KEY ISSUE 3

Why Are Energy Resources Important for Development?

Learning Outcome 9.3.1
Explain the principal sources of demand for fossil fuels.

- **Energy Supply and Demand**
- **Alternative Energy Sources**

Development is based on availability of abundant low-cost energy. Developed countries use large quantities of energy to produce food, run factories, keep homes comfortable, and transport people and goods. Developing countries expect to use more energy to improve the lives of their citizens.

In Chapter 1, we distinguished between renewable resources (those produced in nature more rapidly than consumed by humans) and nonrenewable resources (those produced in nature more slowly than consumed by humans). Most of the energy resources used by humans are nonrenewable. In the long run, sustainable development will necessitate increased reliance on renewable energy.

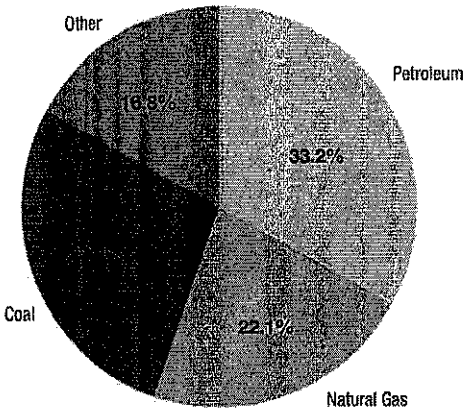
Energy Demand and Supply

Supply is the quantity of something that producers have available for sale. **Demand** is the quantity that consumers are willing and able to buy. Five-sixths of the world's energy needs are supplied by three of Earth's substances (Figure 9-25):

- **Coal.** Coal supplanted wood as the leading energy source in North America and Europe in the late 1800s, as these regions developed rapidly.
- **Petroleum.** Petroleum was first pumped in 1859 but did not become an important source of energy until the diffusion of motor vehicles in the twentieth century.
- **Natural gas.** Natural gas was originally burned off as a waste product of petroleum drilling, but it is now used to heat homes and to produce electricity.

In a developed country like the United States, dependency on these three sources of energy increased rapidly during the twentieth century (Figure 9-26).

Petroleum, natural gas, and coal are known as fossil fuels. A **fossil fuel** is an energy source formed from the residue of plants and animals buried millions of years ago. As sediment accumulated over these remains, intense pressure and chemical reactions slowly converted them into the fossil fuels that are currently used. When these substances are burned, energy that was stored in plants and animals millions of years ago is released.



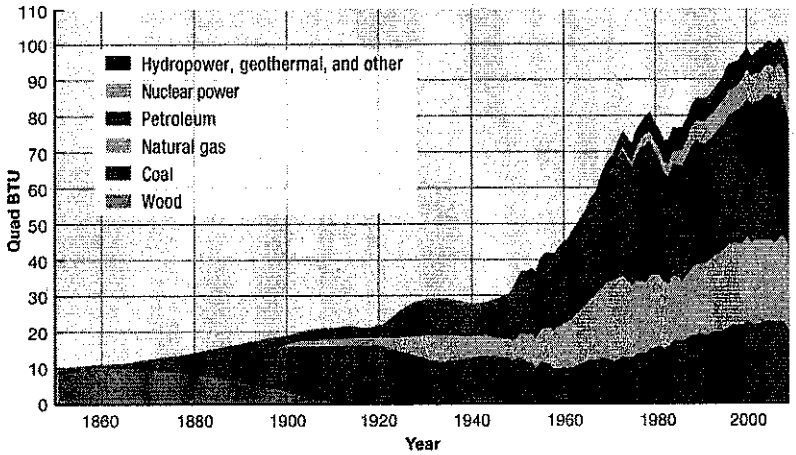
▲ FIGURE 9-25 **WORLD ENERGY DEMAND** Petroleum, coal, and natural gas account for most of the world's energy consumption.

Geographers observe two important inequalities in the global distribution of fossil fuels:

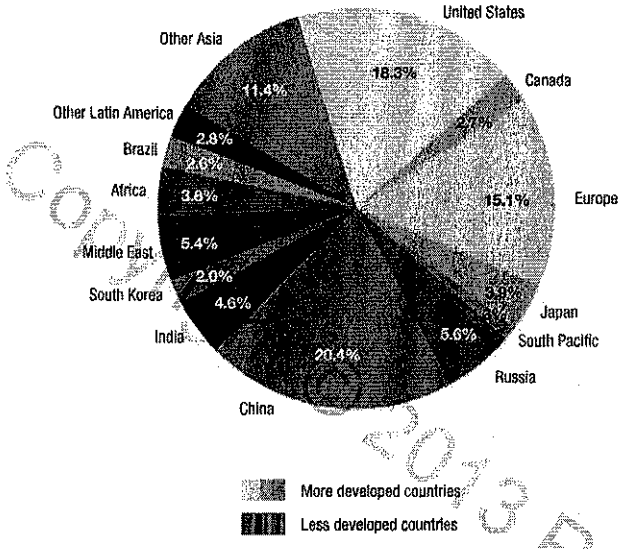
- **Demand.** The heaviest consumers of fossil fuel are in developed countries, whereas most of the reserves are in developing countries.
- **Supply.** Some developing regions have abundant reserves, whereas others have little.

Given the centrality of fossil fuels in contemporary economy and culture, unequal consumption and reserves of fossil fuels have been major sources of instability between developed and developing countries.

Pause and Reflect 9.3.1
Which energy source increased most rapidly in the United States during the twentieth century?



▲ FIGURE 9-26 **CHANGING U.S. ENERGY DEMAND** Coal was the principal energy source in the nineteenth century. Petroleum and natural gas became important in the twentieth century.



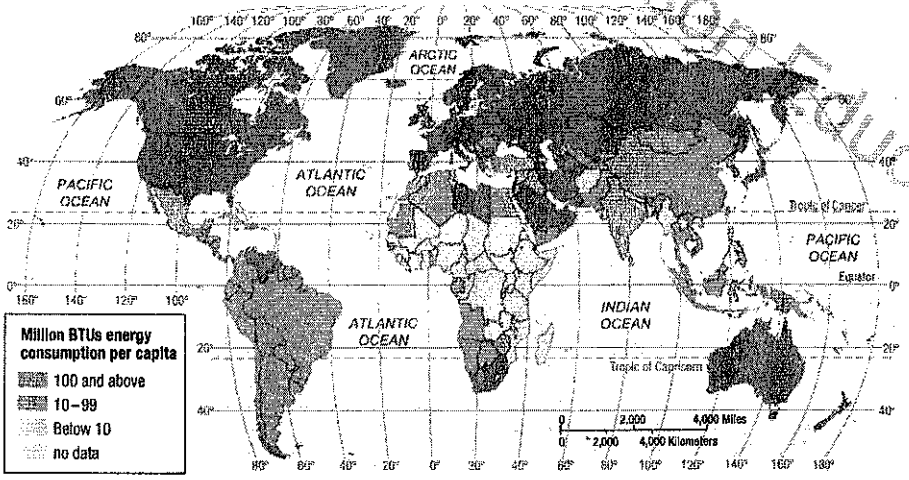
▲ FIGURE 9-27 **SHARE OF WORLD ENERGY DEMAND** Developed and developing countries each consume around one-half of the world's energy.

DEMAND FOR ENERGY

Around one-half of the world's energy is consumed in developed countries and one-half in developing countries (Figure 9-27). The United States had long been the leading consumer of energy, but China now consumes 20 percent of the world's energy, followed by the United States, at 18 percent. The highest per capita consumption of energy is in North America; the region contains one-twentieth of the world's people but consumes one-fourth of the world's energy (Figure 9-28). Developed countries contain only around one-third of the population of developing countries, so per capita consumption of energy is thus around three times higher in developed countries than in developing countries.

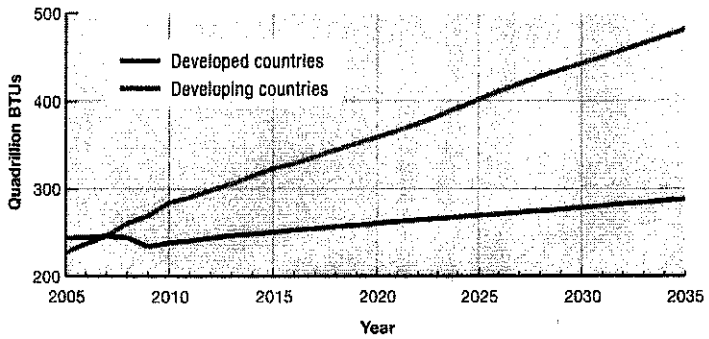
Demand for energy comes from three principal types of consumption in the United States:

- **Businesses.** The main energy demand is for coal, followed by natural gas and petroleum. Some businesses directly burn coal in their own furnaces. Others rely on electricity, mostly generated at coal-burning power plants.
- **Homes.** Energy is demanded primarily for the heating of living spaces and water. Natural gas is the most common source, followed by petroleum (heating oil and kerosene).
- **Transportation.** Almost all transportation systems demand petroleum products, including cars, trucks, buses, airplanes, and most railroads. Only subways, streetcars, and some trains run on coal-generated electricity.



▲ FIGURE 9-28 **ENERGY DEMAND PER CAPITA** The highest per capita consumption is in North America, and the lowest is in sub-Saharan Africa.

In 2007, demand for fossil fuel consumption in developing countries surpassed that of developed countries for the first time (Figure 9-29). The gap in demand between developing and developed countries is expected to widen considerably in the years ahead because consumption of fossil fuels has been increasing at a much faster rate in developing countries—around 3 percent per year, compared to 1 percent per year in developed countries. Increasing reliance on fossil fuels also undermines the goals of sustainable development.



▲ FIGURE 9-29 **FUTURE ENERGY DEMAND** Developing countries are expected to consume 62 percent of the world's energy in 2035.

ENERGY SUPPLY

Learning Outcome 9.3.2

Describe the distribution of production of the three fossil fuels.

Energy is required for development, but Earth's energy resources are not distributed evenly. Why do some regions have an abundant supply of reserves of one or more fossil fuels, but other regions have little? This partly reflects how fossil fuels form.

