Renewable Energy Systems
For now - Forever...

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Wind Power

There's something in the air...

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It's hard not to notice them, their impressive blades moving in slow circles - generating precious electricity.

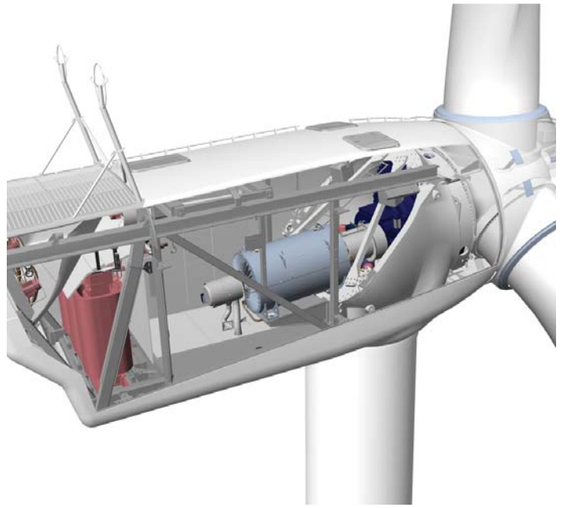
As we come to grips with the fact that carbon based energy sources (coal and oil particularly) are diminishing resources, we now look to the skies for an unlimited supply of energy to heat our homes and to drive our industry. Copper plays a key role in delivering it safely and efficiently.

Wind Kilowatt-Hours

The power output of wind turbines is measured in kilowatts and megawatts. Energy output in a year is measured in kilowatt-hours and megawatt-hours. Since a typical wind turbine usually operates at full power for about 3,000 hours per year, a 10 kilowatt turbine produces about 30,000 kilowatt-hours of energy per year. A one megawatt wind turbine will produce enough energy to supply 200 – 300 North American homes for one year.

Wind Farms

To generate energy on a large scale, wind turbines are grouped together to create wind farms. Wind farm energy production ranges from a few megawatt-hours to hundreds of thousands of megawatt-hours per year. The large-scale wind turbines used have power ratings of 750 kilowatts to 2.5 megawatts. A large Canadian wind farm now operating consists of 200 machines which can generate enough electricity each year to supply 35,000 to 55,000 typical homes.



Internal workings of a wind turbine. Vestas Wind Systems A/S.

Photo: Canadian Wind Energy Association (CanWEA).

And wind farms can be built in agricultural areas with minimal disturbance of farmland. While they do, on paper, take up a certain amount of land (each turbine requires approximately 0.8 hectares (2 acres) of land), the relative impact can be minimal, as the turbine tower base is only a few metres in diameter. The land can continue to be farmed or grazed, with the farmer earning additional income by renting the land to the wind farm proprietor.

Offshore wind farms offer major potential for generation capacity according to a recent study performed for the CCBDA. It is in these facilities that copper submarine cables excel.

Copper in Wind Power

Copper is essential to the proper functioning and efficiency of wind turbines. It is central to the inner workings of the generator, grounds the tower from lightning strikes, and carries the electrical current to where it needs to go. This is especially important in wind energy generation where reliability and performance are paramount in many cases due to often remote and inaccessible locations. Remote communities and mining operations in the far north are examples of where wind and solar systems provide reliable service and offset the consumption of expensive diesel fuel.

Copper... The Green Choice

In addition, copper also has the advantage of being 100% recyclable, so at the end of its service life in these electrical systems, it can be recycled into any number of other copper applications.

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Photovoltaic Systems

A gift from the gods...

Photo: Enbridge Inc.

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The ancient Egyptians believed that the Sun God “Ra” travelled across the sky each day and brought life to earth.

Today our sun is also harvested to create electricity for remote areas of the world not connected to a grid, to generate electricity to go back into the grid, or to provide power to homes and buildings.

What Is It?

Technically, solar photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current using semiconductors that create the photovoltaic effect. Solar panels, made up of solar cells (mostly from various forms of silicon), pick up the rays of the sun and convert it to electricity. Although photovoltaic cells look similar to solar thermal panels, they work differently. Solar thermal panels produce water or steam. Solar photovoltaic panels convert sunlight directly into electricity.

Enough sun falls on earth in 1 hour to meet the world’s energy demand for a year - if it could be collected!

High performance solar panel arrays start the collection process by turning sunshine into electricity, and then converting the electricity to the correct current and voltage through an inverter. The electricity can be transferred to the grid or used directly to power the home appliances and industrial equipment.

Solar PV modules can be grouped together as an array or series of parallel connected modules to provide any level of power requirements, from mere watts (W) to kilowatt (kW) and megawatt (MW) size. So while smaller systems can be used on single family homes, cottages, or other similar sized applications, larger arrays can be used for commercial installations, such as big-box stores, or even utility-scale generation. Solar PV farms covering 100 hectares (247 acres) or more are becoming common sites in rural areas.

Tracking mechanism for a solar array.

Aerial view of Enbridge Sarnia photovoltaic installation. Photo: First Solar.

PV Modules Orientation

PV modules should be oriented between south-east and south-west (due south is best). Modules generally need an unobstructed view of the sun all the year. Systems can be sized to provide 100% of electricity consumption at a cottage or campsite, or as a supplement to conventional utility electricity or genset electricity. A tracking system can orient the solar array to maximize its electricity production throughout the day and the year by tracking the movement of the sun.

The Wrap-Up

PV systems are clean and simple with no moving parts required. They are silent and generate no noise or pollution. Individual systems can match well with the individual AC needs of a home or other residence, and the systems need minimal maintenance, making them an ideal choice for those wanting an easy energy generation option.

