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## 12.0 Nonrenewable Energy: Coal, Oil, Natural Gas, and Nuclear Fuels

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An oil refinery in Antwerp, Belgium.

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**"The United States is dependent on fossil and nuclear fuels for energy and we are constantly reminded of the adverse consequences of this dependence."**

### **There Are No Good Energy Choices**

On April 20, 2010, an explosion and fire occurred at the British Petroleum Deepwater Horizon oil rig in the Gulf of Mexico. Oil gushed from the rig until it was capped 87 days later, on July 15th. The BP accident killed 11 workers on the drilling platform, injured 17 others, and released more than 780 million liters (206 million gallons) of oil into the gulf. Scientists from the Center for Biological Diversity later estimated that at least 6,000 sea turtles, 26,000 marine mammals, and more than 82,000 birds were killed as a result of the spill. The oil spread through the Gulf of Mexico and washed up on the shores of Louisiana, Mississippi, Alabama, and Florida.

Until the Deepwater Horizon incident, the largest spill in U.S. waters had been the March 1989 *Exxon Valdez* accident, when the *Valdez*, a supertanker carrying 200 million liters (53 million gallons) of oil, crashed into a reef in Prince William Sound, Alaska. Roughly 42 million liters (11 million gallons) of oil spilled into the sound. Much of it washed up on shore, contaminating the coastline and killing perhaps half a million birds and

thousands of marine mammals. The number of dead animals was so much greater in the *Exxon Valdez* accident because the spill occurred in a relatively enclosed sound rather than in open waters, such as those in the Gulf of Mexico where the BP accident occurred.

Previous and subsequent oil spills around the world—both on land and in water—have attracted national and international attention. Some spills are caused by leaks or explosions at wells. Others occur when oil is being transported by pipeline or tanker. Accidents can happen even after oil is extracted and transported to a refinery. In 2005, fifteen workers died in an explosion at a British Petroleum oil refinery in Texas. The hazards of fossil fuel use do not end with production. After the oil is refined into gasoline, jet fuel, or diesel fuel, it is used to run vehicles and heat buildings. This combustion process emits pollutants, which cause a number of environmental and human health problems.

Other fossil fuels pose similar risks. In the early 1900s, there were hundreds of accidental coal-mining deaths each year in the United States. While safety measures have improved, mining is still a dangerous business. In April 2010, the worst U.S. coal mine explosion in 40 years killed 29 miners in West Virginia. Long after they leave the mines, tens of thousands of coal miners develop black lung disease and other respiratory ailments that lead to disability or death.

Natural gas is often considered to be a “clean” fossil fuel because its combustion produces lower amounts of particulates, sulfur dioxide, and carbon dioxide than do oil or coal. However, the production of natural gas has negative consequences. “Thumper trucks,” which generate seismic vibrations to identify natural gas deposits underground, can disturb soil and alter groundwater flow, causing some areas to flood and wells to go dry. Drilling for natural gas can also contaminate drinking water. As explained in the opener to Chapter 1, an increasing proportion of natural gas in the United States is now being extracted by hydraulic fracturing, or *fracking*. Once extracted, natural gas requires pipelines to transport it. Pipeline construction is disruptive to the environment and is often opposed by those who live in the affected communities. And even if natural gas is the “clean” fossil fuel, its combustion still results in emission of carbon dioxide, which is the major greenhouse gas produced by human activity.

Nuclear energy—which is not a fossil fuel, but a nonrenewable energy resource—has contributed to energy catastrophes as well. Most recently, a 2011 earthquake off the coast of Japan resulted in a tsunami that damaged the nuclear reactors at the Fukushima nuclear power plant, leading to the release of radioactive gases (see p. 335 for further discussion). Even when operating properly, a nuclear power plant generates radioactive nuclear waste. Storage of this waste is currently an unresolved environmental challenge.

The United States is dependent on fossil and nuclear fuels for energy and we are constantly reminded of the adverse consequences of this dependence. Many of the benefits of our modern society—health care, comfortable living conditions, easy travel, abundant food—rely on readily accessible and relatively affordable fossil and nuclear fuels—but the costs to society are high.



An offshore oil drilling platform.

Sources: S. McGraw, *The End of Country* (Random House, 2011); L. Margonelli, *Oil on the Brain* (Broadway Books, 2008).

## UNDERSTAND THE KEY IDEAS

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We use energy in all aspects of our daily lives: heating and cooling, cooking, lighting, communications, and travel. In these activities, humans convert energy resources such as natural gas and oil into useful forms of energy such as motion, heat, and electricity, with varying degrees of efficiency and environmental effects. We learned the fundamental energy concepts underlying these conversions in Chapter 2. This chapter focuses on conventional, nonrenewable energy resources—coal, oil, natural gas, and nuclear fuels.

After reading this chapter you should be able to

- describe how energy use and energy resources have varied over time, both in the United States and worldwide.
  - compare the energy efficiencies of the extraction and conversion of different fuels.
  - explain the various means of generating electricity.
  - discuss the uses and consequences of using coal, oil, natural gas, and nuclear fuels.
  - describe projections of future supplies of our conventional energy resources.
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