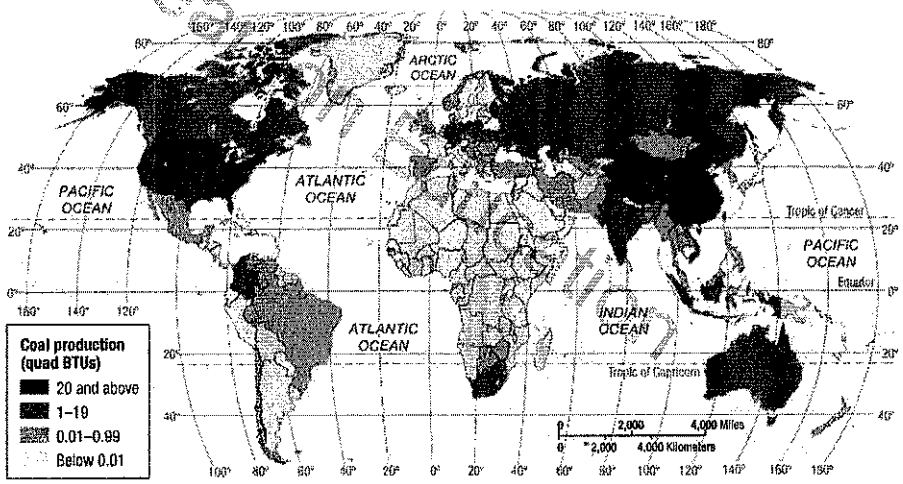
- **Coal.** Coal formed in tropical locations, in lush, swampy areas rich in plants. Thanks to the slow movement of Earth's drifting continents, the tropical swamps of 250 million years ago have relocated to the mid-latitudes. As a result, today's main reserves of coal are in mid-latitude countries rather than in the tropics. China is responsible for supplying nearly one-half of the world's coal, other developing countries one-fourth, and developed countries (primarily the United States) the remaining one-fourth (Figure 9-30).
- **Petroleum.** Petroleum formed millions of years ago from residue deposited on the seafloor. Some still lies beneath such seas as the Persian Gulf and the North Sea, but other reserves are located beneath land that was under water millions of years ago. Russia and Saudi Arabia together supply one-fourth of the world's petroleum, other developing countries (primarily in Southwest and Central Asia) one-half, and developed countries (primarily the United States) the remaining one-fourth (Figure 9-31).
- **Natural gas.** Natural gas, like petroleum, formed millions of years ago from sediment deposited on the seafloor. One-third of natural gas production is supplied by Russia and Southwest Asia, one-third by other developing regions, and one-third by developed countries (primarily the United States) (Figure 9-32). Within the United States, the principal natural gas fields are in Texas, Oklahoma, and the Appalachian Mountains (Figure 9-33).

Figures 9-30, 9-31, and 9-32 use the same units (quad BTU), as well as the same classes. "Quad" is short for quadrillion (1 quadrillion = 1,000,000,000,000,000), and BTU is short for British thermal unit. One quad BTU equals approximately 8 million U.S. gallons of gasoline, which would fill the tanks of one-half million cars.

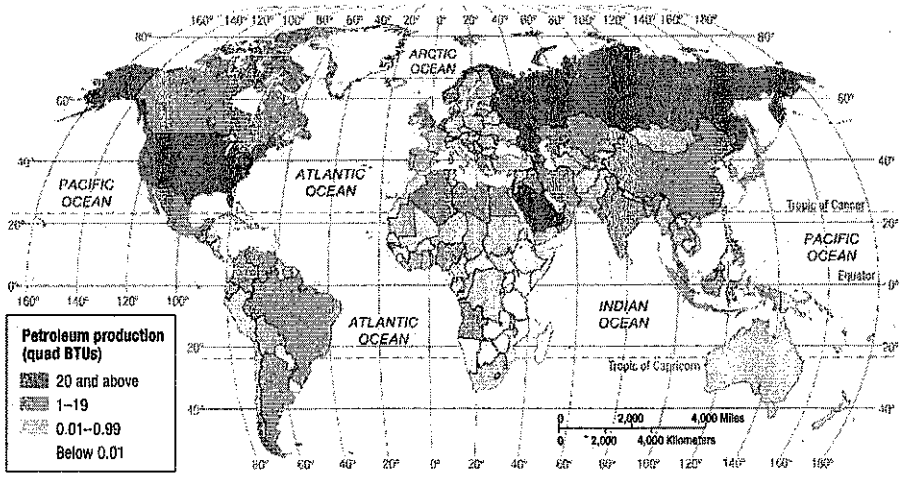
Pause and Reflect 9.3.2

Which country produces at least 20 quad BTUs of all three of the fossil fuels?

Developed countries supply a large share of the world's fossil fuels, but they demand more energy than they produce, so they must import fossil fuels, especially petroleum, from developing countries. The United States and Europe import more than half their petroleum, and Japan imports more than 90 percent. With demand increasing rapidly in developing countries, the developed countries face greater competition in obtaining the world's remaining supplies of fossil fuels. Many of the developing countries with low



▲ FIGURE 9-30 **COAL PRODUCTION** China is the world's leading producer of coal, followed by the United states.

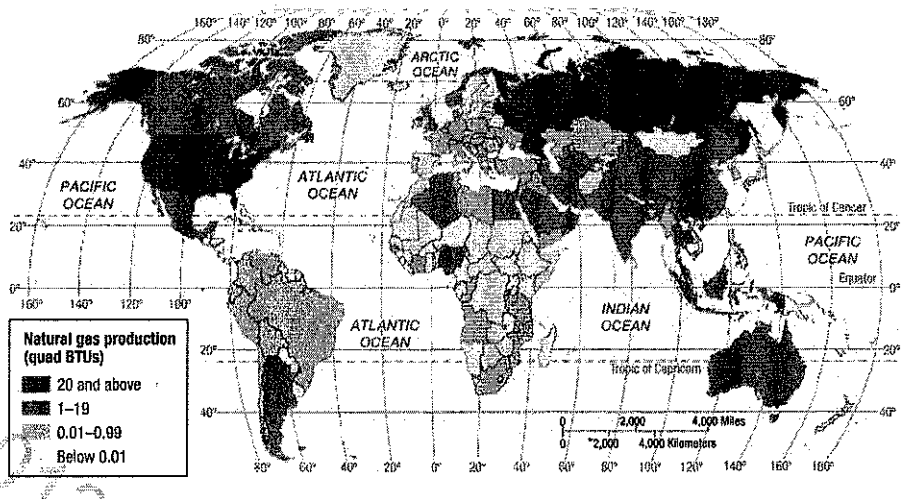


▲ FIGURE 9-31 **PETROLEUM PRODUCTION** Russia, Saudi Arabia, and the United States are the leading producers of petroleum.

HDIs also lack energy resources, and they lack the funds to pay for importing them.

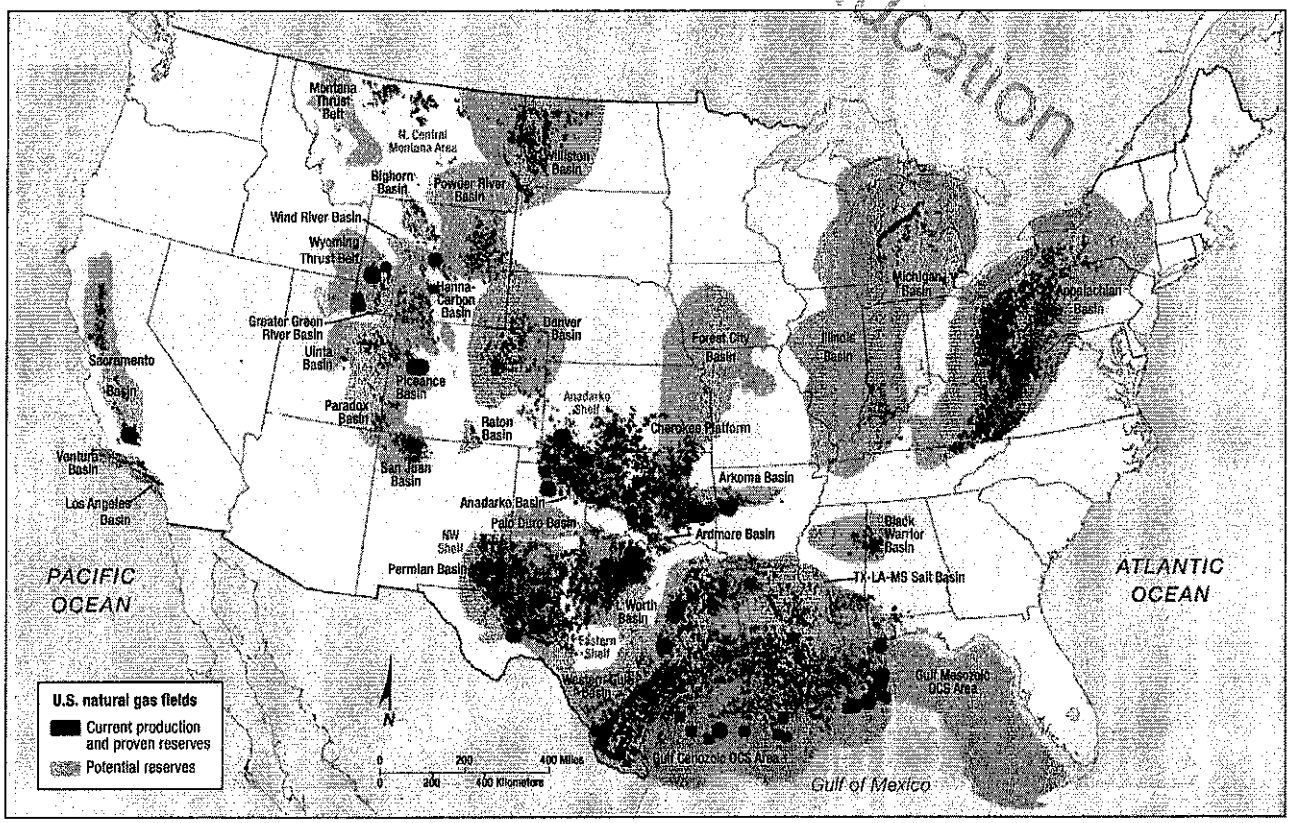
Compounding future energy challenges, Earth's energy resources are divided between those that are renewable and those that are not:

- **Renewable energy** has an essentially unlimited supply and is not depleted when used by people. Examples include hydroelectric, geothermal, fusion, wind, biomass, and solar energy.
- **Nonrenewable energy** forms so slowly that for practical purposes, it cannot be renewed. Examples are the three fossil fuels that currently supply most of the world's energy needs.



▲ FIGURE 9-32 **NATURAL GAS PRODUCTION** The United States and Russia are the leading producers of natural gas.

Because of dwindling supplies of fossil fuels, most of the buildings in which people live, work, and study will have to be heated another way. Cars, trucks, and buses will have to operate on some other energy source. Because plastic is made from petroleum, objects made of plastic will have to be made from other materials. Other resources can be used for heat, fuel, and manufacturing, but they are likely to be more expensive and less convenient to use than fossil fuels. And converting from fossil fuels will likely disrupt daily lives and cause hardship. On the other hand, the search for alternatives to fossil fuels may also create development opportunities.



▲ FIGURE 9-33 **NATURAL GAS FIELDS IN THE UNITED STATES** The principal natural gas fields are in Oklahoma, Texas, and the Appalachians.

ENERGY RESERVES

Learning Outcome 9.3.3
Analyze the distribution of reserves of fossil fuels and differentiate between proven and potential reserves.

