voluntary green power purchasing and green pricing programs.

<table>
<tr><td colspan="2">India: Small Hydropower Programme

The Small Hydro Programme provides loan interest subsidies for commercial projects, and finances up to 90 percent of state-owned projects in the small hydro sector. The program also provides incentives for surveys, site investigations and feasibility studies. The Indian Renewable Energy Development Agency (IREDA), the financial institution under MNES, provides soft loans for commercial projects up to 25 MW.</td></tr>
<tr><td>System size: up to 25 MW</td><td>Main instrument: Incentives for project development activities; interest buy-downs for commercial projects (1.5 to 7.5 percent) and subsidies for government projects (25 to 90 percent).</td></tr>
<tr><td>Program start date: 1994</td><td>MW installed since start: India has 420 small hydropower projects of up to 25 MW station capacity, with an aggregate capacity of over 1423 MW. Over 187 projects in this range with aggregate capacity of 521 MW are under construction. It is not known how much of this was supported by the program.</td></tr>
<tr><td colspan="2">Links: Program web site</td></tr>
<tr><td>Contact:
A.K. Chopra
Small Hydro Programme
Ph 24363067
Email: chopraak@nic.in</td><td>Program administrator:
Ministry of Nonconventional Energy Resources (India)</td></tr>
<tr><td colspan="2">Similar initiatives:</td></tr>
</table>

UK: Clear Skies Program (household and community grants)

Clear Skies is a £10 million (extended to £12.5 million in 2004) grant program funded by the Department of Trade and Industry and managed by Building Research Establishment Ltd, aims to give householders and communities a chance to realize the benefits of renewable energy by providing grants and access to sources of advice.

Householders can obtain grants between £400 to £5000 whilst not-for-profit community organizations can receive up to £50,000 for grants. Installations must be accomplished by professional installers. For household grants, the amount of grant is dependent upon the technology installed. For community grants, the size of the grant is the lower of 50 percent of installed cost or £50,000 regardless of the technology.

Grants are given to the following renewable energy installations:

- Solar thermal
- Wind turbines
- Micro/small scale hydro turbines
- Ground source heat pumps
- Room heaters/stoves with automated wood pellet feed
- Wood fuelled boiler systems

Linked to this program, the Community Renewables Initiative (CRI) was launched in February 2002 and provides advice and free training on all topics associated with renewable energy. A similar service is provided by the Renewable Energy Advice Centre (REAC) pilots. Both schemes are funded by the DTI and have already been successful in helping communities establish their own renewable energy projects. The Countryside Agency runs the CRI and the Energy Saving Trust runs the REACs.

System size: (small hydro) Households: Minimum size of 0.5 kWe. Installations larger than 5 kWe are allowable but capacity above that level will not incur a grant. Communities: not specified	**Main instrument:** Grants of £1000 per kWe installed up to a maximum of £5000 for residential; up to £50,000, or 50 percent of installed costs for community projects
Program start date: April 2003	**MW installed since start:** 15 small hydro systems were supported by the fund between 2003 and January 2006 in the residential sector, plus eight systems in the community sector
Links: Clear Skies Program	
Contact: Clear Skies Program Email: info@clear-skies.org	**Program administrator:** Building Research Establishment Ltd Garston, Watford (UK) www.bre.co.uk enquiries@bre.co.uk Phone: +(44)1923 664000
Similar initiatives:	

4.6 Heat Pumps

Earth Energy Utility Corporation (Energy Service Contracts)

Established in 2000, Earth Energy Utility Corp. (EEU) applied a utility concept to the provision of GeoExchange technology by providing a turn-key installation and operation of ground source or water heat pump systems, and delivering service to building owners through long term utility contracts at fixed rates. EEU was active all over Canada. The company offered, among others, complete financing and a 50-year utility charge freeze.

EEU was available to owners of large-scale developments (no single residential units). Customers pay a fixed monthly fee that is equal to the utility bill that would have been paid at the time of purchase, had a conventional heating system been installed. However, the monthly fee is guaranteed for 50 years. Also, the lease down payment is only 75 percent of the installation cost for a conventional system. EEU covers any repairs and replacements over 50 years without extra costs to the lessee. The concept is supported by some European investors (Swiss Re, pension funds, etc.). No government subsidies support this initiative.

Due to the lack of qualified installers for geothermal systems in Canada, EEU lost much of its potential business. Few incentives are provided for geothermal heat pumps in Canada, whereas countries like the UK and Austria provide generous grants for households and institutions deciding to install such systems. EEU is therefore moving its business to Europe, where the investment climate is a lot better.

System size: Projects 100,000 sq ft or larger.	**Main instrument:** Long-term contract for heat at a fixed price
Program start date: 2000	**MW installed since start:** unknown
Link: (no longer available)	
Contact: n/a	**Program administrator:** Earth Energy Utility
Similar initiatives: Lifetime Energy is an initiative of Waterloo Hydro (/Ontario) and NextEnergy, which offers heat pumps to residential and commercial customers who can pay off the cost of their systems on their monthly energy bills. HLT Energies, in Montreal, pursues a similar business model in the solar thermal sector. EcoCentroGen in the UK offers a similar package, although not with a long-term rate freeze as many of its facilities are natural gas-based (see Case Study).	

<table>
<tr><td colspan="2">Canada: Earth Power Program (MB Hydro)

Manitoba Hydro provides assistance to homeowners to buy ground source heat pumps. The loan option is available through participating geothermal heat pump installers, and the loan can be paid off through Manitoba Hydro, over monthly utility bills. The program also offers a subsidy to carry out feasibility studies for commercial applications. Due to the program, Manitoba experiences a 40 to 50 percent annual growth rate with respect to groundsource heat pumps. Twenty to thirty percent of Canada’s heat pump installations take place in Manitoba, which has less than 10 percent of the country’s population.</td></tr>
<tr><td>System size: Not specified. Groundsource heat pumps must be installed by accredited installers according to CSA standards.</td><td>Main instrument:
Residential: Loan of up to $15,000 interest rate is 6.5 percent, fixed over the term of the loan (maximum 15 years). The loan is paid off over the hydro bill.
Commercial: Up to 50 percent or $10,000 subsidy for feasibility studies. MB Hydro also pays a custom incentive to businesses, composed of
• $135 per winter kW saved,
• $50 per summer kW saved, and
• $0.04 per kWh saved in the first year.</td></tr>
<tr><td>Program start date: 2002</td><td>MW installed since start: 350 units financed for a total of nearly $5 M</td></tr>
<tr><td colspan="2">Link:
Earth Power Program</td></tr>
<tr><td>Contact:
phone (888) 624-9376
Email:
earthpowerinfo@hydro.mb.ca</td><td>Program administrator:
Earth Power Program
Manitoba Hydro
820 Taylor Avenue
Winnipeg, Manitoba
Canada R3M 3T1
<http://www.hydro.mb.ca/></td></tr>
<tr><td colspan="2">Similar initiatives: BC Hydro’s Power Smart program and several other utility energy efficiency programs offer incentives to businesses for energy-saving measures. Fannie Mae (United States) provides green mortgages that can roll the cost of energy improvements into a home mortgage. The UK’s Clear Skies Program <www.clear-skies.org> provides grants of £1,200 per heat pump installation.</td></tr>
</table>

4.7 Biomass Systems

Biomass is a very diversified sector. There are biomass wastes, such as agricultural and domestic residues, as well as forest residues, or energy crops (both from forestry and agriculture). Most of these can be used in a variety of ways, using many different technologies. Many renewable energy support programs, such as renewable portfolio standards, feed-in tariffs, tax exemptions and others, support biomass energy systems as well. Following are some programs from countries that have put a lot of effort into developing their biomass resource.

<table>
<tr><td colspan="2">Germany: Biomass and Energy Program (Schleswig-Holstein)
Germany's federal feed-in law already supports biomass systems together with a range of other renewable energy technologies. However, state governments find it necessary to provide extra incentives to mobilize biomass resources, as the feed-in tariffs cannot account for a great variety of regional circumstances. Once example of such a program is the Biomass and Energy Initiative of the state of Schleswig-Holstein. This program has provided capital subsidies for biomass projects (including methanization, combustion) with a budget of €12 million from 2001 to 2006. It builds upon experience of the first program, which ran from 1996 to 2000 and supported wood straw and biogas projects with €6.75 million (23 MW_{th}). By 1 September 2004, the new program supported 21 projects in the areas of methanization, power generation, cogeneration, pelletizing, and wood chip processing. The grants are provided through a regional investment bank.</td></tr>
<tr><td>System size: industrial</td><td>Main instrument: Capital grants (up to 40 percent)</td></tr>
<tr><td>Program start date: 2001</td><td>MW installed since start: unknown</td></tr>
<tr><td colspan="2">Link: Program web site</td></tr>
<tr><td>Contact:
Energieagentur der Investitionsbank Schleswig-Holstein,
Erik Brauer
Tel: +(49) 431 9905-3293,
E-Mail: erik.brauer@ibank-sh.de</td><td>Program administrator:
Investitionsbank Schleswig-Holstein
www.ib-sh.de</td></tr>
<tr><td colspan="2">Similar initiatives: Other states in Germany, the United States and elsewhere provide similar grant programs for biomass and other technologies.</td></tr>
</table>

Sweden: Exemption for Biomass for Home Heating from Energy Tax Sweden has supported home heating systems based on biomass by exempting biomass from the federal energy tax. Gas and electric heating is subject to energy taxes amounting to 62 percent, including VAT. For wood, only VAT is paid, which amounts to only 25 percent. This results in much lower fuel prices for wood heating than for a heating system based on electricity, natural gas or heating oil. Although energy taxes are not as common in north America as in Europe, the example illustrates that tax exemptions can be an efficient means to encourage renewable energy use.	
System size: home heating	**Main instrument:** Energy tax exemption
Program start date: 2004	**MW installed since start:** unknown
Link: Report	
Contact:	**Program administrator:** Finance Ministry of Sweden
Similar initiatives: The Netherlands has used energy tax exemptions to further renewable energy in the past. Germany also provides such tax exemptions.	