Copper in Photovoltaics

Copper plays a key role in the performance of solar PV systems, even if not readily apparent. Copper PV electrical cables connect modules, arrays and sub-fields. Inverters contain copper windings, and copper grounding cables ensure the safety and security of the entire system. Copper obviously plays a big role in the technology advancements in photovoltaics.

Okanagan College – Penticton, B.C.

The Okanagan College 260 kW grid-tied PV roof installation is currently the largest solar photovoltaic system in Western Canada. The electrical output from the Penticton system supplies almost all of the electrical power needed by the College’s Jim Pattison Centre of Excellence in Sustainable Building Technologies & Renewable Energy Conservation. The PV system and the Centre’s solar water heating system produce virtually 100% of the buildings energy requirements. All components of the PV system are grounded using braided copper conductors as per code requirements.

Okanagan College. Photo: SkyFire Energy Inc.

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Other forms of Renewable Energy

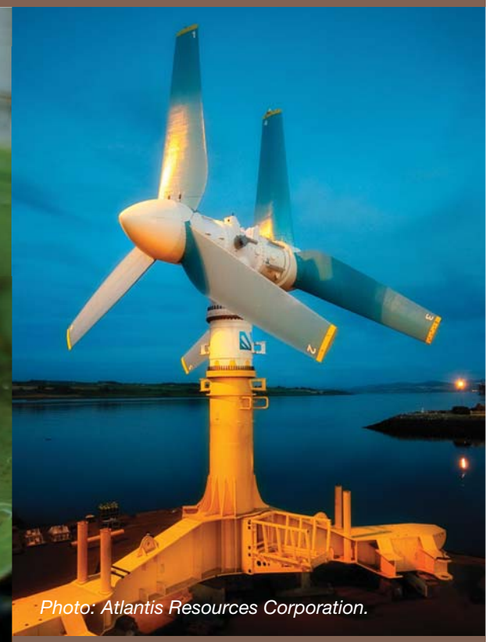

Photo: Atlantis Resources Corporation.

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While wind and solar are the emerging commercial technologies today, other types of renewable energy are on the horizon.

Hydrokinetic Power

This is the technical term for tidal and "run-of-river" energy generation – think waterwheel; all three are driven by flowing water. Hydrokinetic turbines are underwater; the former places the generating turbine in the path of tidal flows (like the Bay of Fundy) while the latter places them in a flowing river. In either case there is little, if any, environmental impact or disturbance. Once in place the turbines operate similar in principle to wind power generators. While not yet widely used, there is enough potential to power large regions of Canada, from coast to coast. The end result of this technology is the electricity generated will be transmitted to on-shore grids by submarine cables with copper conductors.

Wave Power

Wave power is the transfer of energy by ocean surface waves - and can contribute to electricity generation. The generating structures are often modular ocean-going buoys. The rising and falling of the waves moves the buoy-like structure, creating mechanical energy. This in turn is converted into electricity and transmitted to shore over a submerged transmission cable, which typically has one or more copper conductors, due to its natural corrosion resistance and superior performance in marine environments.

Hydroelectricity

The most widely used form of renewable energy in Canada is power generated through the use of the gravitational force of falling or flowing water. Once

Hydro power stations generate about a quarter of all the electricity used in the world.

completed, a hydroelectric complex produces no direct waste. While most of us are familiar with large-scale hydro generation facilities such as dams and reservoirs, small scale hydroelectric systems can be installed in even small rivers or streams.

DX Geothermal

In the early 1990's, Maritime Geothermal designed and built their first Direct Exchange System. A DXG heat pump uses buried copper tube filled with a circulating refrigerant to remove heat from the earth. With a refrigerant as the working fluid, the copper ground loop becomes the primary heat exchanger for the heat pump. This results in a higher efficiency through the elimination of the secondary earth heat exchanger which typically is plastic with a mixture of water and antifreeze as its working fluid. The high thermal conductivity of copper capitalizes on the available heat from the relatively constant ground temperature of approximately 9°C (48°F) below the frost line.

Copper is used extensively in DX units.

Solar Thermal

Solar Thermal

Solar thermal systems come in various sizes suitable for single-family houses to large-scale process water heating. In all systems, the basic concept is to heat a fluid (often water) in a solar collector and allow it to flow to another medium where the heat energy is transferred. The systems can be as simple as a drain-down water system, or a complex system that transfers the energy to systems used for domestic water heating, space heating or process heating.

Drake Landing

A recently completed residential development in Okotoks, Alberta is using solar power to supply about 90% of its space heating and more than 60% of its domestic hot water.

The 52-home Drake Landing Solar Community uses 800 Enerworks single glazed, flat plate solar collectors on the roofs of the detached garages behind the houses for the space heating system. Each house is also equipped with an Enerworks domestic hot water appliance consisting of two solar collectors mounted on the roof, an energy package and storage tank with accessories. It supplies hot water throughout the year.

Halifax Solar City

In 2013 1,000 Halifax and Dartmouth city residences were approved to have solar hot water collectors installed on their roofs under the Halifax Regional Municipality Solar City Program. Thermo Dynamics is supplying the systems of the solar collectors, a heat exchanger and a PV solar pump to circulate the solar fluid from the collectors to the heat exchangers. Based on the results to date, the Solar City Program is slated to be a resounding success.

Copper's role in solar thermal systems builds on its decades of exceptional performance in mechanical fluid handling applications.

Drake Landing, Okotoks, Alberta. Photo: D. McClenahan, Natural Resources Canada.

Copper solar heat exchanger units fabricated for Solar City in Halifax N.S. Photo: R.J. Catterall.

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