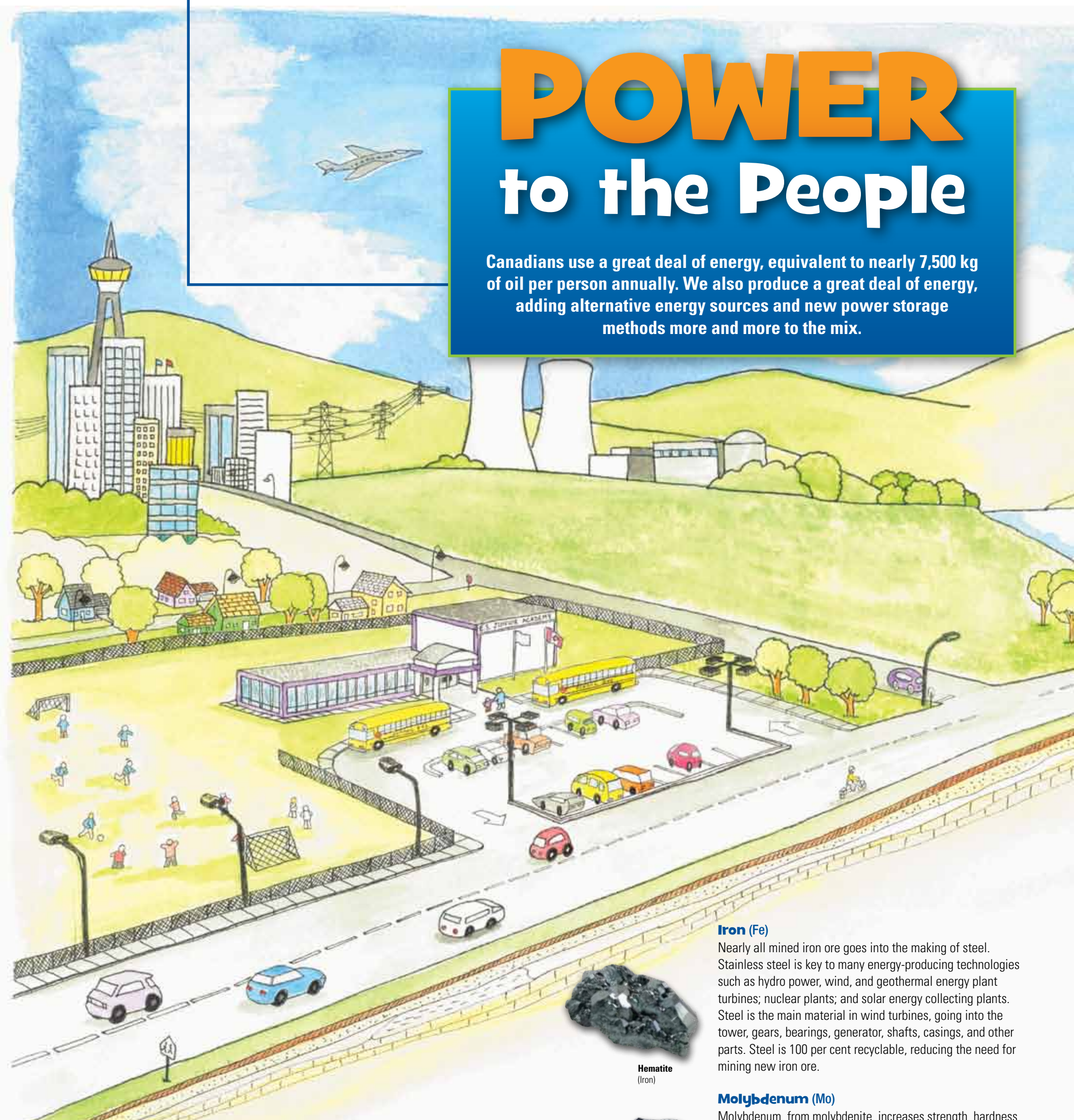
POWER to the People

Canadians use a great deal of energy, equivalent to nearly 7,500 kg of oil per person annually. We also produce a great deal of energy, adding alternative energy sources and new power storage methods more and more to the mix.