China: Large- and Medium-scale Biogas Development The Chinese government supports the construction of large- and medium-scale biogas plants in the "vegetable basket" livestock feeding base in suburbs of cities in coastal areas and some other large and medium-size cities. Since 2001, with the support of national finance, the fund designated by Ministry of Agriculture to support biogas development has jumped from CNY100 million to CNY350 million. In 2003, the central government earmarked CNY1 billion to support household biogas development.	
System size: medium- to large-size (50 to 5,000 m^3)	**Main instrument:** Government subsidy
Program start date: 2001	**MW installed since start:** 2500 biogas plants were planned for construction by 2005, which could supply biogas to 300,000 households. By 2010, 5000 reactors are to be completed.
Link: China Renewables (Bioenergy) China Biogas	
Contact: Shangbin Gao Tel: (86) 10 64193079 Fax: (86) 10 64193082 Email: gaoshb@agri.gov.cn	**Program administrator:** Ministry of Agriculture (China)
Similar initiatives:	

UK: Clear Skies Program (household and community grants)

Clear Skies is a £10 million (extended to £12.5 million in 2004) grant program funded by the Department of Trade and Industry and managed by Building Research Establishment Ltd, aims to give householders and communities a chance to realize the benefits of renewable energy by providing grants and access to sources of advice.

Householders can obtain grants between £400 to £5000 while not-for-profit community organizations can receive up to £50,000 for grants. Installations must be accomplished by professional installers. For household grants, the amount of grant is dependent upon the technology installed. For community grants, the size of the grant is the lower of 50 percent of installed cost, or £50,000, regardless of the technology.

Grants are given to the following renewable energy installations:

- Solar thermal
- Wind turbines
- Micro/small-scale hydro turbines
- Groundsource heat pumps
- Room heaters/stoves with automated wood pellet feed
- Wood-fuelled boiler systems

Linked to this program, the Community Renewables Initiative (CRI) was launched in February 2002 and provides advice and free training on all topics associated with renewable energy. A similar service is provided by the Renewable Energy Advice Centre (REAC) pilots. Both schemes are funded by the DTI and have already been successful in helping communities establish their own renewable energy projects. The Countryside Agency runs the CRI and the Energy Saving Trust runs the REACs.

System size: (biomass) Not specified. Wood pellet stoves or boiler systems are eligible. Boilers must comprise the main heating system of the house.	**Main instrument:** Grants of £600 for pellet stoves, regardless of system size for households and communities. £1,500 per system for wood-fired boilers.
Program start date: April 2003	**MW installed since start:** 96 boilers and 51 pellet stoves were supported by the Fund as of January 2006 in the residential sector, plus another 65 biomass systems in the community sector.
Links: Clear Skies Program	
Contact: Clear Skies Program Email: info@clear-skies.org	**Program administrator:** Building Research Establishment Ltd Garston, Watford (UK) enquiries@bre.co.uk Phone: +(44)1923 664000
Similar initiatives:	

INDIA: Indian Renewable Energy Development Agency Limited (IREDA)

The IREDA was established in 1987 as a Public Sector Non-Banking Company under the Ministry of Nonconventional Energy Sources with the objective of providing loans for new and renewable sources of energy. It has played a key role in the development of renewable energy in India.

The IREDA was established in 1987. The IREDA functions as the promotional and financing arm of the Ministry and has been able to tie up funds from domestic and international institutions for lending to end-users, manufacturers, financial intermediaries and entrepreneurs, predominantly in the private sector

Eligible sectors for financing are: hydro, wind, biomass (power cogeneration, waste to energy, bio fuels), solar (photovoltaic, thermal, water pumping), new initiatives, emerging technologies (fuel cells, battery powered vehicles) and energy efficiency.

System size: Wind: >225 kW Biomass Power: 1 to 7.5 MW Biomass Co-Generation: Sugar industries: >7.5 MW All others: no limitations Hydro: <25 MW Wastes to energy: <6 MW	**Main instrument:** Loans for up to 75 percent (some exceptions) of total project cost for 10 years terms with a three-year grace period.
Program start date: 1998	**MW installed since start:** 2545 MW total of power generation
Link: IREDA web site	
Contact: **Indian Renewable Energy Development Agency Limited** New Delhi, India Tel: +(91) 11.24682214-21 Fax: +(91)11.24682202 Email: contact@iredaltd.com	**Program administrator:** Indian Renewable Energy Development Agency Limited
Similar initiatives:	

Table 3 Overview of Programs *(can be used to create web site links — underlined are external links)*

Color codes: municipal; state; federal; industry/utility; community/NGO

Technologies	Grants and Incentives	Loans	Tax Credits	Other
Solar PV	Solar Buy-Down Program (Los Angeles) Solar PV grants (UK) Emerging Renewables Program (California)	German Credit Agency for Reconstruction low-interest loans	Business Energy Tax Credit (United States) Renewable Electricity Production Tax Credit (United States)	Renewable Energy Sources Act (Germany) Solar Clubs (UK)
Solar Hot Water	Residential Energy Retrofit Grants (Austria) Clear Skies Program (UK)	India soft loan program		Energy service contracts (Canada)
Solar Space Heating	Enbridge MultiCHOICE Program (Ontario)		Solar Energy Equipment Exemption (Florida) Business Energy Tax Credit (United States)	
Large wind turbines	Wind Power Production Incentive (Canada)		Renewable Electricity Production Tax Credit (United States)	Austin Power Green Choice Program
Small wind turbines	Clear Skies Program (UK) Emerging Renewables Program (California)	Renewable Energy Development Agency (India)		
Small, mini- or micro-hydro systems	Clear Skies Program (UK) Small Hydropower Programme (India)	Small Hydropower Programme (India) Renewable Energy Development Agency (India)	Renewable Electricity Production Tax Credit (United States)	
Geothermal heat pumps	Clear Skies Program (UK)	Earth Power Program (Manitoba Hydro)	Business Energy Tax Credit (United States)	Energy service contracts (Canada)
Large biomass systems	Biogas Development Subsidy (China)	Biomass and Energy Program (Schleswig-Holstein) Renewable Energy Development Agency (India)	Renewable Electricity Production Tax Credit (United States)	Austin Power Green Choice Program
Residential	Clear Skies Program		Energy Tax	

biomass-based systems	(UK) Biogas Development Subsidy (China)		Exemption (Sweden)	

5 Selected Detailed Case Studies

(Note: the links marked "full text" are included in the case studies below, following this section 5; the others are external links)

5.1 First Nation Projects

Canada: Oijé Bougoumou (Biomass District Heat)
This Quebec First Nations project uses a revolving fund to finance the extension of a district heating system to newly constructed homes. The money saved by avoiding the use of heating oil is recycled into the fund to be reinvested (full text).

United States: Native Americans Tap North Dakota Wind with US Department of Energy Funding Assistance

5.2 Distributed Energy in Developing Countries

The Indushree Power Project in Raskat, Himachal Pradesh
Raskat, in Himachal Pradesh, is a typical 'remote Indian village in the hills: lush, green, and small, with no more than 15 homesteads accommodating a small populace of 100, and frugal in basic facilities. Since August 2002, it has been the source of reliable and quality electric power supply to the inhabitants of a dozen adjoining villages (full text).

Chile's Rural Electrification Program
Chile has seen electrification as a key measure in alleviating poverty in rural areas: in 1990, nearly 240,000 rural households—more than one million people, or almost half the rural population—had no access to electricity (full text).

5.3 Community Wind Power Projects

The following links provide case studies on "grassroots" initiatives that enable wind power projects with support and financing from community groups, providing specific benefits to the local economy that do not occur in most other financing arrangements.

Denmark: The Middelgrunden project was once the largest offshore wind farm in Denmark, and was erected right in front of Copenhagen harbor, largely due to the involvement to a wind ownership cooperative (full text).
Canada: Toronto's WindShare Turbine
UK: Community-owned wind turbine in the Dulas Valley (Wales)
United States: COOPERATIVE WIND: How Co-ops and Advocates Expanded Wind Power in Minnesota

5.4 Corporate Investment in North America

Canada: The SunBridge Wind Power Project (Saskatchewan)
Saskatchewan's first wind farm of 11 MW is a $22-million project, financed through a 50/50 partnership between Suncor and Enbridge, Inc. It is a good example of how government purchasing can provide an incentive for industry to develop green power (full text).

Canada: Erie Shore Wind Farm, Ontario
The Erie Shore wind farm is a brand new renewable energy project financed by the Clean Power Income Fund. This case study explains what criteria the Fund looked at before it invested in southern Ontario's largest wind farm (99 MW) (full text).

United States: Madison Windpower Project, New York
The Madison wind farm started producing in 2000. It is unique as it is fully owner-financed, and draws upon renewable energy certificates for part of its income. Having received funding from the New York State Energy Research and Development Authority, it is also a good example of public-private cooperation in the renewable energy sector.

5.5 Private Initiatives to Advance Distributed Renewables

UK: EcoCentroGen: The Low-Carbon Distributed Energy Utility
Established in 2001, EcoCentroGen (ECG) is an energy service company (ESCO) in Britain. Funding for its business comes from the British investment community, but projects have also been implemented in other countries (full text).

Case Study 1: First Nations and Renewables

The Oujé-Bougoumou Biomass District Heating Facility (Quebec, Canada)

Description of the Project

The Oujé-Bougoumou community is Cree Nation village in northern Quebec built between 1991 and 1995. The community planning and construction efforts were guided by a traditional philosophy of sustainable development. Among other innovations, the community installed a state-of-the-art biomass fuelled district heating system to provide space heating and domestic hot water for the entire village, using waste sawdust from nearby sawmills as a fuel. The new village, in general, represents a translation of traditional indigenous values into the context of contemporary technological possibilities. The Oujé-Bougoumou community received several noteworthy awards from the international community for its accomplishments and vision. The key features of the distributed heating system are:

- installed in 1993;
- 135 homes and 16 public buildings;
- homes rated above the Canadian R-2000 building energy efficiency standard;
- two biomass boilers, plus oil backup boilers;
- distribution system consists of 600 m of steel pipe, 2,300 m of plastic pipe (PEX);
- typically consumes 3,000 to 4,000 tonnes of sawdust per year;
- costs C$25,000 per year in fuel for the entire village; and
- energy meters are installed at each household for billing purposes.

The three main contributors to the success of this project were:

- **Oujé-Bougoumou Community:** investigated how to best use its funds for constructing a new village, and wanted to achieve a more sustainable community by using renewable energy.
- **Natural Resources Canada (NRCan):** Government staff, under the direction of Michael Wiggin, had begun to develop some considerable expertise in the area of district heating and district cooling having been involved in a number of such projects in Canada. NRCan was contacted for technical assistance by the Cree Nation, and also provided funding.
- **Hydro-Quebec electric utility:** Hydro-Quebec generates, transmits and distributes electricity in Quebec. Hydro-Quebec was strictly a financial contributor to this project.
- **FVB Energy**: FVB is an international engineering firm in the energy field. In this project, FVB provided services such as market assessment and feasibility analysis, conceptual and detailed design of the whole district heating system and the commissioning.