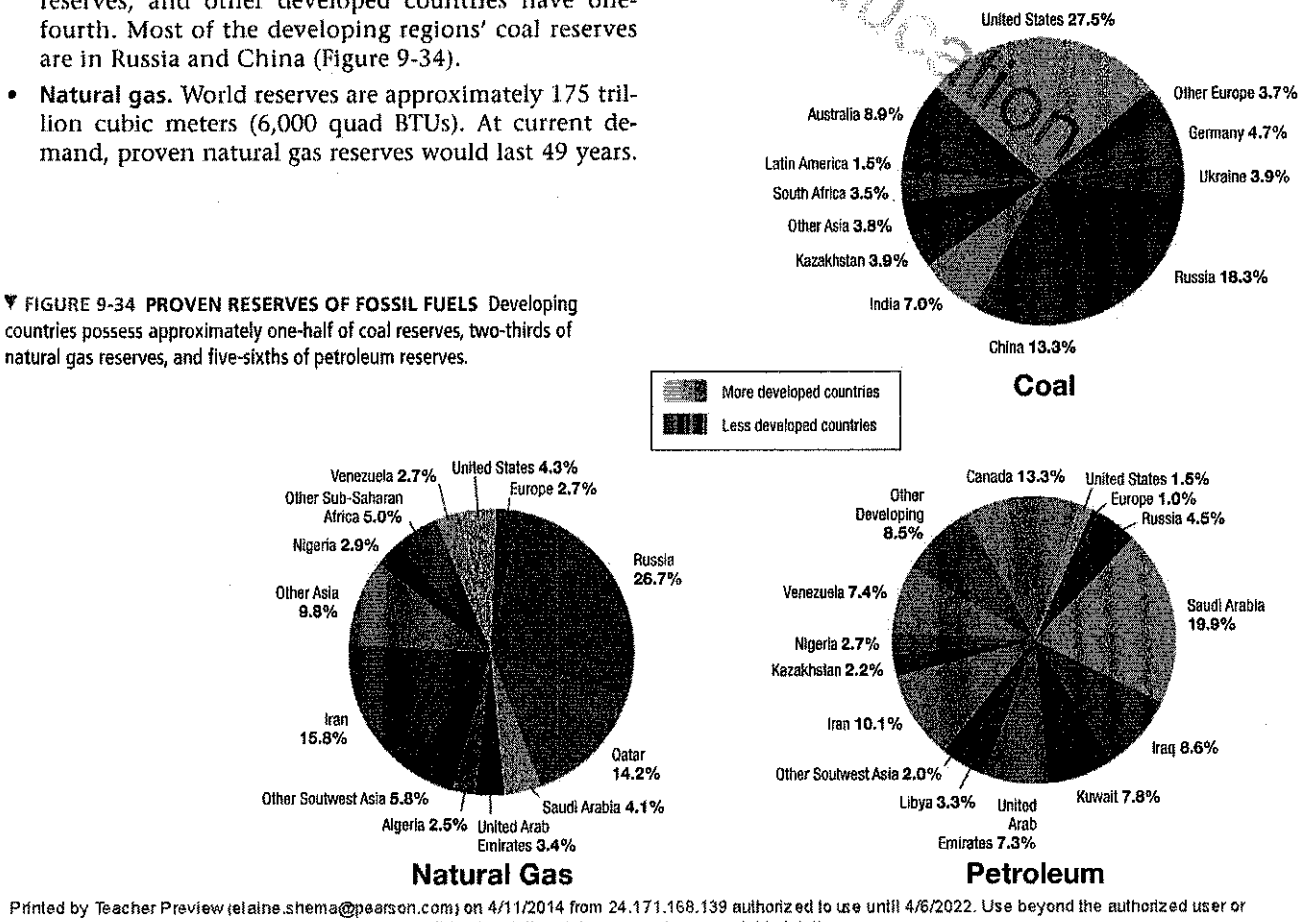
The world faces an energy challenge because of rapid depletion of the remaining supply of the three fossil fuels that current meet most of the world's energy needs. How much fossil fuel remains? Despite the critical importance of this question for the future, no one can answer it precisely. Because petroleum, natural gas, and coal are deposited beneath Earth's surface, considerable technology and skill are required to locate these substances and estimate their volume.

PROVEN RESERVES. The supply of energy remaining in deposits that have been discovered is called a **proven reserve.** Proven reserves can be measured with reasonable accuracy:

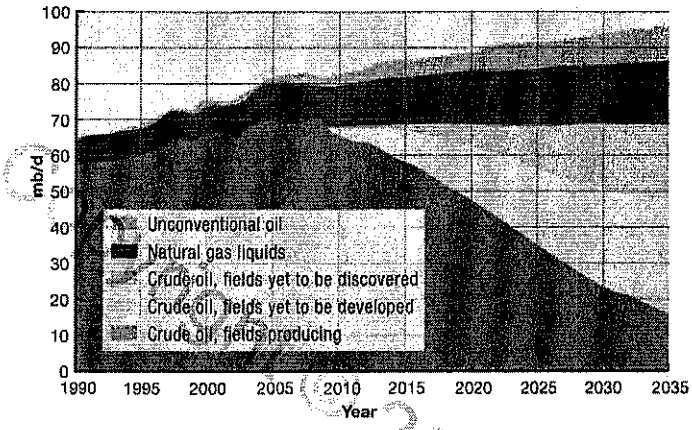
- **Coal.** World reserves are approximately 1 quadrillion metric tons (23 million quad BTUs). At current demand, proven coal reserves would last 131 years. Developed and developing regions each have about one-half of the supply of proven reserves. The United States has approximately one-fourth of the proven reserves, and other developed countries have one-fourth. Most of the developing regions' coal reserves are in Russia and China (Figure 9-34).
- **Natural gas.** World reserves are approximately 175 trillion cubic meters (6,000 quad BTUs). At current demand, proven natural gas reserves would last 49 years. Less than 10 percent of natural gas reserves are in developed countries, primarily the United States. The dark red areas in Figure 9-33 show proven reserve fields in the United States, as well as areas of current production. Russia, Iran, and Qatar together have nearly 60 percent of the world's proven natural gas reserves, and five other developing countries have most of the remainder.
- **Petroleum.** World reserves are approximately 1.3 trillion barrels (5,000 quad BTUs). At current demand, proven petroleum reserves would last 43 years. Developing countries possess 85 percent of the proven petroleum reserves, most of which is in Southwest Asia and North Africa and Central Asia. Saudi Arabia, Canada, and Iran together have more than 40 percent of the world's proven petroleum reserves.

Developed countries have historically possessed a disproportionately high supply of the world's proven fossil-fuel reserves. Europe's nineteenth-century industrial development depended on its abundant coal fields, and extensive coal and petroleum supplies helped the United States become the leading industrial power of the twentieth century.

But this dominance is ending in the twenty-first century. Many of Europe's coal mines have closed because either the coal has been exhausted or extracting the remaining supply would be too expensive, and the region's



▼ FIGURE 9-34 **PROVEN RESERVES OF FOSSIL FUELS** Developing countries possess approximately one-half of coal reserves, two-thirds of natural gas reserves, and five-sixths of petroleum reserves.



▲ FIGURE 9-35 **PETROLEUM PRODUCTION OUTLOOK** The International Energy Agency forecasts that potential reserves will be converted to proven reserves through discovery and development of new fields at about the same rate as already proven reserves are depleted.

petroleum and natural gas (in the North Sea) account for only small percentages of worldwide supplies. Japan has never had significant fossil fuel reserves. The United States still has extensive coal reserves, but its petroleum and natural gas reserves are being depleted rapidly.

Pause and Reflect 9.3.3

No country ranks among the leaders in proven reserves in all three fossil fuels. Which two countries possess at least 10 percent of the proven reserves of two of the three fossil fuels?

POTENTIAL RESERVES. Some fossil fuel deposits have not yet been discovered. The supply in deposits that are undiscovered but thought to exist is a **potential reserve**. When a potential reserve is actually discovered, it is reclassified as a proven reserve (Figure 9-35). Potential reserves can be converted to proven reserves in several ways:

- **Undiscovered fields.** The largest, most accessible deposits of petroleum, natural gas, and coal have already been exploited. Newly discovered reserves are generally smaller and more remote, such as beneath the seafloor, and extraction is costly. Exploration costs have increased because methods are more elaborate and the probability of finding new reserves is less. But as energy prices climb, exploration costs may be justified.
- **Enhanced recovery from already discovered fields.** When it was first exploited, petroleum "gushed" from wells drilled into rock layers saturated with it. Coal was quarried in open pits. But now extraction is more difficult. Sometimes pumping is not sufficient to remove petroleum, but water or carbon dioxide may be forced into wells to push out the remaining resource. The problem of removing the last supplies from a proven field is comparable to wringing out a soaked towel. It is easy to quickly remove the main volume of water, but the last few percent require more time and patience and special technology.
- **Unconventional sources.** Some sources are called unconventional because methods currently used to extract resources won't work. Also, we do not currently have economically feasible, environmentally sound technology with which to extract these sources.

An important example of an unconventional source is oil sands, which are saturated with a thick petroleum commonly called tar because of its dark color and strong odor. Native Americans used the tar to caulk canoes in the eighteenth century. The oil must be extracted from the sands through mining, which can be environmentally damaging, and current technology makes processing expensive. Abundant oil sands are found in Alberta, Canada, as well as in Venezuela and Russia. As demand has increased for petroleum, and as prices have risen, the mining of Alberta oil sands has become profitable, and extensive deposits of oil in Alberta oil sands have been reclassified from potential to proven reserves in recent years (Figure 9-36). As a result, Canada is now thought to have 13 percent of world's petroleum proven reserves, second behind Saudi Arabia, although overall oil sands are still classified as unconventional sources.

Another important unconventional source that has been increasingly exploited in recent years is extraction of natural gas through hydraulic fracturing, commonly called **fracking**. Rocks break apart naturally, and gas can fill the space between the rocks. Fracking involves pumping water at high pressure to further break apart rocks and thereby release more gas that can be extracted. Opponents of fracking fear environmental damage from pumping high-pressure water beneath Earth's surface. Safety precautions can minimize the environmental threat, but fracking does require the use of a large supply of water, and water is in high demand for other important uses, such as human consumption and agriculture.

▲ FIGURE 9-36 **CANADA'S OIL SANDS** Canada has the world's second-largest proven reserves of petroleum, which must be extracted from oil sands in Alberta.

CONTROLLING PETROLEUM RESERVES

Learning Outcome 9.3.4
Describe the role of OPEC and changes in the price and availability of petroleum.

Developed countries import most of their petroleum from Southwest Asia & North Africa and Central Asia, where most of the world's proven reserves are concentrated. These regions are the center of ethnic and political conflicts, as discussed in Chapters 7 and 8.

OPEC. Several developing countries possessing substantial petroleum reserves created the Organization of the Petroleum Exporting Countries (OPEC) in 1960. Arab OPEC members in Southwest Asia & North Africa include Algeria, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, and the United Arab Emirates. OPEC members in other regions include Angola, Ecuador, Iran, Nigeria, and Venezuela.