Hematite
(Iron)

METALS & MINERALS

Iron (Fe)

Nearly all mined iron ore goes into the making of steel. Stainless steel is key to many energy-producing technologies such as hydro power, wind, and geothermal energy plant turbines; nuclear plants; and solar energy collecting plants. Steel is the main material in wind turbines, going into the tower, gears, bearings, generator, shafts, casings, and other parts. Steel is 100 per cent recyclable, reducing the need for mining new iron ore.

Cobaltite (Cobalt)

Cobalt (Co)

Cobalt, produced as a by-product of copper and nickel mining, is critical for manufacturing the nickel metal hydride batteries found in hybrid electric vehicles (HEVs), laptop computers, cell phones, and other electronic devices. Lithium-ion batteries, containing 2.28 to 3.18 kg of cobalt, are expected to dominate future HEV markets. They recharge faster and reduce air pollution and fuel consumption by at least 50 per cent.

Copper

Copper (Cu)

Copper is essential to the transportation of electricity. In the form of power line wire, it carries electricity across the country for home and business use. It is also indispensable to the proper functioning and efficiency of wind turbines. The metal plays a central role in the inner workings of the generator, grounds the towers from lightning strikes, and carries the electrical current. Copper coils can also be found in the geothermal powered generators that produce electricity.

Sphalerite
(Germanium)

Germanium (Ge)

Germanium, a by-product of zinc mining, is more efficient than silicon at converting solar energy into electricity in photovoltaic cells. Germanium solar cells have a 40 per cent efficiency compared to 20 per cent for silicon, but cost much more. Because they are efficient and lightweight, germanium solar cells are used on satellites and spacecraft.

Molybdenite
(Molybdenum)

Molybdenum (Mo)

Molybdenum, from molybdenite, increases strength, hardness, durability, and conductivity in alloys (mixtures of two or more elements, at least one being a metal.) Moly alloys go into drill bits used by the geothermal energy industry, propellers that harness wind energy, electrical connectors in solar power, and construction of "green cars."

Garnierite
(Nickel)

Nickel (Ni)

Nickel is key to clean energy. Nickel metal hydride (NiMH) batteries, used in hybrid electric vehicles (HEVs), contain about 10 kg of nickel. Hybrid cars with NiMH batteries produce 50 per cent less pollution and greenhouse gases than comparable gasoline cars. Rechargeable batteries made with nickel power cell phones, laptops, digital cameras, and other electronic devices. Nickel alloys reduce the weight of aircraft frames, allowing the aircraft to use less fuel.

Nickel-containing stainless steel and nickel-base alloys, strong and resistant to corrosion, have many uses. A single wind turbine generally contains 500 kg of nickel. A typical nuclear reactor uses up to 20 different nickel alloys.

Platinum

Platinum (Pt)

Platinum, found in deposits of gold-bearing sands and as a by-product of nickel mining, is critical to the development of fuel cell technology. Platinum acts as a catalyst in fuel cells to convert hydrogen (fuel) and oxygen to heat, water, and electricity. The amount of platinum catalyst required to power a fuel cell is 0.5 to 0.8 grams/kilowatt.

SUN

WIND

WATER

EARTH

Mining Makes It Happen

Quartz
(Silica)

Silica (Si)

Most solar photovoltaic systems use silicon cells to turn the sun's rays into energy. These cells are typically made of silicon dioxide, which is made from quartz sand, a common and abundant natural resource. Computer chips also use silicon, driving up the price and creating a shortage of solar-grade silicon.

Silver

Silver (Ag)

Silver, found as a pure free metal in the Earth, makes up 90 per cent of a glass paste applied along the top and bottom of crystalline silicon photovoltaic cells. When sunlight strikes the cells, the silver collects the electrons generated and transforms them into electric current. A group of roofing tile solar cells can power a house for one day and recharge batteries for use after dark.

Rutile
(Titanium)

Titanium (Ti)

Titanium, found in ilmenite and rutile, is as strong as steel, but weighs 40 per cent less. It is used as an alloying agent to produce strong, lightweight metals that resist corrosion and tolerate temperature extremes. Titanium alloys help make aircraft lighter, reducing fuel consumption. Titanium could also offer a solution to the storage and release of hydrogen in fuel cells.

Uraninite (Uranium)

Uranium (U)

The basic fuel for a nuclear power reactor is uranium—a heavy metal able to release abundant concentrated energy. Pellets of uranium oxide (UO_2) are arranged in tubes to form fuel rods, which are arranged into fuel assemblies in the reactor core. About 14 per cent of the world's electricity is generated by nuclear power stations.