The Decision-Making Process

The values of the community of Oujé-Bougoumou are very much focused on sustainability and the decision-making in the district heating project, as well as the development of the whole village, was governed by such principles.

The community first began to talk in 1986, in very conceptual terms, about the possibility of a district heating system fueled by biomass. They had seen such a system installed on a military base and it seemed much more economical. Furthermore, the biomass fuel, sawdust, was readily available in the region. In fact, sawmills in this area of Quebec are burning much of their woodwaste in big beehive-type burners, utilizing only a small amount of the biomass to produce heat for their processes.

A first pre-feasibility study was performed by a management and engineering firm with which the community had had some previous contacts. The results of this initial study suggested that the cost of installing such a system would be prohibitive. The community leaders, however, because they had done some research on their own and because the firm had minimal experience in district heating, decided to seek a second opinion for the sake of the potential benefits they had identified for the community.

This is when they contacted NRCan for technical assistance. The NRCan team at the time was quite familiar with the latest technologies available in the field and was in contact with various professionals who possessed up-to-date expertise. The work of the NRCan team helped the community leaders take a more informed decision.

It is important to say that the decision to go forward with the project was governed by sustainability principles and not just short-term economic return. Such things as environmental impacts, community development, employment generation, impacts on the local housing program and long-term generation of income for the community were all part of the decision process. It was the interest in these potential benefits to the community, which was the driving force behind the community's exploration of the feasibility of such a system.

The Benefits

The main benefit of the biomass solution came from local ownership and substantial savings in operating costs. Community members pay a defined amount of money for their energy services. By reducing the operating costs of heating homes, a greater portion of the funds received for energy services becomes available for the purpose of future housing construction. An important contribution is thus made to the community goal of self-sufficiency in the area of housing. Other benefits of biomass district heating for the community are:

- Money spent on energy services remains in the community, rather than being paid to external companies. Future community development projects could thus be financed internally.
- The project offers long-term hedging against increases in heating costs, since conventional energy costs are on the rise.
- Employment creation within the community for plant operation, delivering the biomass fuel and reading the meters. There was no employment associated with conventional heating.
- Emissions from the biomass system will reduce the production of nitrogen oxides by approximately 35 percent or 160 kg and carbon by 200 tonnes the first year compared with an oil-fired system.

Financing

The total initial cost of the biomass district heating system was approximately C$2.4 million, with approximately half of that amount spent on the distribution system. The average annual cost of the 3,000 to 4,000 tonnes of biomass fuel is C$25,000 and the oil backup boilers are hardly used at all.

At the early stage of the project, the community submitted a request to a federal energy efficiency program for funds to carry out an economic feasibility study of such a system in the new village. However, because the new Oujé-Bougoumou village was to be situated near an existing hydroelectric grid, it was deemed ineligible for program funding.

The community then decided that it had an obligation to contribute to its own future development by dedicating a substantial amount of resources from its own funds: a grant that was part of a socio-economic development fund, received as an agreement with the federal government, which could be used at the discretion of the community.

The community was also able to secure additional important contributions from NRCan and Hydro-Quebec. NRCan, besides its significant technical assistance, contributed approximately C$100,000 to finance the engineering costs. Hydro-Quebec participated with a contribution of approximately C$300,000 for the system. The amount was based on the utility's avoided cost from an improved grid connection for the extra power that would have been required if electric space heaters and water heaters had been chosen instead of the biomass district heating system.

Again, sustainability was key when planning the financing of the operational costs of the district heating system. The community of Oujé-Bougoumou has put up a revolving fund in order to finance its housing needs in a sustainable way. This revolving fund was designed to finance the total construction cost of five to seven new houses annually. The payback process of the revolving fund is the following:

- The owner is only required to pay back 50 percent of the total construction cost of his house,
- The Oujé-Bougoumou community housing program requires the owner to pay 25 percent of his revenues to pay for the loan as well as the other housing costs, including energy supply, until the loan is paid back.

One can see that the rate of reimbursement of the fund is primarily a function of the owner's income and the energy cost. The biomass system, which has operating costs that are only a fraction of that of a conventional energy solution (refer to Table 4), leaves more money in the fund for other future community developments (including the expansion of the district heating system). Again, this was certainly the major benefit of the biomass solution.

TABLE 4 Comparative costs of producing 1.0 MW of heat from different energy sources

Electricity from Hydro Quebec at 1993 rates	C$71.80
Oil at approximately 25 cents/liter	C$30.64
Biomass, the sawdust from the nearby sawmill	C$ 2.44

Source: Duncan Varey, District Heating Coordinator of the Oujé-Bougoumou project

Achievements

The Oujé-Bougoumou leaders and elders achieved their goal of more a sustainable community at various levels. The biomass district heating system was a very important tool in achieving this goal. However, the community's vision does not stop here as they intend to push the contribution of renewable energy further in a near future. They will soon be interviewing potential partners for a run-of-river hydro project near the village. The plan, at this early stage, is to identify a partner to finance the project on the community's land and share the surplus revenues from power sales to Hydro-Quebec with that partner.

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Similar Project: KLUANE FIRST NATION, YUKON – BIOMASS DISTRICT HEATING
The Kluane First Nation is located in Burwash Landing, Yukon, about 300 kilometers northwest of Whitehorse. The community is on mile 1093 of the Alaska Highway and is home to approximately 80 residents.

In order to reduce the dependence and possible price fluctuations of imported heating fuel, in 1998, the Kluane First Nation installed a central heating system to provide hot water and heating to four community buildings using locally harvested wood.

Kluane First Nation
Burwash Landing, YK
phone: +(867) 841-4274

Source: http://www.ontario-sea.org/pdf/FirstNationReportFinal.pdf

Case Study 2a: Distributed Energy in a Developing Country (India)

Small hydropower plants in operation in India: *The Indushree Power Project in Raskat, Himachal Pradesh*

Raskat, in Himachal Pradesh, is a typical 'remote Indian village in the hills'—lush green, small, with no more than 15 homesteads accommodating a small populace of 100, and frugal in basic facilities. Since August 2002, it has been the source of reliable and quality electric power supply to the inhabitants of a dozen adjoining villages. With support from the MNES (Ministry of Nonconventional Energy Sources), the UNDP (United Nations Development Programme), and GEF (Global Environment Facility), a micro-hydropower project, based on the Raskat Nallah was commissioned here in August 2002.

This 1 MW small hydro resource initiative has brought light, and hope, to nearly 700 homes in 12 remote, inaccessible villages in and beyond Raskat. The powerhouse supplies electricity to the villages of Pulga, Kalga, Barshani, Tosh, and Sheela located in the upper reaches of the Parvati valley, connected to the mainland with a dirt road passable only in fair weather.

The village power plant employs ten persons, including a supervisor, four technicians/engineers, a manager for operations and electrical maintenance, an assistant manager for civil works, and three helpers. All employees are from the region.

The Indushree Power Project in Raskat, Himachal Pradesh, one of the north Indian mountain states, is one of the 20 demonstration projects being supported in the hilly states of India under the $7.5 million MNES/UNDP/GEF initiative on Optimizing Development of Small Hydel (hydro) Resources. The project seeks to popularize the use of small hydro energy resources to address the issue of protecting biodiversity and global warming. The overall objective is to upgrade the institutional and human resource capabilities at the local and national levels. To date, master and zonal plans have been produced for 13 hilly states of India and over 2000 sites have been identified for small hydro development.

The reliable 24-hour power supply has created earning opportunities for other enterprising villagers as well. More than 40 electric-powered ropeway trolleys have been put up within the 20-kilometer radius of the Raskat micro hydro project. These ropeways, constructed at a unit cost of 1,000,000 Rupies, carry general supplies, farm commodities, and other goods to and from the Raskat market for the villagers from their homes atop the hills. The savings for the villagers in time and effort have been enormous, making the ropeway trolley business a runaway success.

Not a single tree was cut while putting up the project. Indeed, to keep the frequent landslides from damaging the project site, thousands of trees have been planted on the loose rocky terrain around the site.

By Manu Avinash and Krishna Kumar, College of Engineering, Trivandrum, India

(This article was abridged from the Energy Saving Now web site)

Case Study 2b: Distributed Energy in a Developing Country (Chile)

Chile's Rural Electrification Program (Programa de Electrificación Rural, PER)

Chile has seen electrification as a key measure in alleviating poverty in rural areas: in 1990, nearly 240,000 rural households—more than 1 million people, or almost half the rural population—had no access to electricity. Its rural electrification program includes subsidies designed to be consistent with the broad principles of energy reform: decentralization of decisions to the regional and community level, competition (between technologies as well as suppliers), and a requirement that all partners in the process—users and private companies as well as the state—contribute to the financing of expansion projects. The short-term result: an increase in rural electrification of about 50 percent in the first five years of the program (1994 to 1999).

The Outset

The lack of access to electricity was concentrated in a few regions where most of the rural population lives. It affected mainly lower-income families, since the wealthier could usually afford to install generators or pay for extension of the distribution grid. Rural electrification in Chile had traditionally been the responsibility of state-owned power companies, which followed centrally developed plans and relied on subsidies from the central government or cross-subsidies from tariffs set above cost in urban areas. Lack of funding and more pressing priorities had resulted in slow progress: rural electrification only increased by 14.8 percent between 1982 and 1992.

Then, in the 1980s important changes in the administrative organization of the country and in the electricity industry brought an end to the former mechanism. Chile liberalized its markets, privatized state-owned electricity companies, and allowed the private sector the key role in investment. Before selling the electricity companies, the state split them into generation and transmission companies and distribution utilities. The distribution utilities were divided according to the areas in which they operated, but no exclusive distribution rights were granted. The National Energy Commission (*Comisión Nacional de Energía*—CNE) was created as the main policymaking and regulatory body. A new electricity law established free entry and competition in generation, a nonexclusive concession system for distribution, and a pricing scheme based on marginal costs, with generation charges reviewed every six months and distribution charges every four years.

The national government had traditionally been highly centralized, which tended to concentrate decision-making and wealth in the capital and the main cities and promoted rural-urban migration. To counter these forces, in the 1970s, the country was organized into twelve regions and a metropolitan area for the capital, Santiago. The new regional governments acquired growing decision-making rights in such matters as allocating the state investment budget among projects and designing and implementing regional development programs. The role of the central government increasingly became to define national policies, design policy tools, and provide investment funds to the regional governments.