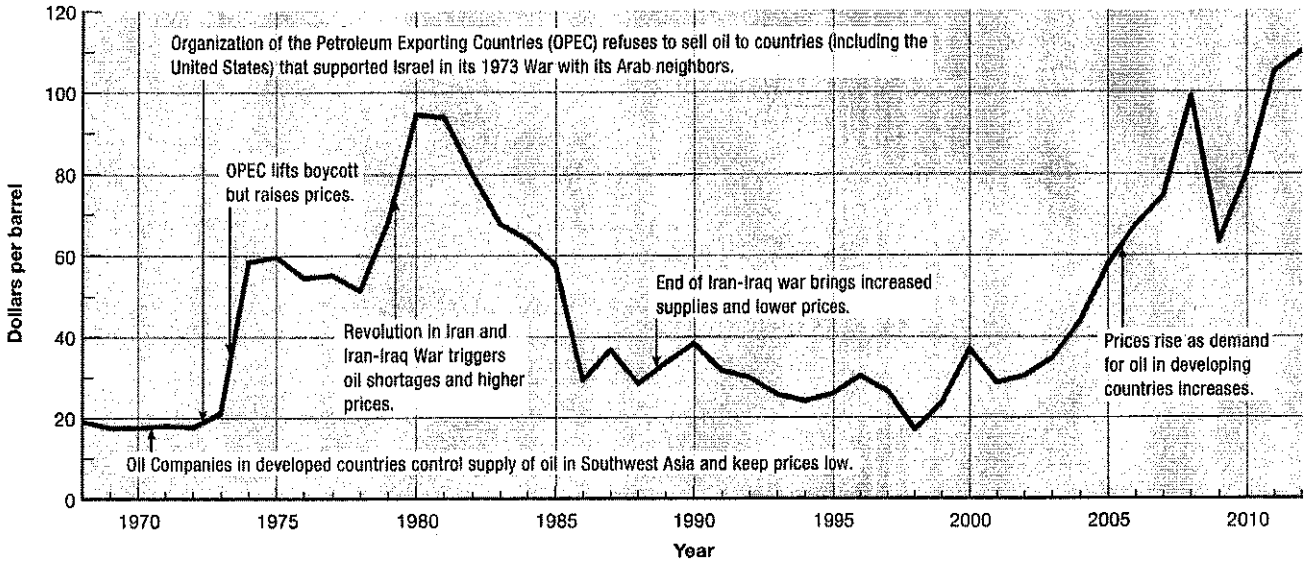
OPEC was originally formed to enable oil-rich developing countries to gain more control over their resource. U.S. and European transnational companies, which had originally explored and exploited the oil fields, were selling the petroleum at low prices to consumers in developed countries and keeping most of the profits. Countries possessing the oil reserves nationalized or more tightly controlled the fields, and prices were set by governments rather than by petroleum companies. Under OPEC control, world oil prices have increased sharply on several occasions, especially during the 1970s and 1980s and in the early twenty-first century (Figure 9-37).

CHANGING U.S. PETROLEUM SOURCES. The United States produced more petroleum than it consumed during the first half of the twentieth century. Beginning in the 1950s, the handful of large transnational companies then in control of international petroleum distribution determined that extracting domestic petroleum was more expensive than importing it from Southwest and Central Asia. U.S. petroleum imports increased from 14 percent of total consumption in 1954 to 58 percent in 2009 (Figure 9-38). European countries and Japan have always depended on foreign petroleum because of limited domestic supplies. China changed from a net exporter to an importer of petroleum during the 1990s.

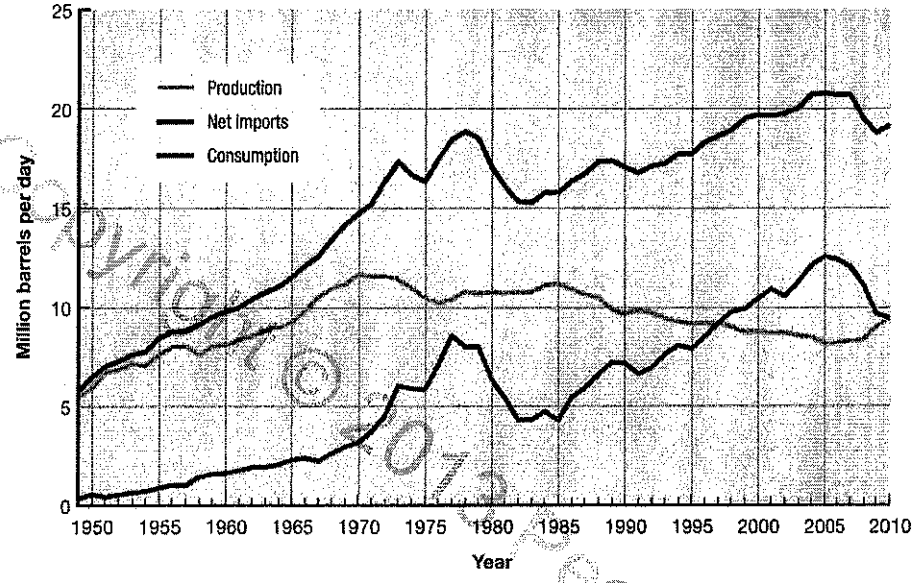
The United States reduced its dependency on imported oil in the immediate wake of the 1970s shocks, and the share of imports from OPEC countries declined from two-thirds during the 1970s to one-third during the 1980s (Figure 9-39). Conservation measures also dampened demand for petroleum in most developed countries during the late twentieth century. The average vehicle driven in the United States, for example, got 14 miles per gallon in 1975, compared to 22 miles per gallon in 1985.

The price of petroleum plummeted during the 1980s and settled during the 1990s at the lowest level in modern history, adjusting for inflation (Figure 9-40). With petroleum prices remaining low into the twenty-first century, consumption increased. Americans bought more gas-guzzling trucks and sport-utility vehicles and drove longer distances. Developed countries entered the twenty-first century optimistic that oil prices would remain low for some time. But in 2008, prices hit a record high, in both real terms and accounting for inflation. The 2008 oil shock contributed to the severe global recession that began then.

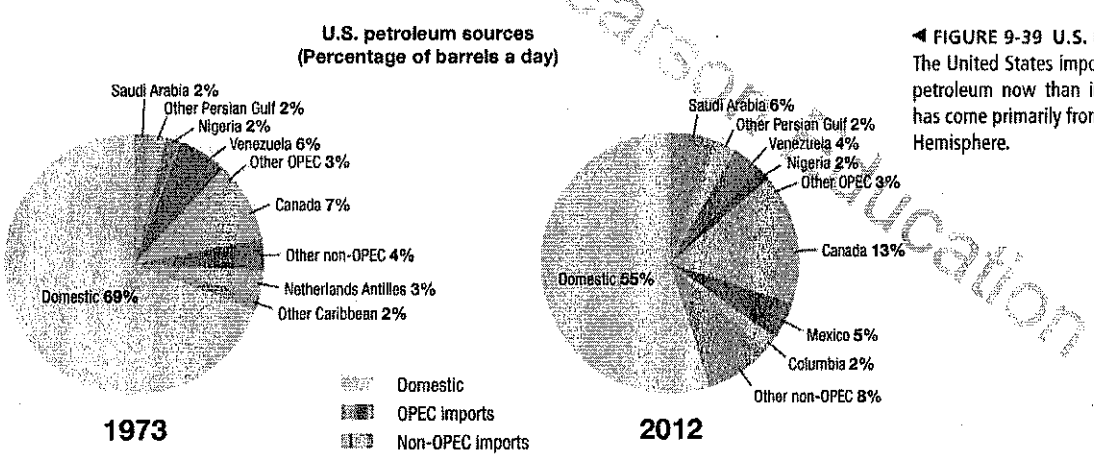
The world will not literally "run out" of petroleum during the twenty-first century. However, at some point, extracting the remaining petroleum reserves will prove so expensive and environmentally damaging that use of



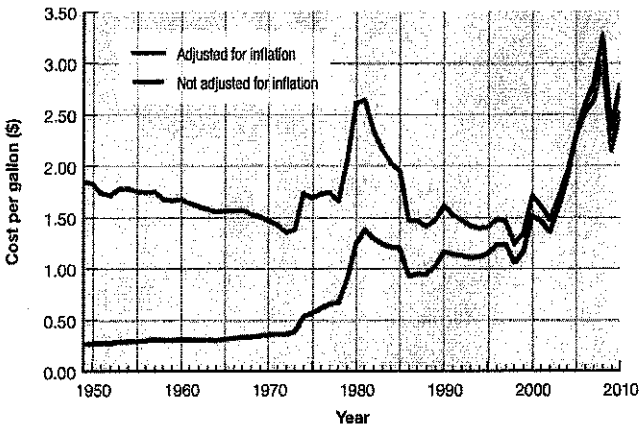
▲ FIGURE 9-37 **OIL PRICE HISTORY** Oil prices have increased sharply on several occasions.



◀ **FIGURE 9-38 U.S. PETROLEUM CONSUMPTION, PRODUCTION, AND IMPORTS** U.S. production has remained relatively constant since the 1960s. Increasing consumption has been served by increasing imports.



◀ **FIGURE 9-39 U.S. PETROLEUM SOURCES** The United States imports a higher percentage of petroleum now than in the 1970s. The increase has come primarily from elsewhere in the Western Hemisphere.



▲ **FIGURE 9-40 U.S. GASOLINE PRICES** The line adjusted for inflation is in 2005 dollars.

alternative energy sources will accelerate, and dependency on petroleum will diminish. The issues for the world are whether dwindling petroleum reserves are handled wisely and other energy sources are substituted peacefully. Given the massive growth in petroleum consumption expected in developing countries such as China and India, the United States and other developed countries may have little influence over when prices rise and supplies decline. In this challenging environment, all countries will need to pursue sustainable development strategies based on increased reliance on renewable energy sources.

Pause and Reflect 9.3.4

What country exports the most petroleum to the United States?

Alternative Energy Sources

Learning Outcome 9.3.5
Describe the distribution of nuclear energy and challenges in using it.

An especially strong challenge in the quest for sustainable development is substituting renewable energy resources for nonrenewable ones. Although renewable resources can be harnessed for energy, continued reliance on the three main nonrenewable fossil fuels—petroleum, natural gas, and coal—continues to be the less expensive alternative. About 20 percent of energy consumed in the world, and 15 percent in the United States, is generated by sources other than the three main fossil fuels.

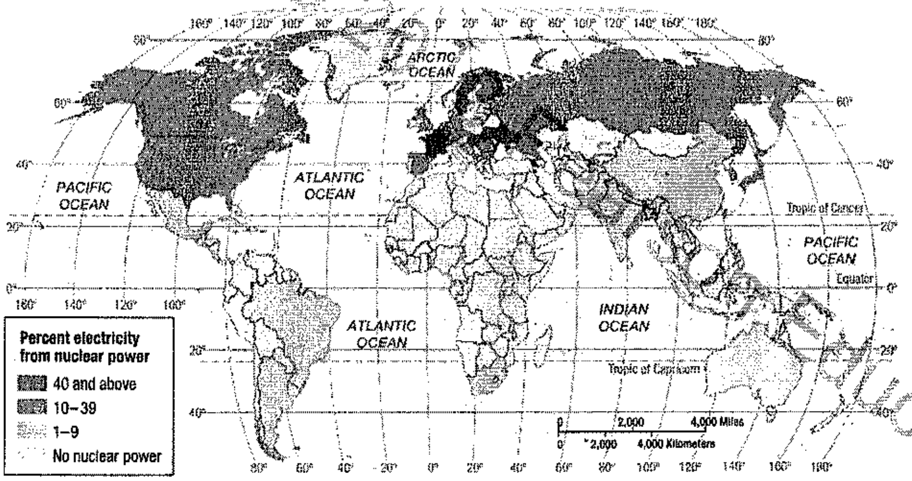
The two principal sources other than fossil fuels are nuclear and hydroelectric energy. But both of these widely used energy sources have limitations when viiewed from a sustainable development perspective.