Zircon (Zirconium)

Zirconium (Zr)

Zirconium is primarily used for nuclear power. Long zirconium alloy (zircaloy) tubes containing uranium pellets form the fuel rods, the zirconium being hard, corrosion-resistant, and permeable to neutrons. Very pure nuclear grade zirconium is used to make zircaloy, which is about 98 per cent zirconium.

Limestone
(Aggregates)

AGGREGATES

Aggregates include hard rocks that require breaking up—igneous (granite, basalt), metamorphic (quartzite), and sedimentary (limestone, sandstone)—and loose sand and gravel that have been broken up by natural processes. Coarse and fine aggregates, mixed with cement and water, make up concrete, the world's most widely used building material. Large hydroelectric dams for utility electricity generation are constructed from reinforced concrete beginning with thick footings at the base of the dam and working upwards. Using the right types of aggregates in the concrete is essential to the dam's longevity.

Monazite
(Thorium, Cerium, Lanthanum)

Bastnäsite
(Cerium, Lanthanum, Yttrium, Neodymium)

RARE EARTH ELEMENTS

Fifteen lanthanide elements, or metals, and the metals yttrium and scandium make up Rare Earth Elements (REEs). Although abundant in the Earth's crust—similar to nickel and tin in abundance—they do not occur in large, concentrated deposits, so are difficult to mine. The minerals bastnäsite and monazite are the primary source of world REE supplies. REEs are integral to rechargeable batteries for electric and hybrid vehicles, powerful magnets in wind and tidal electricity turbine generators, and control rods in nuclear technology. Also, rare earth magnets reduce energy consumption in electrical appliances such as refrigerators.

POWER

brought to you by...

Alternative Energy Technology

Alternative energy includes renewable energy that comes from natural, renewable resources such as sunlight, wind, water, and geothermal heat. In 2011, renewable power generation made up more than 20 per cent of the world's total power generation. Canada ranked sixth in the world in the percentage of its electricity produced by renewable resources. Hydroelectric power leads the way in Canada, while wind and solar power are on the rise and geothermal energy is being explored. Another alternative source of power in Canada is nuclear energy.

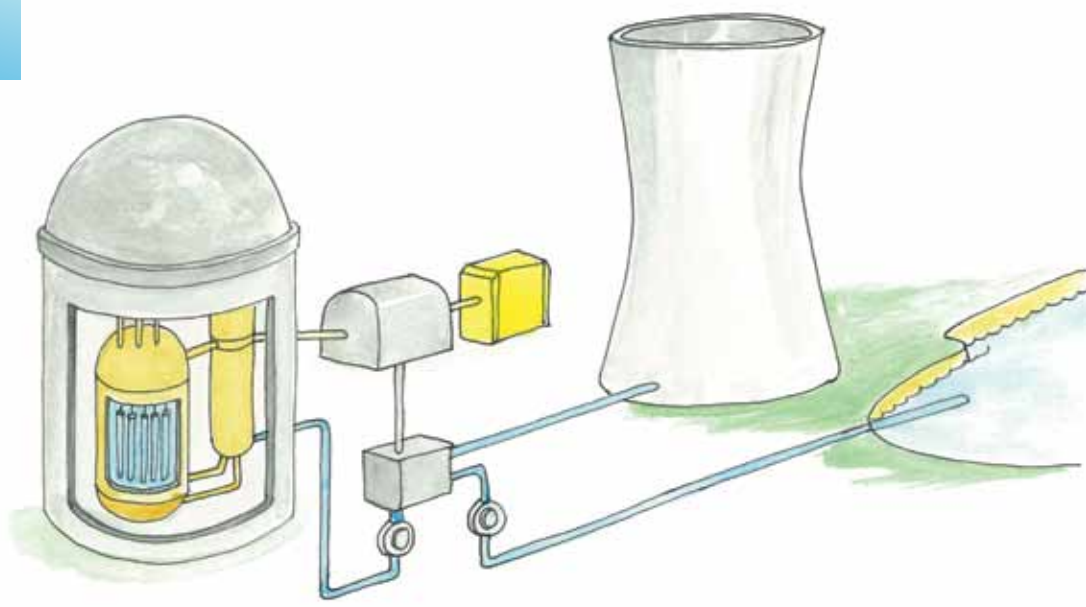
Whatever energy sources we use, the metals and minerals of the Earth, along with the people who find and process them, make them possible. Mining Makes It Happen.