The Program

To increase rural access to electricity, Chile launched the Rural Electrification Program in 1994. Like many rural electrification projects, the program has had to address these challenges: how to ensure sustainability, how to avoid politicization and corruption of the process (and subsidy delivery mechanisms), how to develop ways to deliver service to isolated communities, and how

to involve the private sector. The program set up a special fund to competitively allocate a one-time grant to private electricity distribution companies to cover part of their investment costs in rural electrification projects. Operating costs have to be financed with tariff charges set by the regulatory authority. Bids are conducted annually. To apply for a subsidy, companies present their projects to regional governments, which allocate funds to those scoring best on several objective criteria: cost-benefit analysis, amount of investment covered by the companies, and social impact. The central government allocates the subsidy funds to the regions on the basis of two criteria: how much progress a region made in rural electrification in the previous year and how many households still lack electricity. Regional governments also allocate their own resources to the program. The program is based on four main principles:

1. **Decentralized decision-making:** regional governments identify needs, choose the solutions, and participate in the decisions on the allocation of central funds. To involve local communities, the program requires that projects be requested by organizations, rather than individuals: communities in areas lacking electricity supply generally propose the rural electrification projects, supported by local distribution companies interested in providing the service. The central government provides economic resources and technical assistance and help coordinate the institutions involved in the program. It also provides the criteria and tools for evaluating projects to ensure coherent decisions and efficient allocation of investment resources.
2. **Joint financing:** To ensure sustainability, all participants—the state, the electricity companies, and the users—contribute to the funding of investment projects. The state's participation is needed because rural electrification projects usually are unprofitable for electric utilities, as a result of low electricity consumption, the distance from distribution centers, and the dispersion of dwellings. Subsidies are only allocated only to projects with a positive social return. The state's contribution, delivered through the special fund, also covers expenditures related to managing the overall program. The private sector owns and operates the energy facilities.
3. **Competition:** There is competition for funding among projects proposed by different rural communities, among distribution companies interested in supplying these communities, and among regions requesting funds from the central government. The rules for deciding among competing projects are transparent and stable, established by the central government. They consider the average cost required to provide a certain quality of service, the local electricity needs, and the sustainability of proposed solutions. Priority is given to zones showing the capacity to implement the program. Zones with high poverty and low community involvement, where sustainability is more likely to be a problem (particularly where self-generation is used), would initially require more institutional assistance.
4. **Appropriate technologies:** For solutions to rural electrification needs, the program would consider not only extension of the existing distribution grids but also other technological alternatives. These alternatives, mainly for self-generation in isolated communities, include:
    - photovoltaic solutions for isolated rural dwellings,
    - hybrid systems that reduce fossil fuel dependence and operating costs,
    - small hydroelectric power stations, independent or combined with other energy sources, and
    - experimental solutions based on wind power and biomass systems, which would require a resource assessment before being implemented.

    If technically and economically feasible, the first choice is to provide service at the standards offered by the distribution grid (AC current of 220 volts at 50 hertz, with twenty-

four-hour availability). Where the costs of this solution are too high, alternative technologies are considered. To ensure sustainability in these cases, all costs over the life of the projects need to be considered in the appraisal, as well as organizational schemes for operating and maintaining the projects

Successes

The Rural Electrification Program was launched in November 1994, with a target of providing 75 percent electrification by the year 2000, and 100 percent after ten years (now revised to 90 percent by 2006). Administered by the National Energy Commission, it has increased the coverage of electricity systems in rural areas from 53 percent in 1992 to 76 percent at the end of 1999 (see **Figure 5**). In addition, the program has promoted social equity and improved the living conditions of the poor. It has also shown that it is possible to create market incentives that lead to efficient private solutions to rural electrification—an important lesson at a time that so many developing countries are reforming their power markets and privatizing their state-owned electric utilities.

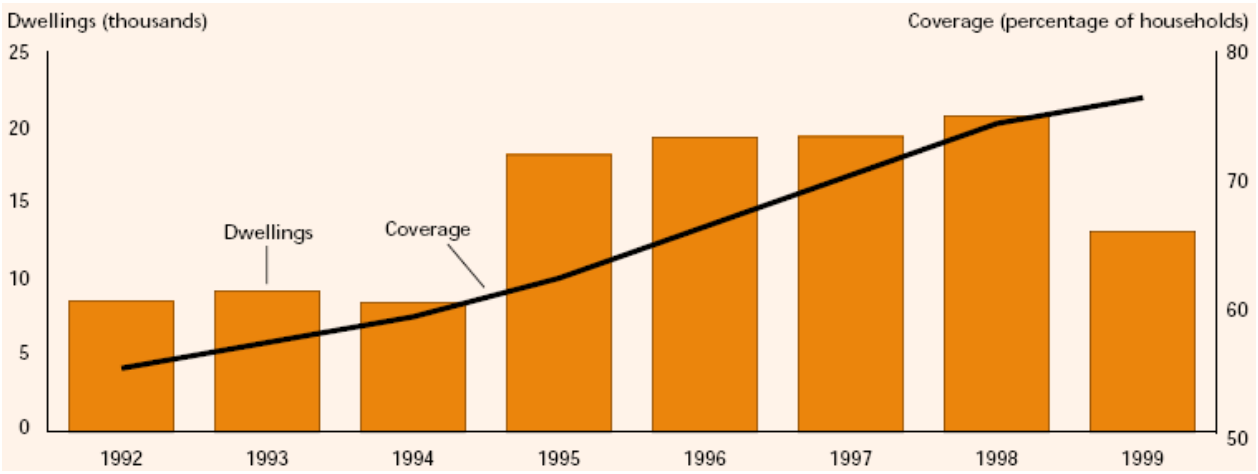

Figure 5 Increase in rural electrification under the Program, from 1994 to 1999
Source: Chile National Energy Commmission

Regional governments have managed the program well. They have promoted the program among communities, provided basic assistance in preparing the projects, decided which would be implemented, and allocated resources accordingly. They have also coordinated and monitored the implementation of the projects. Some regions—mainly those with the greatest needs and those in which rural electrification is more politically sensitive—have created special units for rural electrification, in some cases based on their experience in the field. Essential in involving regional authorities is the fact that success in the program has become a key political achievement.

The Rural Electrification Program also works in conjunction with other social programs, such as education and telecommunication programs, to bring computers into rural schools. As a result of the Rural Electrification Program, rural areas are seeing signs of economic development and an increase in the standard of living.

The Process

A community presents a project to its municipality, which then asks the distribution company to prepare a technical proposal, at no cost to the municipality, or contracts for this service with an independent consulting company. Once the proposal is prepared, the municipality lists the project in a publicly accessible register. Using the prescribed criteria and tools, the regional planning agency evaluates the projects, analyzing their economic and financial costs and benefits and calculating the contribution of the company and the subsidy required. Only projects with a positive social return but a negative financial return are considered for subsidies.

After being analyzed, the projects are submitted to the head of the regional government in a portfolio of all those meeting the minimum requirements. The head of the regional government then presents a proposal to the regional council, which has to allocate the state funds among the projects taking into account the number of beneficiaries, the unit cost, and the financing needs. The regional government then allocates the funds to the companies that presented the projects selected. Once a project has been implemented, the distribution company takes care of operation, management, and maintenance, recovering its costs through the tariffs charged to consumers, which are set by the CNE.

Financing

To achieve a rural electrification coverage of 76 percent by 2000, subsidies (grants) amounting to US$112 million were provided, somewhat less than the $150 million anticipated in the original budget. This covers subsidies from the special fund and resources allocated by regional governments. The investment cost subsidy cannot exceed the (negative) net present value of the project, and in any case has to be smaller than the total investment. This scheme allows a 10 percent real rate of return on investment over thirty years, similar to that used for setting tariffs for the projects. In 1995, the average state subsidy per dwelling amounted to US$1,080; in 1999 it reached US$1,510, while the absolute share of government investment decreased from 70 percent in 1992 (before the program) to 62 percent in 1999.

To ensure that the rural electrification program could achieve its goals, a separate fund was created in 1995 to provide additional resources. The fund could be used to finance projects (grid extension or self-generation), feasibility studies, and preparation of project portfolios. To encourage regional governments to invest their own resources in rural electrification projects, it was decided that the special fund would be allocated among regions on the basis of their achievements in rural electrification in the previous year and the number of dwellings still lacking electricity.

Private distribution companies are required to invest at least the amount calculated for each project using a pre-defined formula set by government, to avoid such risks as “goldplating.” The company must operate the projects once they are built. Private investment in the program totaled US$60 million by 1999, and contributed about 30 percent to overall project implementation costs.

Users have to cover the costs of the in-house wiring, the electric meter, and the connection to the grid. These expenditures, about 10 percent of the costs of each project, are initially financed by the distribution company and then recovered from the users over time. Once the project is operating, the users have to pay the regulated tariffs.

Grants from international organizations have also been used in the program, especially for experimental projects based on self-generation systems using alternative energy sources. Starting at the end of 2001, the UN Global Environmental Facility (GEF), provided financial

assistance for renewable energy projects in rural Chile. Since then, a pilot wind-diesel installation has been completed on an island with 72 families, as well as several feasibility studies for other remote locations. In northern Chile, an initiative to install 6,000 residential solar PV systems started in 2003, linked to the creation of local cooperatives for the maintenance of these systems. A first micro-hydropower station was inaugurated in 2002, and four more were installed in 2003, with feasibility studies for several other locations underway. In September 2003, the Inter-American Development Bank approved a US$40 million loan to support rural electrification in the three poorest regions of Chile, using both conventional and non-conventional power sources.

Use of Renewable Energy Technologies

Most of the projects have involved extension of the grid, a solution that usually means a lower cost per connected dwelling and a higher quality of service. But several projects have relied on alternative technologies, primarily one-house photovoltaic systems. These systems have been installed in isolated areas in the northern part of the country (nearly 1,000 dwellings by 2000), which has some of the strongest solar radiation in the world. Micro wind, biomass, and hydropower generators have been used as well, mainly in the southern part of the country. Wind and biomass technologies have been used in experimental projects and usually with technical assistance from international organizations, given the lack of experience with them in Chile and the need for further research on the availability and sustainability of these energy sources

The non-conventional technologies generally provide electricity at a higher cost and poorer quality (lower voltage, fewer hours of service). But they have been an attractive alternative where extending the grid is too costly because of the distance from the existing grid or the high dispersion of dwellings. Both these causes have increased the marginal cost of rural electrification in Chile.

Since the signing of bilateral agreement in 1994, the US National Renewable Energy Laboratory (NREL) has worked with the Chilean *Comisión Nacional de Energía* (CNE) to help integrate renewable energy into its rural electrification program. This work has recently expanded to include cooperation with the Chile's National Forestry Agency and Chile's participation in the IES program.