NUCLEAR ENERGY

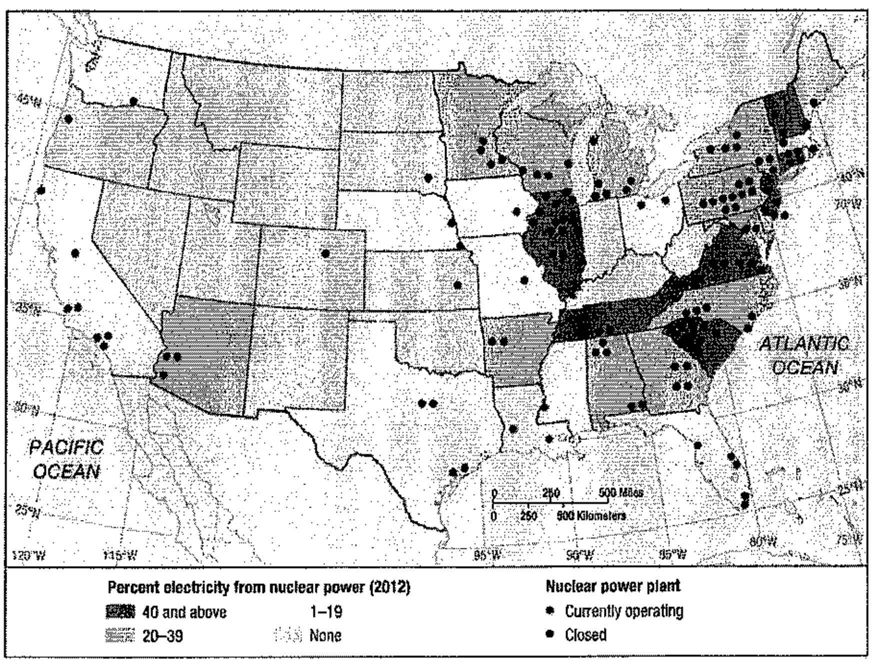
Nuclear power is not renewable, but some view it as an alternative to fossil fuels. The big advantage of nuclear power is the large amount of energy released from a small amount of material. One kilogram of enriched nuclear fuel contains more than 2 million times the energy in 1 kilogram of coal.

Nuclear power supplies 14 percent of the world's electricity. Two-thirds of the world's nuclear power is generated in developed countries, with Europe and North America responsible for generating one-third each. Only 30 of the world's nearly 200 countries make some use of nuclear power, including 19 developed countries and only 11 developing countries. The countries most highly dependent on nuclear power are clustered in Europe (Figure 9-41), where it supplies 80 percent of all electricity in France and more than 50 percent in Belgium, Slovakia, and Ukraine.

Dependency on nuclear power varies widely among U.S. states (Figure 9-42). Nuclear power accounts for more than 70 percent of electricity in Vermont and more than one-half in Connecticut, New Jersey, and South Carolina. At the other extreme, 20 states and the District of Columbia have no nuclear power plants. Nuclear power presents serious challenges, as described in the following sections.



▲ FIGURE 9-41 **ELECTRICITY FROM NUCLEAR POWER** Nuclear power is used in 37 countries, primarily in Europe and North America.



▲ FIGURE 9-42 **NUCLEAR POWER BY U.S. STATE** One-third of electricity is generated from nuclear power in the Northeast, compared to less than one-tenth in the West.

POTENTIAL ACCIDENTS. A nuclear power plant produces electricity from energy released by splitting uranium atoms in a controlled environment, a process called **fission**. One product of all nuclear reactions is **radioactive waste**, certain types of which are lethal to people exposed to it. Elaborate safety precautions are taken to prevent the leaking of nuclear fuel from a power plant.

Nuclear power plants cannot explode, like a nuclear bomb, because the quantities of uranium are too small and cannot be brought together fast enough. However, it is possible to have a runaway reaction, which overheats the reactor, causing a meltdown, possible steam explosions, and scattering of radioactive material into the atmosphere. This happened in 1986 at Chernobyl, then in the Soviet Union and now in the north of Ukraine, near the Belarus border. The accident caused 56 deaths due to exposure to high radiation doses and an estimated 4,000 cancer-related deaths to people who lived near the plant.

Following an earthquake and tsunami in 2011, three of the six reactors at Japan's Fukushima Daiichi nuclear power plant experienced full meltdown, resulting in release of radioactive materials. Three workers died; the death toll among nearby residents exposed to high levels of radioactivity won't be known for years.

RADIOACTIVE WASTE. The waste from nuclear fission is highly radioactive and lethal, and it remains so for many years. Plutonium for making nuclear weapons can be harvested from this waste. Pipes, concrete, and water near the fissioning fuel also become "hot" with radioactivity. No one has yet devised permanent storage for radioactive waste. The waste cannot be burned or chemically treated, and it must be isolated for several thousand years until it loses its radioactivity. Spent fuel in the United States is stored "temporarily" in cooling tanks at nuclear power plants, but these tanks are nearly full. The United States is Earth's third-largest country in land area, yet it has failed to find a suitable underground storage site because of worry about groundwater contamination. In 2002, the U.S. Department of Energy approved a plan to store the waste in Nevada's Yucca Mountains. But soon after taking office in 2009, the Obama administration reversed the decision and halted construction on the nearly complete repository.

BOMB MATERIAL. Nuclear power has been used in warfare twice, in August 1945, when the United States dropped atomic bombs on Hiroshima and Nagasaki, Japan, ending World War II. No government has dared to use these bombs in a war since then because leaders recognize that a full-scale nuclear conflict could terminate human civilization.

The United States and Russia (previously the Soviet Union) each have several thousand nuclear weapons. China, France, and the United Kingdom have several hundred nuclear weapons each, India and Pakistan several dozen each, and North Korea a handful. Israel is suspected of possessing nuclear weapons but has not admitted to it, and Iran has been developing the capability. Other countries have initiated nuclear programs over the years but have not advanced to the weapons stage. The diffusion of nuclear programs to countries sympathetic to terrorists has been particularly worrying to the rest of the world and has been a major factor in long-time tensions between Iran and other countries that do not want Iran to gain the capability of building a nuclear weapon.

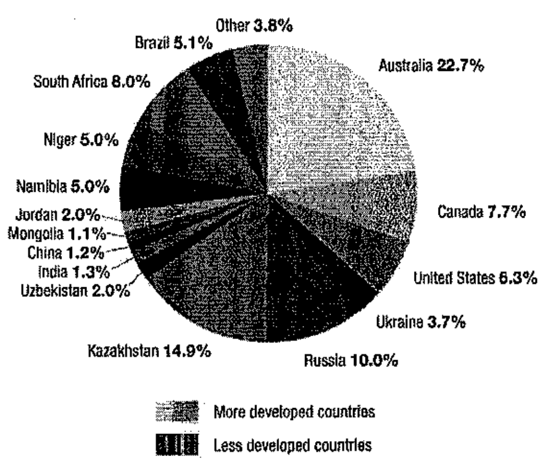
Pause and Reflect 9.3.5

Iran has claimed that it is interested in nuclear power for peaceful uses. Review the maps and charts of fossil fuel production and proven reserves on the previous two spreads. Does Iran appear to have other resources for generating electricity?

LIMITED URANIUM RESERVES. Like fossil fuels, uranium is a nonrenewable resource. Proven uranium reserves will last about 124 years at current rates of use. And they are not distributed uniformly around the world: Australia has 23 percent of the world's proven uranium reserves, Kazakhstan 15 percent, and Russia 10 percent (Figure 9-43). The chemical composition of natural uranium further aggravates the scarcity problem. Uranium ore naturally contains only 0.7 percent U-235; a greater concentration is needed for power generation.

A **breeder reactor** turns uranium into a renewable resource by generating plutonium, also a nuclear fuel. However, plutonium is more lethal than uranium and could cause more deaths and injuries in an accident. It is also easier to fashion into a bomb. Because of these risks, few breeder reactors have been built, and none are in the United States.

HIGH COST. Nuclear power plants cost several billion dollars to build, primarily because of the elaborate safety measures required. Without double and triple backup systems at nuclear power plants, nuclear energy would be too dangerous to use. Uranium is mined in one place, refined in another, and used in still another. As with coal, mining uranium can pollute land and water and damage miners' health. The complexities of safe transportation add to the cost. As a result, generating electricity from nuclear plants is much more expensive than from coal-burning plants. The future of nuclear power has been seriously hurt by the high costs associated with reducing risks.



▲ FIGURE 9-43 WORLD URANIUM RESERVES
Australia, Kazakhstan, and Russia have the most uranium reserves.

RENEWABLE ENERGY

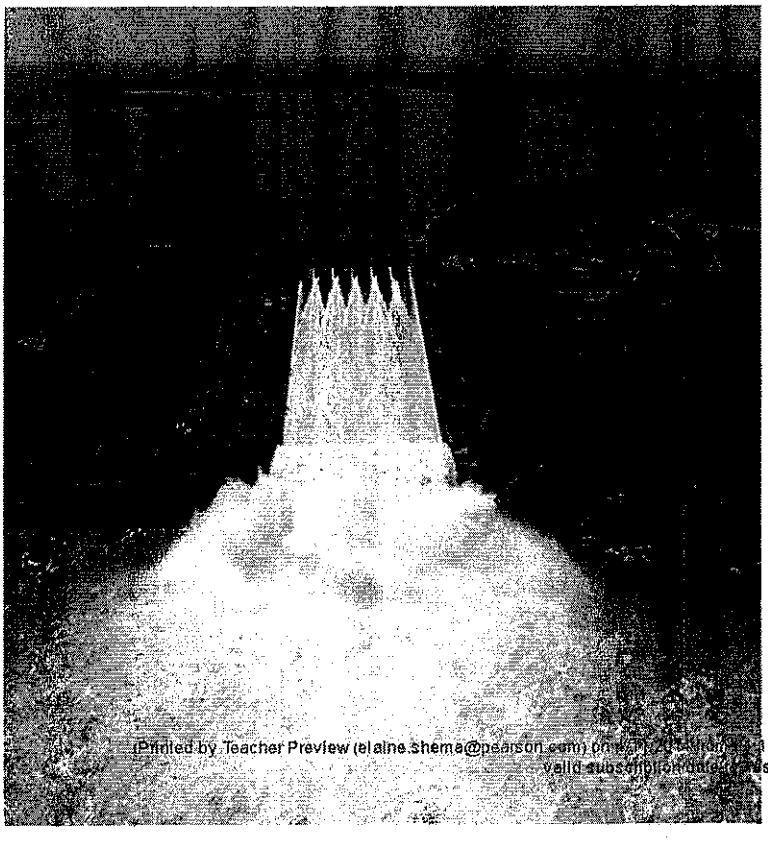
Learning Outcome 9.3.6
Identify challenges to increasing the use of alternative energy sources.

