HOW DO WE USE FLOW RESOURCES FOR ENERGY?

Our energy needs are increasing. To meet these needs, people use resources such as wood, coal, oil, and gas. However, not all countries have large supplies of these natural resources or can easily purchase them. As well, use of these resources causes high levels of air pollution and most of them are non-renewable. At some point, they will run out. For these reasons, many countries with steady and high levels of sunshine and wind, fast-flowing rivers, or access to ocean tides and waves are turning to flow resources to generate power.

USING WATER TO CREATE POWER

For thousands of years, people have used the energy created by the moving or falling water of rivers to help with many tasks. Today, there are a number of factors that determine whether a country will use flow energy to generate electricity or not. However, countries with powerful rivers and hilly landscapes have the best geography for generating hydroelectric power, while countries with coastal waters have opportunities for creating electricity using tidal and wave power.

HYDROELECTRIC DAMS

Some hydro dams are built on fast-flowing rivers or rivers with a large drop in elevation. The dam directs the water so that it flows through a turbine. This turns the blades, and the spinning turbine turns a shaft that connects to a generator. It converts the energy of the falling water into electrical energy. Figure 7.18 shows the connection between the water, turbine, generator, and the hydro tower.

China produces the most hydropower in the world. In 2008, four countries—Albania, Bhutan, Lesotho, and Paraguay (Figure 7.19)—created all their electricity from hydropower.

FIGURE 7.18 How a hydroelectric dam works
There are different perspectives on whether hydroelectricity can be a sustainable energy source for the future. It does not use fossil fuels or cause much pollution. However, a dam changes the flow of a river. This can alter, or destroy, habitats for fish or wildlife. A dam can result in local flooding, which can damage or eliminate unique ecosystems in the region.

**OCEAN TIDES**

Tides, which are the rise and flow of the ocean, occur once or twice a day. There are several methods used today to turn tidal power into electricity. One is the tidal barrage. A **tidal barrage** is a large dam used in locations where there is a great range between high and low tides. When the tide comes in, water rises behind the dam. As it flows back to the ocean, it turns turbines in the dam. The turbines create electricity through generators.

**FIGURE 7.19** Itaipu Dam, on the border of Paraguay and Brazil, is the largest hydroelectric power plant in the world.

**Where does my electricity come from?**

**tidal barrage** dam built across a river, bay, or estuary that controls the flow of water from tides through turbines to create electricity
USE OF TIDAL POWER TECHNOLOGY

One advantage of using tidal energy is that the energy source is reliable. Tides rise and fall every day without fail. However, a tidal barrage does affect ecosystems. For example, it slows the ebb of the tide. This means that beaches that were normally drained of water during low tide are no longer exposed for as long as they used to be. The tidal barrage changes the timing of the water levels, which changes the growth of algae and the creatures that depend on it for survival. Fish migration can change, and so can the salt levels in an estuary. Marine animals can get caught in the quickly moving blades of the barrage turbines.

WAVES CREATE POWER

There are only a few experimental wave generator plants in use. They are installed on or below the surface of the ocean. It is estimated that if wave power were harnessed properly, it could provide 10 percent of the world’s energy supply. Figure 7.20 shows an example of a wave generator.

However, waves are not consistent and forceful everywhere in the ocean. Wave-generator technology would have to be able to resist salt water and storms. The technology is new and undergoing development, so it is still expensive. On the other hand, wave generators do not release chemicals into the environment. There are many places where generators could be placed, since the ocean is so large. As well, they seem to have a low impact on the environment.
USING WIND TO CREATE ENERGY

For thousands of years, energy from the wind has been used to power boats with sails and to pump water. More recently, wind power has been used to generate electricity. Wind turbines are tall towers with blades. The wind turns the blades, which turn gears. These are connected to a generator. It converts the wind energy to electricity.

In some places, wind power is used on a small scale. For example, wind turbines provide electricity to communities that do not have a regular source of electricity.

There are many wind farms around the world. Some of them are in deserts, between mountains, and on the windy foothills of mountain ranges. Some wind farms are set up offshore to capture the power of ocean winds. Figure 7.21 shows which countries produced the most wind power in 2013. In 2013, wind farms in Canada were powering more than 2 million homes, making up 1.5 percent of Canada’s total electricity demand. Using wind instead of coal to produce electricity for 200 homes has the same effect as taking 417 cars off the road or planting 10,000 trees.