NREL has provided significant technical support to CNE to help them integrate renewable energy and efficiency into their rural electrification programs, including training in resource assessment, power system design, and the use of NREL hybrid system design software; power system implementation; and site visits and consultations. NREL's will leverage this technical assistance with a new UNDP/GEF program to remove barriers to the use of renewable energy for rural electrification.

Likewise, the United Nations Development Programme has supported Chile in enabling renewable energy technologies since the year 2000. This project assists in removing barriers to the use of Nonconventional Renewable Energies (NCRE) within the framework of the National Rural Electrification Program of Chile, by developing a set of activities that will allow for a decrease in the greenhouse gas emissions produced by energy sources in rural areas and improve the living conditions of rural communities. By means of co-funding and a financing mechanism, approximately 10,370 households out of a total household market of 74,000 will be supplied with electricity. This project also aims to generate, within rural electrification, the market conditions that will allow for the reduction of emissions produced by diesel-fuelled electricity systems. The desired effect is to establish the market conditions for the NCRE to develop in rural and urban areas.

Lessons Learned

An innovative aspect of the program has been its promotion of rural electrification in a competitive environment dominated by private companies. It has successfully introduced competition at several levels: among communities, for financing for their projects; among distribution companies, for implementation of their projects; and among regions, for the funds provided by the central government. The participation of private distribution companies has been critical to the program's success. From the companies' perspective, rural electrification is a long-term business and riskier than traditional distribution. Customer payments, even with generally low default rates, are usually small, while operating and maintenance costs are high compared with those for urban distribution. Companies expect consumption to increase gradually, as users realize the potential of electricity for income-generating activities (for example, for water pumps, cooling installations, and processing plants for agricultural, fishing, and forestry products). But given the lack of exclusive distribution rights, companies have seen participation in rural electrification as a strategic move to protect the existing distribution area and discourage entry by competitors.

While renewable energy systems have played an important part in the program, these technologies have not lived up to the initial expectations of planners in 1996. Several factors are responsible for this situation, including:

- The project selection mechanism used in Chile focuses on short-term costs of electricity which are lower for conventional fossil fuel-based power plants than for renewable projects. It fails to give adequate incentives for long-term planning and decision-making necessary for sustainable energy development. Pollution and other environmental consequences are not reflected in energy prices of conventional fossil fuels.
- Lack of technical expertise in utility managers and maintenance staff, due both to personnel turnover at the utilities themselves, and to the lack of continuity from the implementation stage to execution and long-term management
- Wide financial shortfalls of the renewables projects, due to high maintenance costs, combined with monthly user charges which do not provide sufficient cash-flow to cover them;
- General user dissatisfaction, resulting from the low capacity of the systems installed and from feelings of unresponsive service from distribution companies.

One distribution company, Emelectric, is actually considering the feasibility of building lines to the areas currently served with solar energy, in order to solve these problems while also complying with its 20-year service guarantee with the regional government. At the same time, a number of prescriptions, both technical and managerial, might be implemented to improve the future performance of renewable energy systems within the structure of the PER. Some of these are in fact being attempted in other regions:

- instituting long-term maintenance contracts with firms specializing in renewable energy technologies (Region IV);
- subcontracting project implementation and management to provide continuity (Region X);
- defining large blocks of installations targeted for renewables, in order to provide an economically attractive user base (Region X).

Based to a large part on "A case study on subsidizing rural electrification in Chile," by Alejandro Jadresic, former Minister of Energy in Chile.

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Case Study 3: Denmark – Wind Power Community Groups

The Middelgrunden Wind Turbine Cooperative, Copenhagen Harbor

Description
The Middelgrunden Wind Turbine Cooperative was, when formed in 1997, the world's largest wind energy cooperative, and the project was to be the largest wind farm worldwide based on dual ownership, and the largest offshore wind farm in the world. The Middelgrunden wind farm consists of 20 wind turbines of 2MW operated offshore just outside Copenhagen's harbor. The turbines have a diameter of 76 m on a hub height of 64 m. They are installed in a shallow area where water depth ranges from three to six meters.

The 100 GWh produced annually represent approximately four percent of the residential energy needs of the city of Copenhagen, Scandinavia's largest city.

Background
Private investors have played an important role in the development of Denmark into a strong wind nation from the very beginning. Today, 20 percent of its total energy needs are fulfilled by wind power and private investors are alone responsible for 86 percent of it. In fact, more than 150,000 Danish families are members of wind turbine cooperatives. It is culturally a common thing to think of a cooperative when planning a wind farm in Denmark.

Wind cooperatives have the incentive of a tax rebate, allowing tax-free income from renewable energy systems up to a certain limit. The revenues above that limit are granted a lower income tax than normal. Other government incentives that profited the Middelgrunden project were the high Danish feed-in tariff fixed for 10 years and the 8 percent target for renewable energy of the City of Copenhagen.

There has been a recent change in government in Denmark and the new authorities are in the process of changing the rules of promotion for renewable energy in general. They will likely shift toward a market price with green certificates. This has brought uncertainties and the installation of new wind capacity in Denmark has been postponed until more information is available.

History
The Middelgrunden wind farm project was initiated in 1996 when the Copenhagen Environment and Energy Office had identified the wind power potential and took the initiative to propose and organize the project. They took the first step to investigate the feasibility of an offshore wind farm at Middelgrunden and formed a working group involving citizens interested in wind energy. This initiative then led, with strong public support, to the formation of the cooperative in 1997. It took two years of negotiations to convince the power utility of the potential of the project and to arrange a contract between the cooperative and the utility. The final approval was given in 1999 allowing the construction to start the next year.

The strength of the partnership was put to work right from the start of the project when there was a huge need for investigations of the visual and environmental impact. The site's proximity to Copenhagen had left many politicians and citizens concerned about the impacts on the city as well as on the environment. It is probably the effort made by the cooperative and Copenhagen Energy right from the beginning to secure local acceptance that made the project possible. Indeed, the multifaceted group that was formed by the cooperative and Copenhagen Energy

provided particularly good contacts with the public, the media and the different stakeholders on one side, and good support from the municipality on the other. It is in the process of argumentations, however, that the original project of 27 wind turbines was downgraded to 20 because of concerns regarding the visual impact of the project.

The whole project was developed by the cooperative and Copenhagen Energy, which were to own and manage 10 turbines each after the end of the construction phase. Today, and since the production started January 2001, each partner runs a separate business, but during the construction phase all costs and revenues were shared equally to avoid conflicting interests as to which turbines were to be installed first.

The cooperative uses the consulting services of the Copenhagen Environment and Energy Office for the administration of its 10 turbines and SEAS, a consumer-owned wind consulting company, is still greatly involved in the technical side of the project, especially with the various problems that occurred concerning the transformer and switchgears.

Financing

The source of funding of cooperative is the sale of shares. Each share in a wind project entitles the owner to an average annual production of 1 MWh of the electricity produced. In total, 40,500 shares were sold to the members of the cooperative, with most members holding exactly the five shares required to qualify for a simplified tax return and a tax break worth 3,000 DKK per year.

The initial price for one share was €567 and is now subject to free trade. For the Middelgrunden cooperative, it was important to sell the totality of its shares before commissioning, as it cannot contract any debts, subject to its own bylaws. In fact, all shares sold were paid upfront to cover the expenses. More than 40,000 shares were sold over a three-year period before 2000, and the rest were easily sold once the project was closer to realization. At the early stage, before permits were obtained and the project became a reality, the wind cooperative financed its work by selling pre-subscriptions, at €7 per share. Nearly 30,000 shares were reserved that way.

The economic risk in the project was minimal as the Danish Electricity Act guarantied a price of 0.6 DKK/kWh (approximately €0.08) for the first 12,000 full-load-hours (12,000 full-load-hours equal six years of operation at Middelgrunden). A minimum sales price of 0.43 DKK/kWh (approximately €0.057) is then offered for 10 years. To be eligible, however, the project had to be approved before the end of 1999; it was approved on 13 December 1999.

The expectations were that the project would give an attractive economic return by dividing the profits equally among all shares. It is important to note that, in Denmark, the first 3,000 DKK (€400) of revenue from renewable energy production is tax-free. In the case of the Middelgrunden cooperative, that represents approximately the revenues from five shares. The extra revenues above that limit are subject to a reduced income tax rate of 30 percent. This tax incentive and the cultural appreciation of renewable energy may well explain the popularity of private investment in renewable energy in Denmark. It represents a good return on investment and a means of reducing the income tax burden, which is around 50 percent in Denmark.

The only direct contribution from the government to the project was a loan granted by the Danish Energy Authority, which was used to finance the extensive feasibility study of the Middelgrunden project.

Local Ownership
Local commitment to the Middelgrunden project has proven a key factor in carrying through this wind development. Without the involvement of local people the Middelgrunden project would have never succeeded. The benefits of local ownership in the project of the Middelgrunden wind farm are:

1. **Education and awareness**
   During the establishment of the Middelgrunden project, more than 50,000 people received information directly and more than 50,000 people visited the Middelgrunden homepage. For many people electricity suddenly was something that did not just come out of the socket.

2. **Dialogue and discussions**
   Through dialogues with different interest groups, Copenhagen Energy and Environment Office and the Middelgrunden Cooperative, with its 8,500 members, generated a widespread understanding for and social acceptance of the chosen location and layout of the farm.

3. **Conflict resolution**
   The Middelgrunden working group avoided or solved potential conflicts by taking direct contact to various local interest groups at an early stage in the development of the project.

4. **Generation near the point of use**
   The grid loss is minimized by local electricity production. In Denmark, the average grid loss is 9 percent of the electricity production; in some countries it goes as high as 17 percent. The loss inside the Middelgrunden wind farm is 2.7 percent, and including the cable to the shore and distribution the loss is less than 5 percent.

   The table below summarizes the roles both the cooperative and Copenhagen Energy have had in making this project a successful one.

