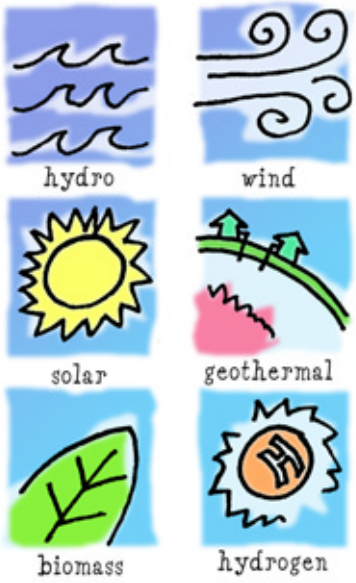
Solutions to Climate Change — High School Backgrounder 13

Renewable Energy Opportunities

We use energy to run our vehicles, heat our homes, turn on our lights, harvest our food, run our industries, fly our planes.... Get the picture? Energy helps make the world go round!

But some types of energy also help put those nasty climate changing greenhouse gases (GHGs) into the atmosphere. Fuels like oil, gas, and coal are the main culprits as they put loads of GHGs into the environment when we use them.

There is a fixed amount of fossil fuels – there is only so much oil, gas and coal in the ground. So eventually we will run out. We call these fuels "non-renewable" fuels, because once we use them, they're gone.



"Renewable energy" is energy that that is usually available in a never-ending supply. It is made by capturing energy – from things like the sun, wind and falling water. Also, many of the renewable energies don't produce GHGs or other forms of pollution when we use them. So renewable sources of energy are endless and generally cleaner.

This backgrounder describes some of the renewable energy sources we can use instead of fossil fuels to help reduce GHG emissions in the world.

Where Does Your Power Come From?

When you flick on your lights at home, do you know where the electricity comes from?

In many northern communities in Canada, there are large generators that burn diesel (a fossil fuel) to create electricity. These generators send a lot of GHGs and other air pollutants into the atmosphere.

Also, the diesel is usually transported into the community by a truck, plane or barge. All of these forms of transportation burn fossil fuels. So GHGs are produced both when the diesel is brought into the community and when the diesel is burned in the generator. A bit of a double whammy!

In some northern communities, flowing water is used to create electricity. This is called hydroelectric power and it can be a GHG-free source of power. In Canada, 61% of all of the country's electricity is produced by hydropower, while less that 10% of the electricity in the United States is generated by hydropower.

It is important to remember that hydropower causes some environmental concerns that should be considered. For example, most hydroelectric projects involve building a dam across a river. This dam interferes with the natural flow of a river and floods a lot of land upstream of the dam. People now know that the flooded areas (hydro reservoirs) can end up producing significant amounts of carbon dioxide and methane (both GHGs). This can occur for decades after the dam is built as flooded trees, plants and other organic materials – the vegetation and soils that were present in the flooded forests and wetlands – slowly decay under the water (*see Backgrounder 3)*.

So there are a few trade-offs to think about even with hydroelectric power. But it's usually way better than burning diesel.

DOWN With GHGs, UP With Renewables!

Although most northern communities use diesel generators or hydro-power for most of their electricity, many types of renewable energy can be used for electricity for our lights, heat for our homes, or fuel for our machines and vehicles.

The following descriptions outline some of the main forms of renewable energy that are being used – or could be used – in the north.

What's a turbine!?

Basically, a turbine is a thing that spins to create power. It is made up of a rotor with blades or cups that are turned by moving water, air, steam or gases. This spinning action can turn a generator to produce electricity. A windmill that is used to create electricity is a type of turbine.

Micro-hydro

Although many hydroelectric projects involve building dams that change the flow of a river, there are smaller hydro projects that can produce power by using the natural flow of a river or stream. Small turbines can either sit in the flow of the river, or water can be piped to them to generate power.

These "micro-hydro" projects don't have to dam a river. These smaller projects produce much less power than the big dams, but they also have less impact on the natural environment.