NUCLEAR ENERGY

What's Inside? Zirconium, Uranium, Nickel, Copper, Iron, Rare Earth Elements (REEs)

Nuclear energy is created when metal tubes containing uranium (fuel rods) are used to boil water, producing steam that drives electricity-generating turbines. Uranium must be processed into fuel for a nuclear reactor. In 2011, 30 countries used nuclear reactors to produce energy; about 13.5 per cent of the world's electricity is produced by more than 440 reactors. Nuclear reactors generate a lot of energy using small amounts of uranium and do not emit greenhouse gases; however, they produce radioactive waste that must be managed.

Canada is one of the world's largest uranium producers and is a leader in nuclear research and technology. Atomic Energy of Canada, working with Canadian industry, developed CANDU nuclear power reactors, which are exported worldwide. In 2011, about 15 per cent of Canada's electricity came from nuclear power. Seventeen reactors in three provinces—Ontario, Québec, and New Brunswick—provided over 12,000 MW of power capacity. Canada plans to build two new reactors over the next 10 years.



WIND ENERGY

What's Inside? Copper, Iron, Molybdenum, Aluminum, Zinc, Rare Earth Elements (REEs)

Wind turbines use wind to turn huge tower-mounted propellers, converting its energy to electricity. Well-situated wind turbines produce varying amounts of electricity, averaging 30 to 40 per cent of their capacity annually. Complementing their output with that of other energy sources makes sense. For example, when wind power declines, hydro power can fill the gap. When wind power is up, water can be stored in hydro reservoirs until needed.

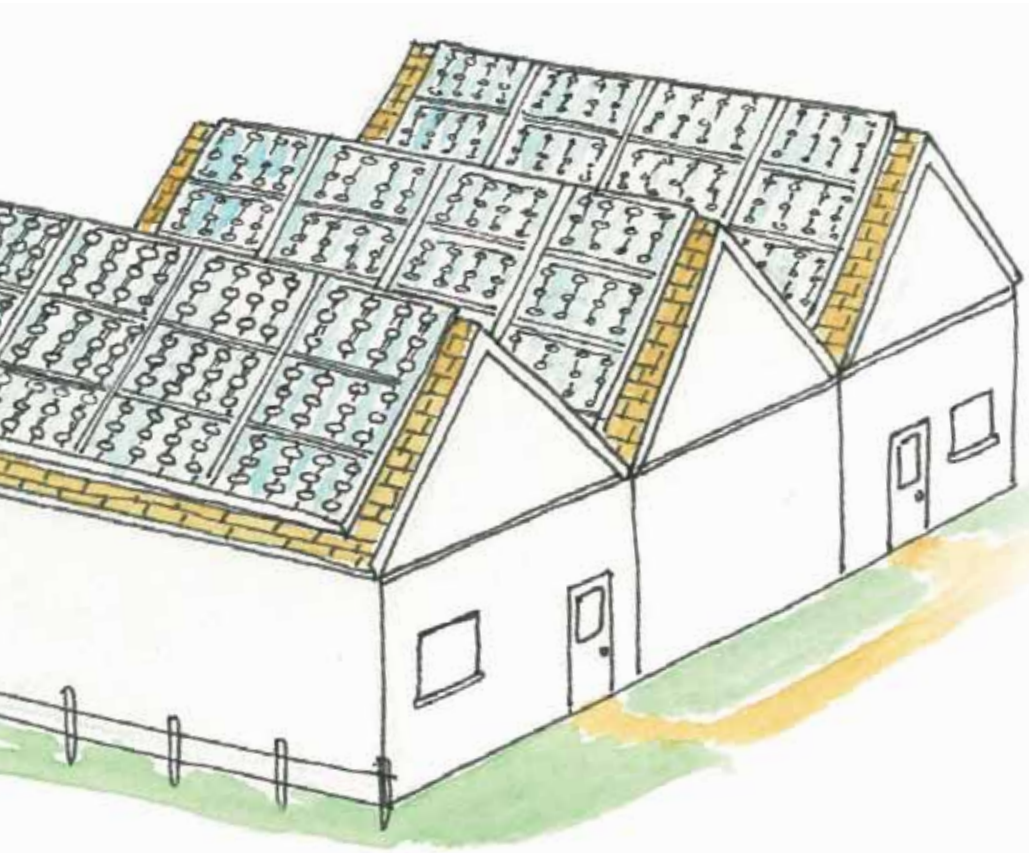
Canada has tremendous wind power potential. Strong, steady winds blow in every province and territory. Some of the best areas are offshore and along coastlines; Canada has the world's longest coastline. In 1997, wind power supplied 25 MW of electricity in Canada. By 2011, it supplied 5,265 MW, enough to power approximately 1.5 million homes annually. Ontario produces the most wind power, more than 1,500 MW. The Canadian Wind Energy Association envisions wind power providing 55,000 MW of Canada's electricity by 2025. That would need land area equal to Prince Edward Island, with about five per cent for wind turbines and the rest for farming or other activities.