	The Cooperative	Copenhagen Energy
Role to make the project successful	• Active and committed members • Political contacts • Active dialogue with all stakeholders (authorities, organizations, fishermen, etc.) • Active involvement of the media • Direct dialogue with the authorities • Large public support	• Denmark's largest municipal-owned power utility • Good and direct contact to the municipality • Technical back-up organization • Wind technology expertise of SEAS Wind Energy Centre • Easily available financing resources • Trustworthy partner

The Actors around the Middelgrunden Project

Middelgrunden Wind Turbine Cooperative	**Private cooperative of 8,552 members sharing the total 40,500 shares** Owner of the 10 southern turbines Development of the project
Copenhagen Energy Wind	**Copenhagen energy utility wind division. Also a 50 percent owner of the Lynetten project in the harbor.** Owner of the 10 northern turbines Development of the project Technical contributor
Copenhagen Environment and Energy Office	Initiator of the project Feasibility investigations Early project organization Formation of the initial working group Administration and operation supervision for the cooperative
SEAS Wind Energy Center	**SEAS is a major consumer owned energy company in Denmark and has extensive experience in wind farm design both inland and offshore and in Denmark as well as abroad.** Major technical contributor
Bonus Energy	Contractor for the turbines
Siemens	Contractor for the switchgears and transformers

Achievements

The 40 MW wind farm was guaranteed to produce at least 89 GWh per year but production was expected to reach as much as 100 GWh per year. The first year of production was 2001, when 68 GWh were produced between March and the end of the year. It is important to note that 2001 was the worst of the last 22 years for wind availability; it represented only 80 percent of a normal year. In 2002, wind resources were 97 percent of a normal year and production was up to 100 GWh. Production suffered several partial and total halts in the first two years, mainly due to transformer breakdown problems. After four years of production, the wind farm efficiency was said to be very satisfactory. The figures showed that energy produced was up to the expectations.

Recommendations based on lessons learned and the issues raised

Recommendations for wind cooperatives on planning and organization of large wind projects:

1. People (potential shareholders, neighbors, interest groups, politicians, etc.) must be involved in the relevant parts of the project during the whole process.

2. Problems with local acceptance can be avoided if interest groups and authorities are contacted at an early stage.

3. It is essential to disseminate the appropriate information at the right time. Many initial reservations about the Middelgrunden project were due to fear of negative impacts.

Careful information campaigns and dialogue assured that the reservations did not develop into serious barriers for the project. For example, neighbors were invited on a tour to visit a modern wind turbine, which convinced them that noise would not be a problem.

4. Relevant and critical reactions should be taken seriously and it is also necessary to adapt the project in order to meet concerns. In the Middelgrunden project the design of the wind farm was changed. It cost an extra year of planning, but broad local support was assured in the end.

5. The Environmental Impact Assessment should be taken very seriously, and responses in the hearing have to be taken into account.

6. Large projects need a minimum amount of start-up capital—or require a large amount of voluntary work.

7. Be very careful when submitting the tender and writing up the contracts. The contractors, who constructed the foundations, claimed extra costs.

Similar projects

Samsoe offshore wind farm
The small island of Samsoe, in Denmark as well, has 100 percent of its energy needs covered by renewable energy. In fact, it produces far more green energy than it consumes in order to compensate for the fossil fuels used on the island, e.g., for transportation. The 2002 offshore Samsoe Wind Farm is locally owned and consists of 10 Bonus 2.3 MW turbines.

Kennemerwind wind farm
The Kennemerwind Wind Farm is a cooperative-owned wind farm built in the Netherlands in 1989. Kennemerwind, like the Middelgrunden project, did not use bank loans or debt financing. It raises all of its capital from members and consistently pays an annual dividend of 7 percent to shareholders.

Lynetten wind farm
Lynetten Windpower was built in 1996 onshore on a dike near the Copenhagen harbor during the main period of large-scale development, when most of the present Danish wind turbines were installed (1995–2001). It consists of 7 x 600 kW turbines and 50 percent of the turbines are owned by a cooperative.

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Useful links

The Middelgrunden Wind Turbine Cooperative

Danish Wind Industry Association

The Middelgrunden Offshore Wind Farm – A Popular Initiative

Case Study 4a: Corporate Investment in North America

The SunBridge Wind Power Project

Description

Saskatchewan's first wind farm is a $22-million 11 MW project, financed through a 50/50 partnership between Suncor and Enbridge, Inc. Suncor is best known as an oilsands producer, while Enbridge operates Canada's longest oil pipeline and is involved in natural gas distribution. The wind farm, located just southeast of Gull Lake, SK, uses 17 Vestas 660 kW turbines. It was in full commercial operation as of June 2003, with Enbridge Pipelines as the operator of the facility. The electricity produced is sold to the Crown corporation SaskPower, the major utility in Saskatchewan.

Motivation

There are four parties playing a role in the SunBridge project, and each one has its specific motivation for participation.

- SunBridge was stimulated by a 10-year, $12.4-million federal government commitment to support green power development in Saskatchewan through the purchase of green energy for federal buildings in the province.
- As the country's single-largest enterprise, the Government of Canada uses a lot of energy for its buildings, resulting in significant emissions of greenhouse gases. To cut down on its emissions, the government obtains some of the electricity to operate its buildings from sources that emit no or few greenhouse gases. The federal government committed to purchasing 25 GWh of electricity from the SunBridge project for its buildings in Saskatchewan.
- Power utility SaskPower found out that its customers desired to have option to purchase green power. Power from the project is therefore EcoLogo certified, a federal government designation granted to green power sources that meet or exceed all government and industry safety and performance standards for renewable energy. SaskPower has established a green pricing program that allows customers to sign up for "green" electricity from the wind power project.
- The corporate partners developing SunBridge have business strategies that call for renewable energy development. Enbridge wants to be a leader in the pursuit of renewable energy options that meet customer demand and have minimal impact on the environment. SunBridge diversifies Enbridge into a business that complements its core energy distribution and transportation platforms. As the operator of SunBridge, Enbridge also gains valuable first hand knowledge in this form of electricity generation. For Suncor, the project was the first major step in its plan to invest at least $100 million in renewable energy by 2005.
- For the electricity buyer , SaskPower, the project is a means for responding to increasing demand for electricity in its service area and the United States, to which it exports electricity.
- Canada was already a signatory to the Kyoto Protocol when the project was implemented. Climate change issues were one of the aspects that the developers wanted to address.
- The project does not benefit from the federal Wind Power Production Incentive, as many other wind projects in Canada do.

Finance
Utility SaskPower is purchasing the wind-generated electricity for sale to the Government of Canada and other customers in Saskatchewan. However, an important driver for this particular project was the commitment of the federal government to purchase about 80 percent of the electricity output of this plant for its own operations in Saskatchewan (in 2005, the government bought 32.4 GWh—i.e., about the complete output of the plant, for its operations in Saskatchewan). The Hon. Maynard Sonntag, Minister of Crown Investments Corporation, Government of Saskatchewan, praised the project as an excellent example of how public and private industry, supported by the commitment from the federal government, are building new relationships and developing strong partnerships that benefit the province's environment and economy.

Environment
Saskatchewan Environment and Resource Management (SERM) gave SunBridge permission to proceed with construction of the wind turbines and power distribution system. After evaluating the results of an environmental review, SERM and Natural Resources Canada were satisfied that all potential environmental impacts associated with the wind project development have been, or will be, addressed.

Prior to construction, SunBridge's management team completed an avian survey, a rare plants survey, and a Heritage Resources Impact Assessment to ensure the project's impact is adequately addressed, particularly in native grassland areas.

Future Projects
While the federal purchasing commitment was one of the drivers that helped the SunBridge project to attract corporate investment, many other projects are now going ahead under different arrangements. Suncor is investing in several other wind farms in Alberta and Ontario, and these projects benefit from long-term contracts at fixed, above-market rates (Ontario) or from the federal Wind Power Production Incentive, which adds 1 cent per kilowatt-hour to the market price obtained for electricity sold to the grid. However, the SunBridge project was the first of its kind in Saskatchewan and the federal commitment to purchase some of the output was clearly a catalyst to jump-start the wind power market in the province.

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Case Study 4b: Renewable Energy Investment Fund in North America

The Erie Shores Wind Farm (Ontario, Canada)

Description
The Erie Shores Wind Farm, owned by Clean Power Income Fund™ is an onshore wind project located on the shores of Lake Erie, in Ontario. Construction started in 2005 and the farm will have 99 MW, consisting of 66 GE wind turbines of 1.5 MW capacity each, by the time it is fully operational, which is scheduled for the second quarter of 2006. The power will be sold to the Ontario Power Authority under a 20-year Renewable Energy Supply Contract ("RES Contract"), as the developer was a successful bidder under the Government of Ontario's first Renewable Energy Supply Request for Proposals ("RES I") in fall 2004.

Clean Power Income Fund is a publicly-traded income trust (TSX: CLE.UN) which provides a long-term cash flow to investors from renewable electricity sources. The Fund invests only in power-generating assets that use renewable energy sources such as water, wind, wood waste and landfill gas. Clean Power is the first income fund to be certified under Canada's Environmental Choice™ Program, which certifies green power products from renewable electricity providers as well as other environmentally friendly products. The Fund's 44 facilities are located in 10 US states and 4 Canadian provinces and will have a total installed capacity of approximately 450 megawatts once the Erie Shores Wind Farm is completed.

Background
The Province of Ontario decided to phase-out all its coal plants by 2009 in order to improve air quality and reduce smog days in Ontario. Its new energy strategy identified renewable energy as one of the key components to secure future energy supplies. The government has therefore launched a series of Requests for Proposals, asking renewable energy developers to submit bids for electricity from renewable energy projects. This has created a market especially for wind power projects, since wind power in Ontario is often cheaper than other types of renewable energy. The average contract price for electricity from the ten renewable energy projects awarded RES Contracts in RES I was 8¢/kWh, and wind farms in Canada also benefit from the federal 1¢/kWh Wind Power Production Incentive.

Financing
The project was developed by AIM PowerGen, an established Canadian renewable energy development company. The entire financing of $186 million comes from Clean Power Income Fund, which owns 100 percent of the wind farm. The financing consists of non-recourse long-term debt and equity bridge financing. The Fund is eligible for all registered Canadian savings, income and deferred profit sharing plans, i.e., it competes for capital in the stock market with other business and industrial investment.

Particularities
The project is one of the largest wind farms in Ontario so far. Situated on Lake Erie, the location has a very good wind regime. It is also relatively close to existing transmission lines, and can therefore easily link with the existing electricity grid. The turbines will be installed on farmland, and each farmer receives a royalty for leasing a small portion of his land to the wind farm. The active involvement of the community and their leaders in Elgin, Bayham and Norfolk Counties has also contributed to the success of this project.