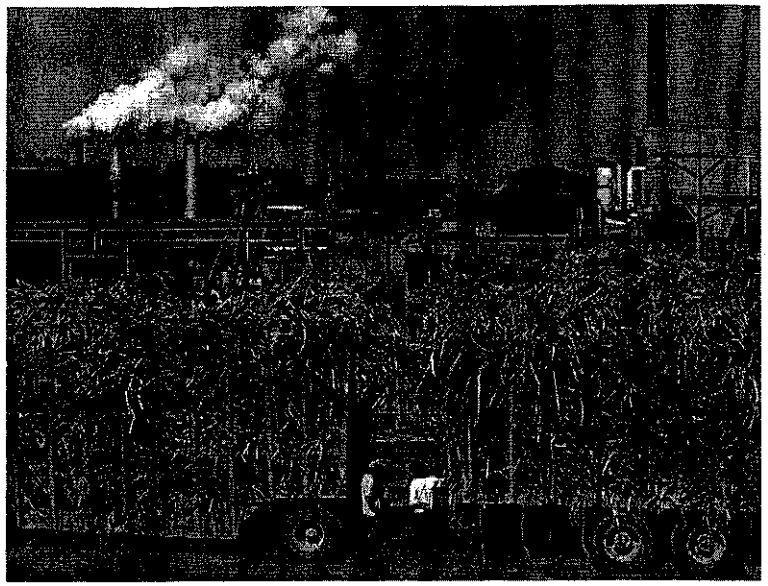
By a wide margin, hydroelectric power is currently the leading source of renewable energy for sustainable development in both developed and developing regions. Biomass and wind power have some usages, and geothermal and solar trail even further in current usage.

HYDROELECTRIC POWER. Generating electricity from the movement of water is called **hydroelectric power.** Water has been a source of mechanical power since before recorded history. It was used to turn water wheels, and the rotational motion was used to grind grain, saw timber, pump water, and operate machines. Hydroelectric is now the world's second-most-popular source of electricity, after coal. Worldwide generation of hydroelectric power is approximately 30 quad BTU, compared to 150 quad BTU for coal.

Two-thirds of the world's hydroelectric power is generated in developing countries and one-third in developed countries. A number of developing countries depend on hydroelectric power for most of their electricity (Figure 9-44). The most populous country to depend primarily on hydroelectric power is Brazil. Overall, Brazil has made considerable progress towards sustainable development by generating approximately 85 percent of its electricity from renewable energy sources. Among developed countries, Canada gets two-thirds of its electricity from hydroelectric power; although the United States is the fourth-leading producer of hydroelectric power, it obtains only 8 percent of its electricity from that source. And this percentage may decline because few acceptable sites to build new dams remain.

▼ **FIGURE 9-44 ELECTRICITY FROM HYDROELECTRIC POWER** Hydroelectricity provides a large percentage of electricity in a number of developing countries, especially in Latin America and sub-Saharan Africa. The Itaipú hydroelectric dam is on the Paraná River in Brazil.





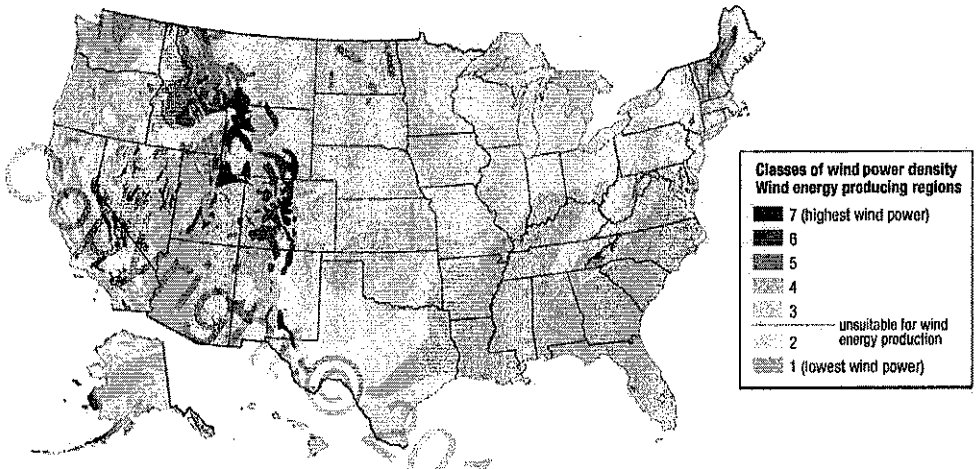
▲ **FIGURE 9-45 BIOMASS FUEL IN BRAZIL** Ethanol is produced from sugarcane in Brazil. This ethanol-producing plant is in Piracicaba.

BIOMASS. **Biomass fuel** is fuel derived from plant material and animal waste. Biomass energy sources include wood and crops. When carefully harvested in forests, wood is a renewable resource that can be used to generate electricity and heat. The waste from processing wood, such as for building construction and demolition, is also available. And crops such as sugarcane, corn, and soybeans can be processed into motor-vehicle fuels. Worldwide production of biomass fuel is approximately 3 quad BTUs, including one-third each in North America, Europe, and developing regions (Figure 9-45). Brazil in particular makes extensive use of biomass to fuel its cars and trucks.

The potential for increasing the use of biomass for fuel is limited, for several reasons:

- Burning biomass may be inefficient because the energy used to produce the crops may be as much as the energy supplied by the crops.
- Biomass already serves essential purposes other than energy, such as providing much of Earth's food, clothing, and shelter.
- When wood is burned for fuel instead of being left in the forest, the fertility of the forest may be reduced.

WIND POWER. Wind has also long been a source of energy, the most obvious examples of its uses being sailboats for travel and windmills for grinding grain. Like moving water turning a water wheel, moving air can turn a turbine.



◀ FIGURE 9-46 **WIND POWER** Winds are especially strong enough to support generation of power in the U.S. Plains states.

The benefits of wind-generated power seem irresistible. Construction of a windmill modifies the environment much less severely than construction of a dam across a river. And wind power has greater potential for increased use because only a small portion of the potential resource has been harnessed. However, wind power has divided the environmental community. Some oppose construction of windmills because they can be noisy and lethal for birds and bats. They can also constitute a visual blight when constructed on mountaintops or offshore in places of outstanding beauty.

Wind usage is similar to the pattern for biomass: Worldwide production is 3 quad BTUs, divided one-third each among North America, Europe, and developing regions. Hundreds of wind "farms" consisting of dozens of windmills each have been constructed across the United States; one-third of the country is considered windy enough to make wind power economically feasible (Figure 9-46), especially North Dakota, Texas, Kansas, South Dakota, and Montana. Twenty percent of Denmark's electricity is being generated through wind power. Wind power has been used only to a limited extent in developing countries. A significant obstacle is the cost of constructing the wind turbines.

Pause and Reflect 9.3.6

Chicago is nicknamed "the Windy City." Based on Figure 9-46, does the Chicago area appear to be a good location for wind power?

GEOTHERMAL ENERGY. Natural nuclear reactions make Earth's interior hot. Toward the surface, in volcanic areas, this heat is especially pronounced. The hot rocks can encounter groundwater, producing heated water or steam that can be tapped by wells. Energy from this hot water or steam is called **geothermal energy**.

Harnessing geothermal energy is most feasible at sites along Earth's surface where crustal plates meet, which are also the sites of many earthquakes and volcanoes. Geothermal energy is being tapped in several locations, including California, Italy, New Zealand, and Japan, and other plate boundary sites are being explored. Iceland and Indonesia make extensive use of geothermal energy. Ironically, in Iceland, an island named for its glaciers, nearly all homes and businesses in the capital of Reykjavik are heated with geothermal steam (Figure 9-47). Worldwide production is less than 1 quad BTU, divided about evenly between developed and developing regions.

NUCLEAR FUSION. Some nuclear power issues could be addressed through nuclear **fusion**, which is the fusing of hydrogen atoms to form helium. Fusion releases spectacular amounts of energy: A gnat-sized amount of hydrogen releases the energy of thousands of tons of coal. But fusion can occur only at very high temperatures (millions of degrees). Such high temperatures have been briefly achieved in hydrogen bomb tests but not on a sustained basis in a power-plant reactor, given present technology. Sources such as fusion are not yet practical, so do not appear in statistics of current energy production.

▼ FIGURE 9-47 **GEOTHERMAL** Geothermal plant near Krafla, Iceland.

SOLAR ENERGY

Learning Outcome 9.3.7
Compare and contrast passive and active solar energy.

The ultimate renewable resource for sustainable development is solar energy supplied by the Sun. Solar energy offers the possibility for countries at low levels of development to promote sustainable development. Through solar energy, people and businesses in developing countries currently unable to obtain electricity can generate energy needed to operate businesses, schools, and hospitals.

Solar sources currently supply the United States with only 1 percent of electricity, but the potential for growth is limitless. The Sun's remaining life is estimated at 5 billion years, and humans appear to be incapable of destroying or depleting that resource. The Sun's energy is free and ubiquitous and cannot be exclusively owned, bought, or sold by any particular individual or enterprise. Utilizing the Sun as a resource does not damage the environment or cause pollution, as does the extraction and burning of nonrenewable fossil fuels.

PASSIVE SOLAR ENERGY. Solar energy is harnessed through either passive or active means. **Passive solar energy systems** capture energy without using special devices. These systems use south-facing windows and dark surfaces to heat and light buildings on sunny days. The Sun's rays penetrate the windows and are converted to heat. Humans act as passive solar energy collectors when they are warmed by sunlight. And since dark objects absorb more energy than light ones, wearing dark clothing warms a person exposed to sunlight even more.

Reliance on passive solar energy increased during the nineteenth century when construction innovations first permitted the hanging of massive glass "curtains" on a thin steel frame. Greenhouses enabled people to grow and view vegetation that required more warmth to flourish than the local climate permitted. Early skyscrapers made effective use of passive solar energy. During World War II when fossil fuels were rationed, consumers looked for alternative energy sources. A major glass manufacturer, Libbey-Owens-Ford Glass Co., responded by publishing a book in 1947 entitled *Your Solar House*. But with electricity and petroleum cheap and abundant after World War II and through most of the twentieth century, passive solar energy rarely played a major role in construction of homes and commercial buildings.

In recent years, building construction and remodeling have made more use of passive solar energy through advances in glass technology. Double- and triple-pane windows have higher insulating values, and low-E (low emissivity) glass can be coated to let heat in but not out. Window panes made with this glass are filled with argon or other gases that increase their insulating values beyond that of windows that have just air between the panes. Phase-change technologies can also switch the glass from opaque to translucent when a voltage is applied.

ACTIVE SOLAR ENERGY. **Active solar energy systems** collect solar energy and convert it either to heat energy or to electricity. The conversion can be accomplished either directly or indirectly.

In direct electric conversion, solar radiation is captured with **photovoltaic cells**, which convert light energy to electrical energy. Bell Laboratories invented the photovoltaic cell in 1954. Each cell generates only a small electric current, but large numbers of these cells wired together produce significant electricity. These cells are made primarily of silicon (also used in computers), the second most abundant element in Earth's crust. When the silicon is combined with one or more other materials, it exhibits distinctive electrical properties in the presence of sunlight, known as the photovoltaic effect. Electrons excited by the light move through the silicon, producing direct current (DC) electricity.