Blow me over!

A wind turbine is a great example of renewable energy power technology that has been around for hundreds of years in some countries. It is the fastest growing source of power in the world.

There are a few "wind farms" in Canada, where hundreds of wind turbines use the free wind to make electricity. Canada produces 137 megawatts of wind power, enough to power about 37,000 homes.

This really isn't very much. Germany produces 6,100 megawatts of wind power! The small country of Denmark creates 2,140 megawatts, about 20% of its energy needs. So Canada has a long way to go to before it is taking full advantage of the free power of wind!

Watt's that?!

A watt is a measurement of electricity.

1 watt = one Christmas lightbulb

1 kilowatt = 1,000 watts

1 megawatt = 1,000 kilowatts (or 1,000,000 watts)

1 gigawatt = 1,000 megawatts (or 1,000,000,000 watts)

1 terawatt = 1,000 gigawatts (or 1,000,000,000,000 watts!)

Wind turbines are also showing up in the North! In Whitehorse, there are two. The smaller one was erected in 1993 and it can produce enough electricity each year for about 23 homes. The bigger wind turbine was put up a few years later and generates enough power every year for 130 homes. It would take about 350,000 litres of diesel to produce this much power! By using wind instead of that much diesel, greenhouse gas emissions are reduced by 900 to 1,000 metric tonnes per year.

Rankin Inlet in Nunavut is an isolated community that has to ship in diesel fuel three to four times a year to run its diesel generator. However, the community has also set up a new wind turbine that is expected to reduce their use of diesel by about 50,000 litres a year. This will save the community about $25,000 per year. It will also keep about 150 tonnes of GHGs from going into the atmosphere. That is like taking 50 small cars off the road!

Catch those rays!

The sun is a huge source of free power. It can be used to generate both electricity and heat.

Have you seen pictures of solar panels that sit on a roof and use the sun to create energy? These panels use technology called solar photovoltaics – or PV for short – to make electricity. In the north, these panels are a great way for hunting camps, cottages, research stations, or others to generate electricity, especially if they are too far away from an area's main source of power (like diesel or hydropower). In the aboriginal community of Kitcisakik, Quebec, solar panels provide enough electricity to meet the needs of 18 families and a community centre!

Other types of solar panels can also be used to heat water. A hotel in Whitehorse, the Gold Rush Inn, heats up all of its water with solar panels most months of the year. The panels on the hotel roof can heat enough water even when all 106 rooms are full in the summer and everyone is taking showers and doing laundry! When the hotel owner installed a special type of solar panel that uses vacuum tubes to heat the water, his utility bill (for power) dropped by $16,000 in the first year!

The sun is also used in many places to help heat buildings. The simplest way is to put most of the windows in a building on the south side so that the sun can passively shine in and heat up the building. North facing windows only let heat out of the building – they don't help any of the sun's heat come in.

There is also a newer technology, called the Solarwall, that helps use the sun's heat to warm the inside of a building even in northern winters. A dark coloured metal with lots of tiny holes in it is placed on a sunny outside wall of a building. The outside air travels through the small holes and is warmed up by the metal (which is warmed up by the sun's heat). This pre-heated air is then moved into the building with fans.

A hot fact

The amount of energy produced by the sun in a two-week period equals the combined stored energy of all the coal, oil and natural gas reserves known to humans.

The Weledeh School in Yellowknife, NWT and the recreation centre in Fort Smith, NWT both have Solarwalls. Even in the short, darker days of December, Fort Smith's Solarwall (combined with something called a heat recovery ventilator) is able to meet 75% of the recreation centre's heating needs! As the sun gets stronger in January and February, the Solarwall provides 100% of the centre's heat!

Now this rocks!

Did you know that you can get heat out of the ground, even in the middle of winter!?

Below the frost line, the ground temperature stays the same season to season. In the middle of winter, the ground below the frost line is actually warmer than the air.