Investment Attractors

A number of aspects made this wind farm an attractive investment for Clean Power Income Fund:

- Wind monitoring over one year has shown the proposed site has a good, stable wind regime.
- The farm has obtained confirmation that it will be granted the federal Wind Power Production incentive, an incentive paid to eligible renewable power producers that amounts to 1 cent per kilowatt-hour and is paid to the producer for 10 years.
- The AIM Powergen management team is pursuing several wind power projects in Canada. Although the Erie Shore project was its first implementation, the management team had extensive project development experience and could convince the funders that it is able to complete the project.
- On average, Clean Power Income Fund's projects have power purchasing contracts of 16 years. For the Erie Shores project, the Ontario Power Authority has granted a 20-year RES Contract. The OPA is an organization that will be able to fulfill its commitment to purchase the electricity in the long term.
- The investment in the project will be accretive to the Fund (i.e., it will increase the distributable cash flow to shareholders), which is within the investment policy of the Fund.
- Project insurance package has been put in place for physical loss, liability, and business interruption (unscheduled repairs).
- The debt is paid back over a long term (20 years), which enhances investor income as compared to a project where gains are reduced due to faster payback.
- Project data and assumptions were confirmed through an independent engineer review.
- The turbine manufacturer (GE) is an established brand and provides a four-year services, operations and warranty contract on its systems;
- The farm will stretch over 29 kilometers and will touch several local communities. The turbines will be erected on farmland, and an agreement with the 25 farmers affected has secured the necessary local support for the wind farm.

Environment

Wind farms generally have very low environmental impacts. An environmental assessment was carried out and confirmed that the site is not expected to result in increased bird kills or other environmental problems. No significant NIMBY issues have been encountered to date.

Lessons Learned

To attract private equity investors or public entities such as Clean Power Income Fund, a renewable energy project needs to have a number of elements that reduce investment risks enough for an investor to decide to co-finance or finance the project:

- a power purchase contract that guarantees the long-term viability of the project until the initial capital investment has been recovered (generally at least 10 years) is a most valuable asset for a renewable energy project; in the best case, the purchasing contract defines a price for the electricity at which the plant can generate a profit, but some projects will also secure financing as merchant plants, based on expected market prices for electricity and any green power certificates or premiums obtained for the "greenness" of a project;
- the power purchaser needs to be an organization in good standing that is likely to be able to purchase the electricity produced over the length of the contract;
- an experienced management team that has a successful track record of pursuing and completing similar projects;

- a known and proven technology that bears low risks with respect to start-up problems, maintenance and repairs, i.e., the expected power output is very likely to be achieved;
- an attractive, accretive rate of return (higher than the average of other projects the investor has invested in)—as investments need to be able to compete in financial markets and should therefore provide a return of 12–18 percent for equity.
- a stable policy environment (such as a renewable portfolio standard) that favors renewables and does not change rules abruptly.

Apart from the above-mentioned aspects, some other elements also play an important role in funding decisions. One of these aspects is the general perceived attitude toward renewable energy systems. Government grant or subsidy programs, green power sales offers and similar activities that try to further green power are indicators that show an investor that a project developer has a better chance of implementing his project. Eligibility for "green label" certification, such as the Canadian EcoLogo^{M} or the American Green-e label increases the chances of selling power at a premium, and may increase the acceptance of the project in the community where it is built.

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Case Study 5: Private Initiatives to Advance Distributed Renewables

EcoCentroGen: The Low-Carbon Distributed Energy Utility

Description

Established in 2001, EcoCentroGen (ECG) is an energy service company in Great Britain that provides distributed energy systems for large residential and mixed residential/commercial developments. Being modular, the energy systems installed can be as small as 200 kW_{el} but the company is also active in markets up to 60 MW.

Traditionally, utility companies could only generate more revenue by selling more energy. ECG offers an alternative product based on a fixed monthly rate for a bundle of services (power, heat, water, Broadband, TV and telephony) for a residential end-user. ECG then educates and promotes incentives for its customers to use less energy. This way, ECG can make more from selling less and makes real inroads into energy conservation.

ECG provides part of the project funding towards design and construction of energy systems, and takes responsibility for the ongoing operation and maintenance of on-site energy centers producing power, heat, cooling and state-of-the-art data services, including digital television, telephony and high-speed broadband.

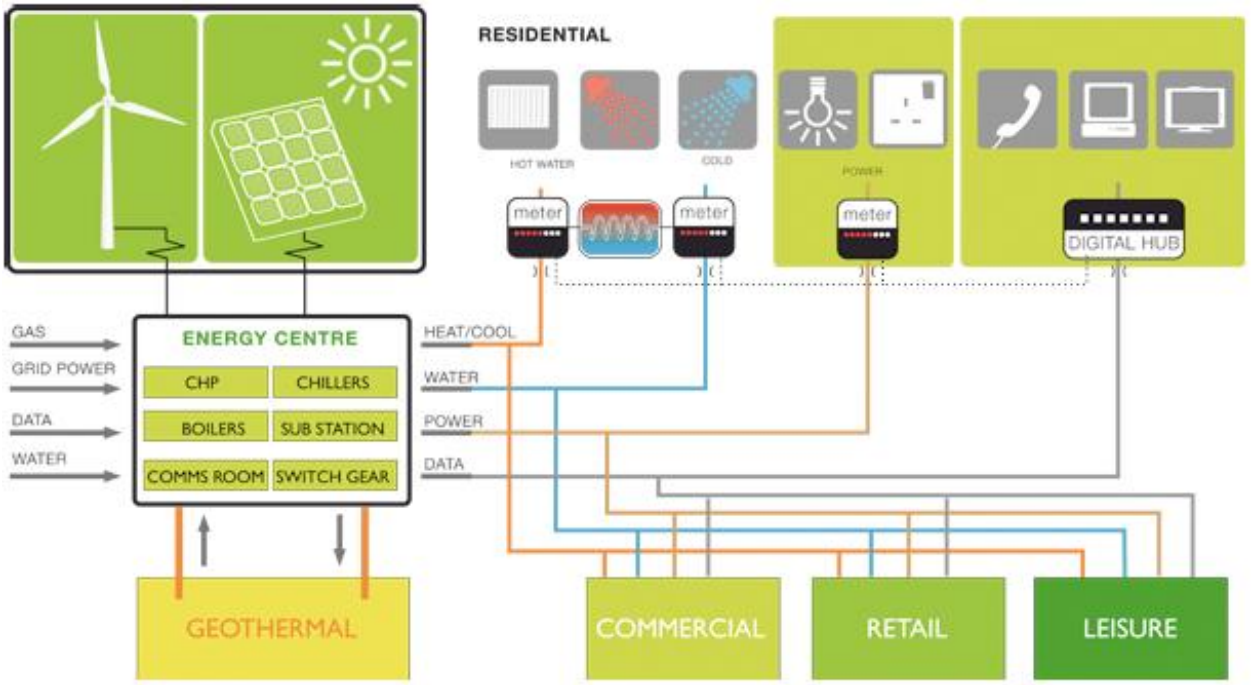

Figure 6 The ECG Energy Centre contains equipment to provide district heat, or link up with external renewable energy generation stations. It delivers electricity, heat and data services to the residential and commercial units in its service area.

The company establishes so-called Energy Centres (see **Figure 6**). These can be a simple power generation unit installed inside a power room or on top of the roof (solar panels), but can also require a separate building, or are installed below ground. The way funding is set up, there is no extra cost to the building owner, as all the incremental cost of renewable energy systems is

borne by ECG. The Energy Centres use a range of technologies, including combined heat and power (CHP), trigeneration (CHP plus cooling), wind, hydro, geothermal, biomass, waste-to-energy or photovoltaics.

Financing

The end user does not pay for any incremental installation cost of the alternative energy system, which is carried by ECG. ECG has a lease contract with the management company of the residential property, which allows it to use and service the Energy Centre. The company pays for any fuel and operating cost, and maintains the energy systems, recovering its cost through long-term performance contracts with the users. These contracts specify a transparent tariff review mechanism to link energy charges to market rates for electricity and gas. ECG bears all related costs, including

- primary fuel,
- operation and maintenance,
- life-cycle costs/plant replacement,
- insurance/administration, and
- metering and billing.

ECG offers its customers a discounted electricity tariff throughout the contract period: in agreement with the client, a "basket" of conventional electricity suppliers is selected, an average price calculated to establish the baseline, and a 10 percent discount to this price is provided to the customer, which then is tracked and reviewed on an annual basis. This ensures that customers always receive discounted low-carbon electricity. ECG is not supported by any government grants or incentives, such as the Clear Skies Program. The projects it implements deliver interesting rates of return, and the company has third-party private investment interests amounting to £225 million.

The Process

ECG obtains information on the project from the developer, and plans the details of the Energy Center. A contract with the developer delimitates both the responsibilities of ECG and those of the developer, in terms of providing infrastructure, installations, and other tasks. An Energy and Data Services Agreement between ECG and the Client gives ECG the contract and lease (for the Energy Centre and Comms room—see figure) to enable it to operate on the development for the agreed contract period, which is typically 30 to 40 years. Such agreements also contain details on services to be provided, response times in case of failures, and key performance indicators. Individual households pay their bills to ECG, and turn to ECG in case of any service interruptions for each of the services provided.

Help from Municipal Governments

Developers who are under the jurisdiction of the Greater London Authority are aware that unless they show an environmentally responsible approach toward low carbon/renewable technologies, the mayor could use his powers of veto to block their Planning applications: The mayor’s Energy Strategy and London’s Spatial Development Strategy require that buildings be designed with improved energy efficiency and renewable energy features. ECG’s service package can help developers address these issues without increasing construction costs.

Implementation Example: Manchester’s Budenberg Haus Projeckte

Urban Splash is a company redeveloping an old industrial site in Woodfield Road, Altrincham (Manchester) to provide 290 very high-quality apartments marketed to higher-income professionals wanting to live close to Manchester city center. The project’s architects are Foster

& Partners and their design generated a significant pre-launch interest in the development. ECG was commissioned by Urban Splash for the provision of finance, detailed design and the supervision of the construction of an energy and data services solution for the project. Plant construction of the Energy Center was geared to all 290 apartments.

The investment by ECG of £1.1m is being recovered from the residents and the landlord (or landlord's agent) in return for heat, electricity, and data services supplied. During the term of the agreement, ECG will:

- receive a fixed monthly management fee for plant operation,
- procure plant fuel supplies and imports of electricity,
- supply residents and landlord with heat, electricity and data services,
- maintain and operate the plant and equipment, and
- be given the opportunity under subsequent phases to further develop the facility on the same basis.

Urban Splash's key project requirement is for a low emissions energy solution and a data solution that 'pushes the boundaries of current technology'. Residents receive low carbon and low cost energy in the form of electricity and heat saving 10 percent over conventional energy costs.
Data and entertainment services include:

- Over 100 digital TV and radio channels
- 1 or 2 Mb broadband connectivity
- TV-based web browsing and e-mail
- Video door entry with on-TV picture-in-picture
- Telephony with TV-based caller ID & address book
- Community portal with local information and classified sections

Resident, developer and management company have access to customer services system with automated routing of all calls, e-mail and web communications with help desk facilities. The Energy Center includes 200 kWe of gas-fired CHP turbines as well as a gas-fired boiler plant.