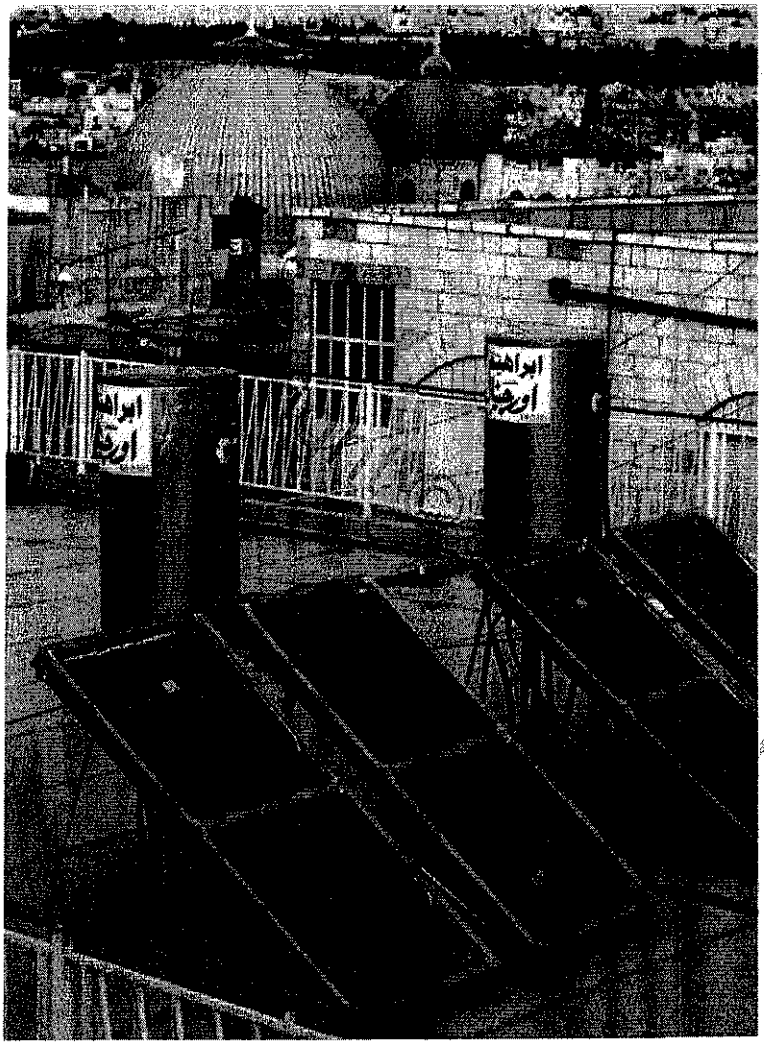
In indirect electric conversion, solar radiation is first converted to heat and then to electricity. The Sun's rays are concentrated by reflectors onto a pipe filled with synthetic oil. The heat from the oil-filled pipe generates steam to run turbines. In heat conversion, solar radiation is concentrated with large reflectors and lenses to heat water or rocks. These store the energy for use at night and on cloudy days. A place that receives relatively little sunlight can use solar energy by using more reflectors and lenses and larger storage containers.

Pause and Reflect 9.3.7
Why are people warned not to leave a dog or child unattended in a parked car during the summer?

GENERATING ELECTRICITY THROUGH SOLAR POWER. Solar power can be produced at a central station and distributed by an electric company, as coal- and nuclear-generated electricity are now supplied. However, with coal still relatively cheap and investment in nuclear facilities already substantial, public and private utility companies have had little interest in solar technology.

In developed countries, solar-generated electricity is used in spacecraft, light-powered calculators, and at remote sites where conventional power is unavailable, such as California's Mojave Desert. Solar energy is used primarily as a substitute for electricity in heating water. Rooftop devices collect, heat, and store water for apartment buildings in Israel and Japan and individual homes in the United States (Figure 9-48). The initial cost of installing a solar water heater is higher than hooking into the central system but may be justified if an individual plans to stay in the same house for a long time.

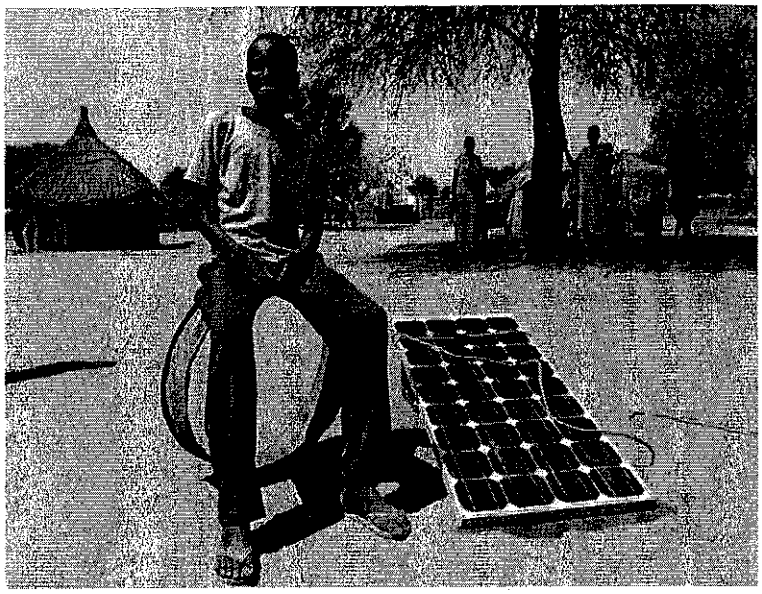
Electricity was popular in early motor vehicles. Of the 4,000 cars sold in the United States in 1900, 38 percent were powered by electricity, 40 percent by steam, and only



▲ FIGURE 9-48 **SOLAR PANELS** Solar panels installed on apartment rooftops in the Old City of Jerusalem are used to heat water, which is stored in the adjacent tanks. The domes are the Church of the Holy Sepulchre, built at the site where Jesus is thought to have been crucified, buried, and resurrected (see Chapter 6).

22 percent by gasoline. The electric car was especially popular in 1900 in large cities of the Northeast, such as New York and Philadelphia, where their relative quietness and cleanliness made them popular as taxicabs. Women also preferred electric cars because they were easier to start than gasoline- or steam-powered ones.

The main shortcomings of the electric car in the early 1900s remain unchanged a century later. Compared to gasoline power, the electric-powered vehicle has a more limited range and costs more to operate. Recharging the battery can take several hours. To address these issues, carmakers offer a variety of vehicles that combine electric and gasoline power. Hybrid vehicles conserve gasoline by running on electricity at low speeds. Other vehicles operate exclusively on battery-powered electricity and use the gasoline engine to recharge the battery (see Chapter 13).



▲ FIGURE 9-49 **SOLAR ENERGY IN DEVELOPING COUNTRIES** Solar panels are generating electricity for this family's house in Rumbek, South Sudan.

In developing countries, the largest and fastest-growing market for photovoltaic cells includes the 2 billion people who lack electricity, especially residents of remote villages. For example, in sub-Saharan Africa, more homes have been electrified in recent years using photovoltaic cells than by hooking up to the central power grid (Figure 9-49). In Morocco, solar panels are sold in bazaars and open markets, next to carpets and tinware.

Solar energy currently accounts for only 0.3 quad BTU worldwide. The cost of cells must drop and their efficiency must improve for solar power to expand rapidly, with or without government support. Solar energy will become more attractive as other energy sources become more expensive. A bright future for solar energy is indicated by the fact that petroleum companies now own the major U.S. manufacturers of photovoltaic cells.

CHECK-IN: KEY ISSUE 3

Why Are Energy Resources Important for Development?

- ✓ **Energy is supplied primarily by three fossil fuels: coal, petroleum, and natural gas.**
- ✓ **The three fossil fuels are nonrenewable, and production and reserves of these fuels are not distributed uniformly across Earth.**
- ✓ **Alternative energy sources include solar, nuclear, biomass, hydroelectric, geothermal, and fusion.**

KEY ISSUE 4

Why Do Countries Face Obstacles to Development?

- Two Paths to Development
- Financing Development
- Making Progress in Development

Learning Outcome 9.4.1
Summarize the two paths to development.

The gap between rich and poor countries is substantial. Poorer countries lack much of what people in richer countries take for granted, such as access to electricity, safe drinking water, and paved roads. To reduce disparities between rich and poor countries, developing countries must develop more rapidly. This means increasing per capita GNI more rapidly and using the additional funds to make more rapid improvements in social and economic conditions. Developing countries face two fundamental obstacles in trying to encourage more rapid development:

- Adopting policies that successfully promote development
- Finding funds to pay for development

Two Paths to Development

To promote development, developing countries choose one of two models:

- **Self-sufficiency.** In the self-sufficiency model, countries encourage domestic production of goods, discourage foreign ownership of businesses and resources, and protect their businesses from international competition.
- **International trade.** In the international trade model, countries open themselves to foreign investment and international markets.

Each has important advantages and faces serious challenges.

For most of the twentieth century, self-sufficiency, or balanced growth, was the more popular of the development alternatives. International trade became more popular beginning in the late twentieth century. However, the global economic slowdown since 2008 has caused some countries to question the international trade approach.

SELF-SUFFICIENCY PATH

Key elements of the self-sufficiency path to development include the following:

- Barriers limit the import of goods from other places. Three widely used barriers include setting high taxes (tariffs) on imported goods to make them more expensive than domestic goods, fixing quotas to limit the quantity of imported goods, and requiring licenses in order to restrict the number of legal importers.
- Fledgling businesses are nursed to success by being isolated from competition with large international corporations. Such insulation from the potentially adverse impacts of decisions made by businesses and governments in developed countries encourages a country's fragile businesses to achieve independence.
- Investment is spread as equally as possible across all sectors of a country's economy and in all regions.
- Incomes in the country side keep pace with those in the city, and reducing poverty takes precedence over encouraging a few people to become wealthy consumers. The pace of development may be modest, but the system is fair because residents and enterprises throughout the country share the benefits of development.

CASE STUDY: INDIA'S QUEST FOR DEVELOPMENT. For several decades after it gained independence from Britain in 1947, India was a leading example of the self-sufficiency strategy. India made effective use of many barriers to trade:

- To import goods into India, most foreign companies had to secure a license, which was a long and cumbersome process because several dozen government agencies had to approve the request (Figure 9-50).
- Once a company received an import license, the government severely restricted the quantity of goods it could sell in India.
- The government imposed heavy taxes on imported goods, which doubled or even tripled the prices to consumers.

▼ FIGURE 9-50 **SELF-SUFFICIENCY: INDIA** Clerks work on the street in Delhi, India.

- Indian businesses were discouraged from producing goods for export.
- Indian money could not be converted to other currencies.

Effectively cut off from the world economy, businesses were supposed to produce goods for consumption inside India:

- A business needed government permission to sell a new product, modernize a factory, expand production, set prices, hire or fire workers, and change the job classification of existing workers.
- If private companies were unable to make a profit selling goods only inside India, the government provided subsidies, such as cheap electricity, or wiped out debts.
- The government owned not just communications, transportation, and power companies, which is common around the world, but it also owned businesses such as insurance companies and automakers, which are left to the private sector in most countries.

By following the self-sufficiency path, India achieved only modest development.

INTERNATIONAL TRADE PATH

The international trade model of development calls for a country to identify its distinctive or unique economic assets. What animal, vegetable, or mineral resources does the country have in abundance that other countries are willing to buy? What product can the country manufacture and distribute at a higher quality and a lower cost than other countries? According to the international trade approach, a country can develop economically by concentrating scarce resources on expansion of its distinctive local industries. The sale of these products in the world market brings funds into the country that can be used to finance other development.