A technology called a ground-source heat pump (or geothermal heat pump) uses a bunch of buried pipes to move that heat from the ground and into a building! A liquid coolant in the pipes – like the one used in your fridge – helps to capture the ground's heat and move it into homes and other buildings. In hotter weather, the process can be reversed so that the cooler ground is used to help cool a hot house!

Some places also have warm or hot water under the ground that can be used to help heat buildings. The warm water is circulated through pipes to help warm up buildings. Studies are being done in Haines Junction, Yukon to see if the 17° C water that flows below the town can be used to heat the buildings above ground! About 40% of the energy in Iceland is produced by hot water extracted from volcanic rocks!

Many northern communities in Canada may also have warm water under them. Studies need to be done to figure out the temperature, how much water is available, and whether or not it is economic to use it as a source of heat.

Bio-what?

Biomass fuel is basically a fuel that is made from any type of biological matter.

Wood

One form of biomass is wood. Wood waste from sawmills or trees from a forest fire area can be burned to create heat or generate electricity. If the same amount of wood we use for energy is allowed to grow again in our lifetime, it is a renewable form of energy.

Ethanol

Another type of biomass fuel is called ethanol. This is an alcohol that is made by fermenting sugars from agricultural crops like corn or wheat. Even fields of grass can be harvested to make ethanol. In Brazil, 24% of the fuel they use is ethanol that is made from sugarcane!

Ethanol can be used to run cars and to make chemicals and plastics. It's true that burning ethanol produces carbon dioxide like other fuels. However, the biological things used to make ethanol (like trees, crops, or grasses) also take carbon dioxide out of the atmosphere when they are growing. So ethanol is much better to use than fossil fuels (like oil and gas) because fossil fuels only put carbon dioxide into the atmosphere. The materials used to make ethanol generally take as much carbon dioxide out of the atmosphere as they later put in when burned as a fuel.

In Ontario, Quebec, the western provinces and the Yukon you can buy gasoline that has some ethanol added to it. This makes the gas burn a little cleaner. Approximately 5–10 percent of Canadian gasoline contains ethanol. Currently, the Canadian ethanol production capacity is 238 million litres.

A high-speed fact!

Ethanol burns very cleanly. It also delivers more power than gasoline so Formula 1 racing cars use ethanol to run their engines!

Bio-Gas

Every human creates gas as they digest food.... It's a gas that none of us likes to smell! Imagine capturing this gas to create energy!

People aren't actually using human farts to create energy. But they are using the same process that our digestive system uses to create a renewable gas that can be used to create energy!

Bacteria in our digestive system help to break down food. As digestion takes place, a gas called methane is produced. Methane is also created when food and other organic materials in a community's dump break down (rot). You could also create methane if you put a bunch of cow manure in a container, added some water and kept the lid on.

And this is exactly what people are doing around the world! Animal and plant wastes on farms are put in sealed tanks with special bacteria. This is creating methane gas. The methane is captured and used for things like cooking and heating.

This isn't rocket science!

People have been using biogas for a long time! In the days before electricity, biogas was drawn from the underground sewer pipes in London and burned in street lamps. Now you know why they were called "gaslights"!

Communities are also putting pipes into their waste dumps to help capture and use the free methane that is being created by rotting food and other waste. Methane is a greenhouse gas that increases climate change so capturing the methane before it escapes into the atmosphere helps to reduce a community's greenhouse gas emissions! A double bonus!

It's a gas!

Do you know what is:

- 14 times lighter than air;
- found in 90% of the matter in the universe; and
- found in water?

The answer is hydrogen. If you take two parts of hydrogen and one part of oxygen you get H_2O... the chemical formula for water! Hydrogen is also found in fossil fuels, biomass, ethanol and much, much more.

When hydrogen is separated from water or the other things it is found in, it can be used to generate electricity or run vehicles. The good news is that when you use hydrogen, you don't produce any GHGs!

