# Your ECOLOGICAL *footprint*

## Your Renewable Energy Footprint

In Chapter 20 you calculated your "fossil fuel footprint"—the quantity of fossil fuels you use directly and indirectly. In the long run we know that the use of oil and other fossil fuels is not sustainable because they are nonrenewable. Replacing fossil fuels with renewable energy sources has important implications for land use and biological productivity. What would your energy footprint look like if you replaced all the fossil fuels you use with renewable energy?

You can answer by calculating the land required to produce a renewable but technologically equivalent substitute for oil. Ethanol is one possible substitute for oil. The land equivalent of oil can therefore be represented as the productive land necessary to grow the biomass that is converted to the equivalent amount of ethanol. How much land would you need to replace your use of oil with a renewable substitute?

1. Find your consumption of oil from Chapter 20's Your Ecological Footprint. Convert that quantity of oil to Btu.

   Energy content of = _____ Btu oil consumption (Btu)

2. Convert your consumption of oil measured in Btu to gallons of oil (1 gallon oil = 130,000 Btu).

   Convert oil consumption = _____ Btu × 1 gallon/130,000 Btu to gasoline equivalent (gallons)

3. Convert your consumption of oil measured in gallons to ethanol (1 gal gasoline = 130,000 Btu; 1 gal ethanol = 76,000 Btu).

   Gallons ethanol needed = _____ gallons gasoline × (1.64 gals ethanol/gal gasoline) to replace 1 gallon gasoline

4. Convert your consumption of ethanol measured in gallons to the quantity of corn needed to produce that ethanol (1 bushel corn yields 2.5 gals ethanol).

   Quantity of corn needed = _____ gallons ethanol × (1 bushel corn/2.5 gal ethanol) to produce ethanol (bushels)

5. Convert the quantity of corn used to produce ethanol to the quantity of land needed to grow that corn (U.S. average corn yield = 110 bushels/acre).

   Quantity of cropland needed = _____ bushels corn × (0.0091 acres/bushel corn) to grow corn (acres)

This last number is the amount of cropland that would be needed to grow the corn needed to replace your use of oil with ethanol.

### STUDENT LEARNING OUTCOME

- Students will be able to describe the land requirements for biomass fuels.

**Biopower** is the use of biomass to generate electricity. Most biopower plants use direct-fire systems that burn biomass feedstocks directly to produce steam that is captured by a turbine and converted by a generator into electricity. In the lumber and paper industries, wood scraps are sometimes directly fed into boilers to produce steam for manufacturing processes or to heat buildings. Gasification systems use high temperatures and an oxygen-starved environment to convert biomass into a gas (a mixture of hydrogen, carbon monoxide, and methane).

### Environmental Impacts of Biomass

Biomass currently supplies about 12% of the world's energy. This major utilization of biomass, in addition to habitat destruction and environmental pollution, contributes to the loss of biodiversity that we discussed in Chapter 12. Harvesting and processing biomass can have significant environmental impacts. Removing vegetation always has implications for soil quality, nutrient cycling, water availability, and biodiversity. Harvesting crop residues, for example, can accelerate soil erosion and deplete the soil of nitrogen and other important nutrients.

One of the most important attributes of bioenergy is its effect on the carbon cycle. If the land from which biomass is harvested is replanted and managed sustainably, the growing trees and other plants remove carbon dioxide from the atmosphere during photosynthesis and store the carbon in their structures. When the biomass is burned, the carbon released back to the atmosphere will be recycled into the next generation of growing plants. When biomass is used for fuel in place of fossil fuels, the carbon in the displaced fossil fuel remains in the ground rather than being discharged to the atmosphere as carbon dioxide. The growth rate of the trees becomes an important consideration. Whereas slow-growing trees can take a long time to recapture released carbon, fast-growing trees can recycle carbon rapidly and will displace fossil fuel use with every cycle.