WIND POWER

Wind power has a smaller effect on the environment than burning coal, oil, or gas. The cost of using the technology is lower, and it does not require fuel to operate. It does not create pollution. Scientists are finding ways to store wind power so the energy can be used even when the wind is not blowing.

However, there are difficulties with wind power. Wind turbines must be located in areas of high winds. Winds do not blow at consistent speeds. They do not blow all the time. Because they need to be maintained, wind turbines cannot be built in areas that are too mountainous or too difficult to access. Some people complain that turbines located near human settlements interfere with the view. Also, environmentalists claim that bird and bat populations are negatively affected by wind farms.

![Wind Power Produced Worldwide, 2013](image)

**FIGURE 7.21** Countries around the world are building onshore and offshore wind farms on a large scale. In 2013, China produced more wind power than any other country.
As you learned in the Introduction, when geographers look at the significance of a place, they also look at interrelationships. Interrelationships can be simple, such as the connection between hikers and the forest they are hiking through. A geographer might ask: What happens to this environment when people hike through it? What changes when more people visit? What happens when people stop visiting?

When geographers examine interrelationships, they usually ask questions such as these:
- What causes these connections?
- What characteristics does the physical environment in a specific area have?
- What characteristics does the human environment in a specific area have?
- Does a physical environment have an impact on the way people use resources or live?
- How do people adapt their behaviour based on the physical environment?
- How do people change the physical environment?
- Do all places have similar interrelationships?
- How do these connections affect the lives of people living in a specific area?

**CAIRNGORMS NATIONAL PARK**

Interrelationships can also be very complex. For example, in 2011, a wind farm company in Scotland applied to build a wind farm near a famous national park, Cairngorms (Figure 7.22). People live and work in the villages within the park boundaries. The wind farm company promised that the turbines would be well hidden from view by a natural ridge. They claimed that people would not see or hear the turbines. One of the local councils supported the building of the turbines, believing that it would reduce the community’s energy costs.

The National Park Authority and the Scottish National Government opposed the development of the wind farm. The local people and outdoors enthusiasts from around the world believed that the wind farm turbines would be visible from most areas of the park, ruining the scenery.

**TRY IT**

1. There are already complex interrelationships between the people who live near or enjoy Cairngorms National Park and the natural environment. How might building a wind farm change these connections? Create questions a geographer would ask to try to understand these connections.

2. Identify a situation in your own community where the natural environment and the human environment are interconnected. Create questions you could ask to help you focus on these connections and understand them better.
USING THE SUN TO CREATE ENERGY

The Sun produces more energy than all of our other energy sources combined. Solar power technologies capture thermal energy, which is the light energy of the Sun.

Using thermal energy can be as simple as opening the blinds in your living room and letting the Sun’s rays shine in and warm the room. Solar thermal collectors can heat a household water tank or a swimming pool. These contain thin plates that absorb the Sun’s heat. Tubes transfer the heat to the water tank or pool.

Another kind of solar power technology converts sunlight into energy in a similar way, but on a much larger scale. It uses large arrays of mirrors to reflect sunlight. The sunlight is concentrated onto a small area (Figure 7.23). Here, a fluid, such as water, is heated and turned into steam. The steam turns a turbine, which generates electrical energy. Another technology that creates solar power is the solar cell, or photovoltaic cell. It is a device containing materials that turn light into energy. The solar facility shown in Figure 7.23 provides electricity for as many as 5500 homes.

SOLAR POWER

Solar power has little impact on the environment. It does not create any noise or pollution. It does not emit any greenhouse gases.

However, solar panels need a large amount of space in order to create a base amount of energy. They cannot produce electrical energy at night. Cloudy weather, air pollution, and seasonal changes can change or limit the amount of sunlight that reaches them. The amount of sunlight an area receives is also affected by geographic location. Areas that receive more than 2000 hours of sunlight will benefit most from the use of solar technology.

CHECK-IN

1. COMMUNICATE With a partner, create a cartoon to explain the positive and negative aspects of one form of flow resource energy from the perspective of a bird or another animal species.

2. EVALUATE AND DRAW CONCLUSIONS What kind of flow resource energy would you suggest Canadians use more frequently, and why?

3. SPATIAL SIGNIFICANCE On a world map, indicate where you think the best locations would be to install technologies to create energy from the Sun, the wind, and the tides and ocean currents. How might knowing about the geography and culture of an area help you make these decisions?