Part of the trick right now is that it takes energy to get hydrogen out of water (or other things in which hydrogen is found). Unfortunately, sometimes the energy we use to extract hydrogen comes from burning fossil fuels that produce GHGs. But inventors are exploring more efficient ways to separate out the hydrogen without creating GHGs!

The other challenge is that hydrogen is a very explosive gas and will catch fire easily. To be safely stored, it needs to be cooled to a chilly -253° C so it will form a liquid. Liquid hydrogen is then stored in specialized containers and pumped through high-tech valves and tubes. This makes hydrogen expensive and difficult to handle.

However, hydrogen fuelled cars and buses are cruising the roads right now in some places. The city of Vancouver, BC was the first place to test out the hydrogen fuel cell in its public buses. The government of Iceland is working on their dream of having all of the country's cars and buses run on hydrogen. Iceland even wants its fishing boats to be using hydrogen by the year 2040. If successful, Iceland will be able to stop importing oil and gas to their island.

Why Don't We All Have Solar Panels and Wind Turbines?

By using the different types of renewable energy, individuals, communities and countries can help to reduce the number of greenhouse gases we are all pumping into the atmosphere. However, it can cost money to switch from one source of energy to another.

For example, if your community already has a diesel generator, is it going to want to spend more money on setting up wind turbines or solar panels? The upfront costs of switching over to a new source of energy can be a barrier for many homeowners and communities.

However, many who have made the investment in new renewable technologies end up saving a lot of money every year on their energy bills! You have to pay money to run an oil furnace or a diesel generator. But energy provided by the sun, wind, and ground heat is free!

So it might cost more money to set up a new renewable source of energy, but the annual cost of running it will be a lot lower than the non-renewable technology. Eventually, the upfront cost of installing a new technology will be recovered from the annual savings in energy costs!

Where to Next?

Switching to renewable energy offers some exciting opportunities for the future. New businesses are already taking advantage of the shift to more renewable and cleaner forms of energy. These businesses are growing quickly.

Some people argue against making the shift to renewable energy. It makes you wonder if these same people had been alive in the past, would they have argued that the car would never replace the horse and buggy? A couple of centuries ago we made the shift to using mostly fossil fuels for our energy. There is no reason we can't make another shift to new energy and cleaner sources! But all of us need to start asking energy companies, businesses and governments to begin that shift!

To find out more about what you and your family can do to reduce your own GHGs, check out Backgrounders 14 and 15. To find out what governments and businesses are doing, look at Backgrounder 17.

Key Points

- Renewable energy can be used over and over again and it usually doesn't produce any greenhouse gas emissions.
- Non-renewable energy is something that can only be used once. Most non-renewable sources of energy (oil, gas and coal) produce greenhouse gases when they are used.
- Water can be used to create hydropower, a renewable energy. Large hydropower projects can create some environmental problems but smaller "micro-hydro" projects usually have a low impact on the environment.
- Other sources of renewable energy include: wind, sun, heat from the ground (or from water under the ground), biomass, biogas and hydrogen fuel.

Want to Know More?

Learn more about the basics of renewable energy and specific forms of renewable energy by checking out these sites:

- **CanREN Youth Site:** http://canren.gc.ca/school/index.asp – Links to about 20 sites on renewable energy, ranging from wind power to solar cookers.
- **Energy Solutions Centre:** http://www.nrgsc.yk.ca – Links to Green Power and Energy Efficiency initiatives in Yukon.
- **Re-Energy:** http://re-energy.ca – Background information, and project instructions for all kinds of renewable energy projects: solar cars, turbines, biogas generators, and more.
- **Solar School:** http://das.ee.unsw.edu.au/~solar/index.html – An animated Australian site, with background information on climate change and renewable energy, plus some interesting Australian examples of solar energy projects.
- **Yukon Department of Environment:** http://www.environmentyukon.gov.yk.ca/epa/climate.shtml – Click on 'Reducing Home Energy Use' and 'Transportation and Greenhouse Gases' for some great ideas on how to reduce your greenhouse gas emissions.