GEOTHERMAL ENERGY

What's Inside? Molybdenum, Iron, Copper, Rare Earth Elements (REEs)

Geothermal energy comes from heat found below the surface of the Earth. For thousands of years, hot springs have given people access to geothermal heat. Today, drilling the Earth to depths of up to 3,000 metres gives greater access, in two ways. Hot water or steam below ground level is brought to the surface, or surface water is pumped down through hot ground and brought back up. The resulting hot water can directly heat homes and buildings or be turned to steam to turn electricity-generating turbines. Geothermal energy plants produce little pollution, operate day and night, and generate high rates of electricity.

Currently, Canada has no operating geothermal power plants. A Geological Survey of Canada assessment found that Canadian geothermal resources could supply up to 10 per cent of our electricity. The most development potential exists in Western Canada. In 2011, six geothermal projects were under development in B.C., Alberta, Saskatchewan, and the Northwest Territories. The Canadian Geothermal Energy Association believes that 5,000 MW of geothermal power could be supplied by 2025.



SOLAR ENERGY

What's Inside? Silver, Silica, Germanium, Molybdenum

Solar energy, or energy from the sun, can provide lighting and heat as well as electricity. Solar photovoltaic (PV) technology uses solar panels to convert the sun's energy to electricity for home and commercial equipment as well as lighting and air conditioning. They can help power remote areas that use expensive fossil fuels or have no electricity. PV panels can be on the ground, on building rooftops, or designed into building materials. In the future, everyday objects, such as clothing, car rooftops, and roads, could become power-generating solar collectors.

Solar energy is generated during the day, when energy is most needed and most expensive. Solar power technologies help utilities match supply with demand and can reduce natural gas usage during peak periods. In Canada, southern Ontario, Québec, and the Prairies receive the most sunlight; however, solar installations exist across the country. From a power capacity of 32.72 MW in 2008 they increased in number and potential to 819 MW in 2011, making solar power .01 per cent of total electricity generation.