Renewable Energy
ECG only works on large-scale projects (minimum 450 households; often large, mixed-use developments), which require three to four years from the approval of the master plan to the first occupation of the new homes constructed. As the company had only realized two projects by the beginning of 2006, no renewable energy systems were incorporated at this stage. However, these systems are included in the plans and will be added over time. The company is involved in 74 projects in total (10 of which are under development), which will include renewable energy systems once they are fully implemented.

The Argument for Distributed Energy Utilities
The distributed energy utility concept offers a range of advantages for developers, customers, and the environment:

- Because ECG provides financing towards the construction of the Energy Centres, there is a significant reduction in a developer's capital costs for the heating and cooling plant and data network.
- Because ECG owns the plant and equipment, they are responsible for its maintenance and the efficient operation of the Energy Centre, avoiding that end users have to care for maintenance, and optimizing the functioning of the equipment.

- Customers only need to sign one single agreement for utility and data services, and only have one address to turn to in case of service interruptions.
- Historically, the boiler and air conditioning plant has been located within each building. Placing utilities inside an Energy Centre leaves more space in the buildings, increasing the inhabitable area.
- The benefits the Energy Centre brings to the site will make it more marketable to potential tenants. Not only are utilities costs lower than usual, but the "green" image of such developments makes them a more attractive buy. Britain's "Eco-Home" assessment system rewards energy efficiency and renewable energy measures in its rating system. ECG homes therefore score better in environmental assessments, which increases their market value.
- Renewable energy sources can be used as the primary (or dual) energy source for CHP (including landfill, mine gases, biogases, sweet flare gas and digester gas (from sewage treatment). For these technologies, primary energy costs can approach zero, or amount to a fraction of the cost of natural gas.
- A natural addition to the centralized facility would be the installation of Biomass systems so that sites could contribute waste products to provide further renewable gas supplies for the CHP plant. For example, sewage treatment plants linked to CHP systems will be attractive when considered for low cost housing schemes, particularly in second and third world countries.
- The potential for this kind of renewable energy facility would be significant. Indeed, the British government has committed that by the year 2010 at least 10 percent of energy should be generated from renewables. The current figure is only 3 percent.

Replication of the Concept

ECG is not aware of any other companies working according to the same pattern, but believes that the concept will spread over time. It sees education as the main tool in promoting is business model. As the economic benefits are obvious, all it takes is to overcome resistance of architects, developers and homeowners to new technologies that work differently from what they may be used to. The "carbon neutral" aspect is an excellent educational tool, and collaborating with the CarbonNeutral Company on educational aspects provides the benefits of an official "stamp of approval" for the environmental benefits leveraged by ECG's projects. Last, but not least, municipal planning departments that try to implement energy efficiency and set targets for renewable energy content in new buildings can help create a market for companies like ECG.

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6 Financing and Renewable Energy Policy-Making

Feed-in tariffs
One of the major barriers to financing renewable energy (RE) projects is investment insecurity due to high productions costs compared to conventional energies. Feed-in tariffs laws that guaranty a price and oblige the grid operators or utilities to buy the green electricity were proven very successful in Europe. On the other hand, government-tendering schemes for renewable energy do often experience a high rate of project failures (can be above 50 percent) as many developers will bid in too low and are then not able to successfully complete the project. It is therefore better to leave contracting up to utilities under feed-in tariff or RPS policies.

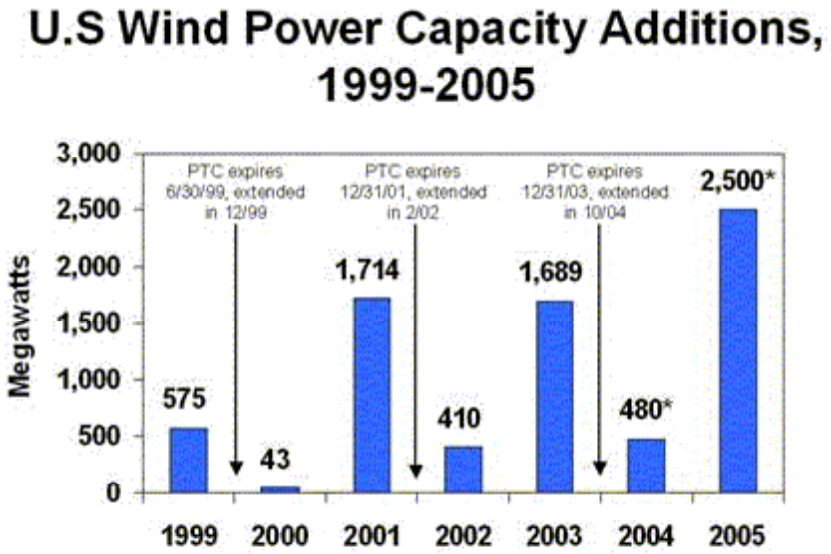
Simple program administration supported at all levels of governments
One common point of less successful programs is the complexity of the administration or application processes. Programs well supported at all levels of governments (regional through federal) have better chances. As well, programs where the difference in cost of electricity from renewable sources is financed through apportionment among the customers instead of through subsidies, as in Germany, for example, can be simpler to administrate.

Mature renewable energy industry and technology
Special attention must also be paid to the specific industry related to the RE source considered for financing. In some markets, financing should not be the only support structure to be considered. The success and sustainability of the implementation of a specific technology could be compromised if the industry supporting it is not mature. For example, if the competency of geothermal contractors is not dependable and systems installed are not up to expectations due to faulty installations, the market will not prosper. A certification is under development for geothermal professionals in Canada. Likewise, the UK and other countries are experiencing a shortage of personnel able to install and operate renewable energy facilities. Emphasis must therefore be put on training a workforce early to support technology deployment.

Planning and education
There are numerous groups that resist RE development for a variety of reasons. It is therefore necessary to support any RE policy with public education about the benefits of RE. Careful energy planning needs to account for the particularities of RE, such as intermittency. Once demonstration projects are successfully completed and operated, confidence in new technologies will increase and the private sector will start to invest. The local and regional resource mix will often have major impacts on the combination of RE technologies that can be used, i.e., this should be taken into account when defining policies and programs.

Stable and predictable policy commitments
Programs with long-term strategies are much more successful than programs with an uncertain future. Again, the German and Spanish programs are good examples. One can consider the history of expirations and renewals of the US Renewable Production Tax Credit (PTC) to see the direct effects of program continuity on added renewable power (**Figure 7**). Before 2005, the PTC had never been extended before its previous expiration. The effects on the US wind industry are well expressed in the following figure. On the other hand, the Japanese solar PV program was a stable, long-term effort that has yielded very good results, making Japan the world leader in solar technology use.

Figure 7. History of US Renewable Production Tax Credit and US Wind Power Additions, 1999–2005



*Data for 2004 and 2005 are based on industry estimates.
Source: American Wind Energy Association, 2004.

7 Key Documents

The following reports were found to be very helpful and informative to identify successful programs and policies. They are listed here as "recommended reading" for any program coordinator and policy-maker.

Janet L. Sawin, National Policy Instruments - Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies Around the World. January 2004.

Eric Martinot, Renewable Energy Knowledge Base: Global Markets, Investments, and Policies. 29 pages, May 2004.

Energy Information Administration, Policies to Promote Non-hydro Renewable Energy in the United States and Selected Countries. Office of Coal, Nuclear, Electric and Alternate Fuels, 30 pages, February 2005.

Eric Martinot, Worldwatch Institute: Renewables 2005: Global Status Report
Renewable Energy Policy Network for the 21st Century

Martin Tampier, Promoting Green Power in Canada: A Look Across Borders (Pollution Probe) Policy descriptions and country case studies. 2002.

Review of Overseas Initiatives that Have Been Taken to Increase the Uptake of Solar Water Heating (2002)

Increasing Energy Access in Developing Countries: The Role of Distributed Generation

The Impact of State Clean Energy Fund Support for Utility-Scale Renewable Energy Projects

Monitoring and evaluation of policy instruments to support renewable electricity in EU Member States

Commission for Environmental Cooperation, What is Renewable? A Summary of Eligibility Criteria Across 27 Renewable Portfolio Standards. 2003 (Also available in French and Spanish.)

European Renewable Energy Council, Renewable Energy Policy Review – Germany.
16 pages, May 2004.

European Renewable Energy Council, Renewable Energy Policy Review – Spain.
13 pages, May 2004.

International Conference for Renewable Energies, Policy Recommendations for Renewable Energies. 19 pages, June 2004.

Global Renewable Energy Markets and Policies
Eric Martinot, 10 pages, 2004

Gary Schmitz, Lori Bird, Blair Swezey, NREL Highlights Leading Utility Green Power Programs. NR-1405, 6 pages, April 2005.

8 Useful Links

The following web sites are of great interest to anyone developing policy in the renewable energy sector.

Renewable Energy Policy Network for the 21st Century
An international network connecting governments, institutions and organizations with those "on the ground," fostering cooperation and relationships.

Renewable Energy and Energy Efficiency Partnership
An international partnership to work together on renewable energy policy and support.

DSIREUSA
The most comprehensive database on state and federal renewable energy initiatives in the United States.

World Resources Institute Green Power Marketing Group
One of the most successful corporate green power purchasing initiatives in the United States, targeting 1,000 MW of green power supported by the initiative by 2010.

World Energy Council
A longstanding organization in the energy field with members in over 90 countries, headquartered in London, UK. The Council has a work program on financing renewable energy projects through private investment and also published the Renewable Energy Projects Handbook on CD, which provides guidance on renewable energy project implementation.

Distributed Energy Case Studies (United States)
A web site with various case studies describing applications in the commercial, industrial, residential sectors, as well as native communities.

Energy Savings Trust (UK)
A web site with a large number of documented case studies on community heating systems, public-private partnerships, and renewable energy projects.

CADETT
With funding from the International Energy Agency and the OECD, the international CADDET web site provides a wealth of information and case studies on renewable energy and energy efficiency.

Renewable Energy Toolkit
The World Bank's REToolkit is intended to serve as a one-stop reference for practitioners when designing and implementing renewable energy projects in developing countries, with guidance to address the most frequently encountered issues. It incorporates best practices and lessons-learned, and addresses implementation needs at each stage of the project cycle, aiming to lower the costs and the time for project preparation, to result in more effective renewable energy projects.

RETSCREEN
Free financial modeling software for a range of renewable energy technologies to do pre-feasibility assessments.

IEA Renewable Energy Policy Database
A database of policies in International Energy Agency member countries.