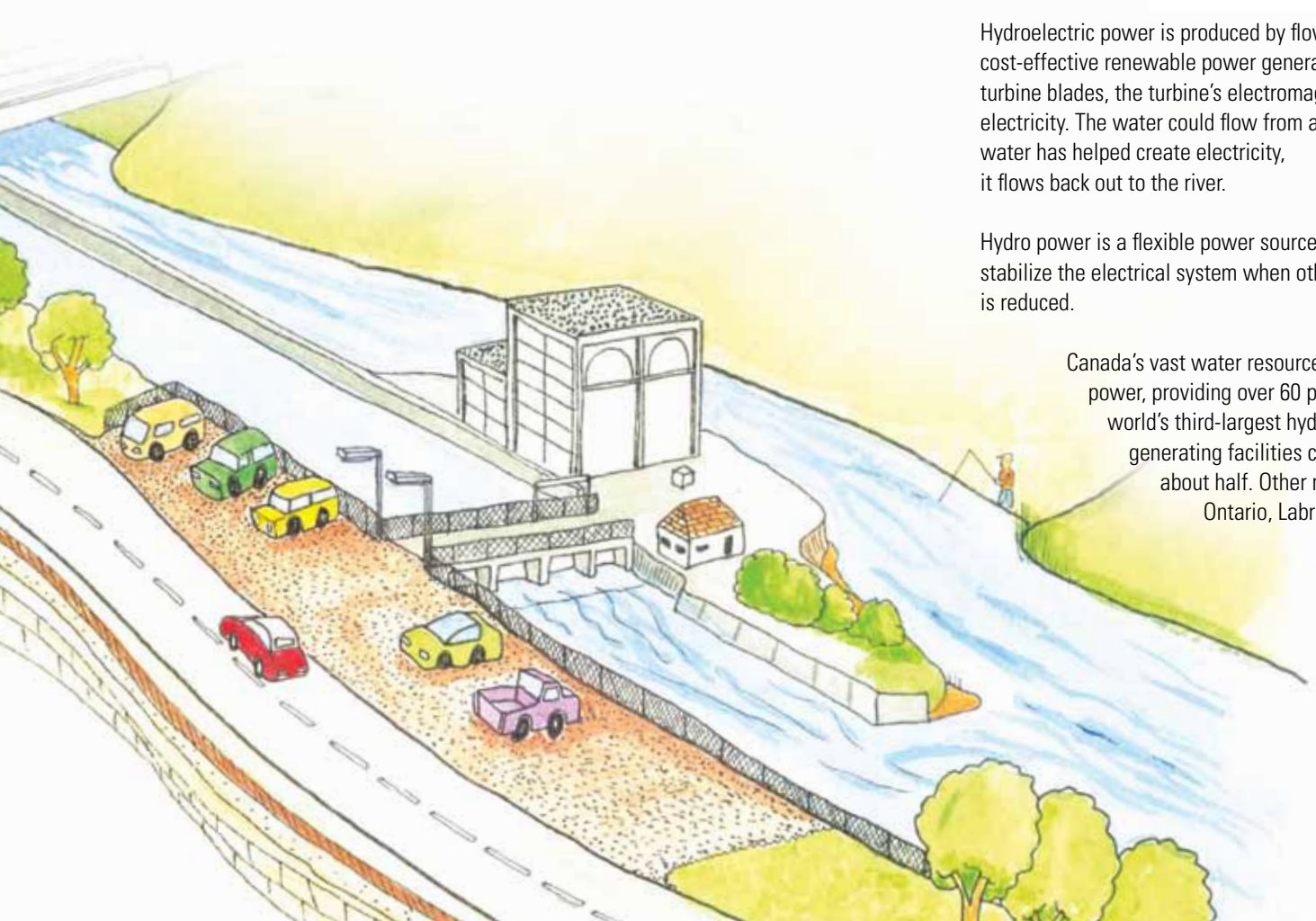
HYDRO POWER

What's Inside? Copper, Iron, Aggregates, Silica, Aluminum, Gypsum

Hydroelectric power is produced by flowing water. Long in use, it is the most reliable and cost-effective renewable power generation technology available. When flowing water turns turbine blades, the turbine's electromagnets interact with the coils of a generator to create electricity. The water could flow from a natural waterfall or from behind a dam. After the water has helped create electricity,
it flows back out to the river.

Hydro power is a flexible power source. Water can be stored in reservoirs and used to stabilize the electrical system when other renewable energy, such as wind and solar power, is reduced.

Canada's vast water resources include many flowing rivers that generate hydro power, providing over 60 per cent of our electricity. In 2010, Canada was the world's third-largest hydroelectricity producer. In 2011, our 491 hydroelectricity generating facilities could produce 70,142 MW, with Québec generating about half. Other major hydroelectricity producing areas include B.C., Ontario, Labrador, and Manitoba.



The People

Great career opportunities exist within the mining industry in all aspects of exploration, development, operations, and site reclamation. These are just a few of the possibilities. To learn about them and more, visit **www.acareerinmining.ca**

Mineral Exploration Helicopter Pilot

Exploration Geologist

Environmental Technician

Heavy Duty Mechanic

Surveyor

Underground Miner

Metallurgical Engineer

Mine Engineer

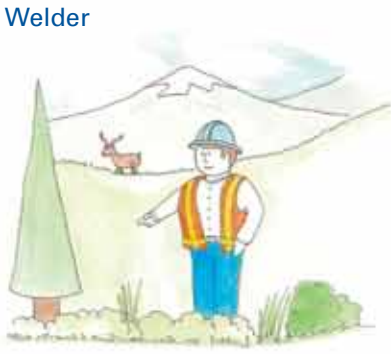
Human Resources Manager

Minerals Processing Operator Technician

Welder

Community Affairs Manager

Diamond Driller



Environmental Coordinator

www.MiningMatters.ca

www.mineralsed.ca

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