ROSTOW MODEL. A pioneering advocate of the international trade approach was W. W. Rostow, who in the 1950s proposed a five-stage model of development. Several countries adopted this approach during the 1960s, although most continued to follow the self-sufficiency approach. The five stages were as follows:

1. **Traditional society.** A traditional society has not yet started a process of development. It contains a very high percentage of people engaged in agriculture and a high percentage of national wealth allocated to what Rostow called "nonproductive" activities, such as the military and religion.
2. **Preconditions for takeoff.** An elite group initiates innovative economic activities. Under the influence of these well-educated leaders, the country starts to invest in new technology and infrastructure, such as water supplies and transportation systems. Support from international funding sources often emphasizes the importance of constructing new infrastructure. These projects will ultimately stimulate an increase in productivity.
3. **Takeoff.** Rapid growth is generated in a limited number of economic activities, such as textiles or food products. These few takeoff industries achieve technical advances and become productive, whereas other sectors of the economy remain dominated by traditional practices.
4. **Drive to maturity.** Modern technology, previously confined to a few takeoff industries, diffuses to a wide variety of industries, which then experience rapid growth comparable to the growth of the take off industries. Workers become more skilled and specialized.
5. **Age of mass consumption.** The economy shifts from production of heavy industry, such as steel and energy, to consumer goods, such as motor vehicles and refrigerators.

According to the international trade model, each country is in one of these five stages of development:

INTERNATIONAL TRADE EXAMPLES. When most developing countries were following the self-sufficiency approach during the twentieth century, two groups of countries chose the international trade approach:

- **The Four Asian Dragons.** Among the first places to adopt the international trade path were South Korea, Singapore, Taiwan, and Hong Kong known as the "four dragons," Singapore and Hong Kong, British colonies until 1965 and 1997, respectively, were large cities surrounded by very small amounts of rural land and had virtually no natural resources. Lacking many natural resources, the four dragons promoted development by concentrating on producing a handful of manufactured goods, especially clothing and electronics. Low labor costs enabled these countries to sell products inexpensively in developed countries.
- **Petroleum-rich Arabian Peninsula states.** The Arabian Peninsula includes Saudi Arabia, the region's largest and most populous country, as well as Kuwait, Bahrain, Oman, and the United Arab Emirates. Once among the world's least developed countries, they were transformed overnight into some of the wealthiest countries, thanks to escalating petroleum prices beginning in the 1970s. Arabian Peninsula countries used petroleum revenues to finance large-scale projects, such as housing, highways, hospitals, airports, universities, and telecommunications networks. Their steel, aluminum, and petrochemical factories competed on world markets with the help of government subsidies. The landscape of these countries has been further changed by the diffusion of consumer goods, such as motor vehicles and electronics. Supermarkets in Arabian Peninsula countries are stocked with food imported from Europe and North America.

Pause and Reflect 9.4.1

Many countries that have adopted the international trade model are relatively small states (see Chapter 8). Why might a nation's size be a factor in the early adoption of the international trade path?

SHORTCOMINGS OF THE TWO DEVELOPMENT PATHS

Learning Outcome 9.4.2
Analyze shortcomings of the two development paths and give reasons why international trade has triumphed.

Shortcomings have been identified with both the self-sufficiency and international trade paths to development.

SELF-SUFFICIENCY CHALLENGES. The experience of India and other developing countries with self-sufficiency revealed two major difficulties:

- **Protection of inefficient businesses.** Businesses could sell all they made, at high government-controlled prices, to customers culled from long waiting lists, so they had little incentive to improve quality, lower production costs, reduce prices, or increase production. Companies protected from international competition were not pressured to keep abreast of rapid technological changes or give high priority to sustainable development and environmental protection.
- **Need for large bureaucracy.** The complex administrative system needed to administer the controls encouraged inefficiency, abuse, and corruption. A large number of people were employed in countries such as India to fill out documents that other countries considered unnecessary intrusions into the prerogatives of private businesses. Potential entrepreneurs found that struggling to produce goods or offer services was less rewarding financially than advising others how to get around the complex government regulations. Other potential entrepreneurs earned more money by illegally importing goods and selling them at inflated prices on the black market.

INTERNATIONAL TRADE CHALLENGES. Three difficulties have hindered countries outside the four Asian dragons and the Arabian Peninsula from developing through the international trade approach:

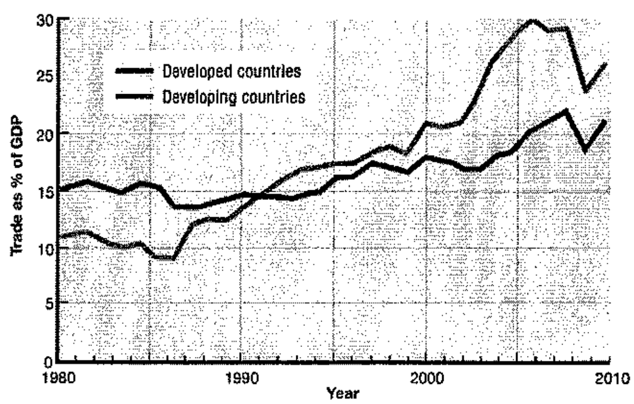
- **Uneven resource distribution.** Arabian Peninsula countries achieved successful development by means of rising petroleum prices. Other countries, however, have found that the prices of their commodities have not increased and in some cases have actually decreased. Developing countries that have depended on the sale of one product have suffered if the price of their leading commodity did not rise as rapidly as the cost of the products they needed to buy. For example, Zambia has extensive copper reserves, but it has been unable to use this asset to promote development because of declining world prices for copper.
- **Increased dependence on developed countries.** Building up a handful of take off industries that sell to people in developed countries may force developing countries to cut back on production of food, clothing, and other necessities for their own people. Rather than finance sustainable development that is environmentally sensitive, these countries may need to use funds generated from the sale of products to other countries to buy these necessities from developed countries for the employees of the take off industries.
- **Market decline.** Countries that depend on selling low-cost manufactured goods find that the world market for many products has declined sharply in recent years. Even before the recent severe recession, developed countries had limited growth in population and market size.

INTERNATIONAL TRADE APPROACH TRIUMPHS

Most countries embraced the international trade approach as the preferred alternative for stimulating development in the late twentieth century. During the late twentieth and early twenty-first centuries trade increased more rapidly than wealth (as measured by GDP), a measure of the growing importance of the international trade approach, especially in developing countries (Figure 9-51).

Optimism about the benefits of the international trade development model was based on three observations:

- Developed countries in Europe and North America were joined by others in Southern and Eastern Europe and Japan during the second half of the twentieth century. If they could become more developed by following this model, why couldn't other countries?
- Developing countries contained an abundant supply of many raw materials sought by manufacturers and producers in developed countries. In the past, European colonial powers extracted many of these resources without paying compensation to the colonies. In a global economy, the sale of these raw materials could generate funds for developing countries with which they could promote development.



▲ **FIGURE 9-51 WORLD TRADE AS A PERCENTAGE OF INCOME**
Trade as a percentage of GDP increased rapidly in developing countries, beginning in the 1990s. The severe recession that began in 2008 caused a sharp decline in trade.

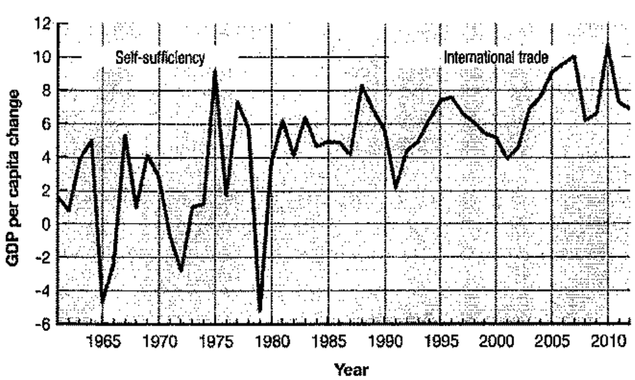
- A country that concentrates on international trade benefits from exposure to the demands, needs, and preferences of consumers in other countries. To remain competitive, the take off industries constantly evaluate changes in international consumer preferences, marketing strategies, production engineering, and design technologies. Concern for international competitiveness in the exporting take off industries can filter through other sectors of the economy.

Longtime advocates of the self-sufficiency approach converted to international trade during the 1990s. India, for example, dismantled its formidable collection of barriers to international trade:

- Foreign companies were allowed to set up factories and sell in India.
- Tariffs and restrictions on the import and export of goods were reduced or eliminated.
- Monopolies in communications, insurance, and other industries were eliminated.
- With increased competition, Indian companies have improved the quality of their products.

During the self-sufficiency era, India's auto industry was dominated by Maruti-Udyog Ltd., which was controlled by the Indian government. Nursed by import duties that rose from 15 percent in 1984 to 66 percent in 1991, Maruti captured more than 80 percent of the Indian market by selling cars that would be considered out-of-date in other countries. In the international trade era, the government sold control of Maruti to the Japanese company Suzuki, which now holds only 45 percent of India's market.

Countries like India converted from self-sufficiency to international trade during the 1990s because of overwhelming evidence at the time that international trade better promoted development (Figure 9-52). After converting to international trade, India's GNI per capita increased on average 6.5 percent per year, compared to 1.8 percent per year under self-sufficiency. Worldwide, GNI increased more than 4 percent annually in countries strongly oriented toward international trade compared with less than 1 percent in countries strongly oriented toward self-sufficiency.



▲ **FIGURE 9-52 GDP PER CAPITA CHANGE IN INDIA** India's per capita GDP has grown much more rapidly since the country converted from the self-sufficiency model to the international trade model.

WORLD TRADE ORGANIZATION

To promote the international trade development model, countries representing 97 percent of world trade established the World Trade Organization (WTO) in 1995. The WTO works to reduce barriers to international trade in two principal ways. First, through the WTO, countries negotiate reduction or elimination of international trade restrictions on manufactured goods, such as government subsidies for exports, quotas for imports, and tariffs on both imports and exports. Also reduced or eliminated are restrictions on the international movement of money by banks, corporations, and wealthy individuals.

The WTO also promotes international trade by enforcing agreements. One country can bring to the WTO an accusation that another country has violated a WTO agreement. The WTO is authorized to rule on the validity of the charge and order remedies. The WTO also protects intellectual property in the age of the Internet. An individual or a corporation can also bring charges to the WTO that someone in another country has violated a copyright or patent, and the WTO can order illegal actions to stop.

Critics have sharply attacked the WTO. Protesters routinely gather in the streets outside high-level meetings of the WTO (Figure 9-53). Progressive critics charge that the WTO is antidemocratic because decisions made behind closed doors promote the interests of large corporations rather than poor people. Conservatives charge that the WTO compromises the power and sovereignty of individual countries because it can order changes in taxes and laws that it considers unfair trading practices.

Pause and Reflect 9.4.2

Top WTO officials meet every two years in a so-called ministerial conference. Where was the most recent conference held? Google "WTO ministerial conference" to find out and to see if there were protests at the conference.

▼ **FIGURE 9-53 WORLD TRADE ORGANIZATION PROTEST** South Korean farmers march in protest during 2005 WTO meetings in Hong Kong.

Financing Development

Learning Outcome 9.4.3

Identify the main sources of financing development.

Developing countries lack money to fund development, so they obtain financial support from developed countries. Finance comes from two primary sources: direct investment by transnational corporations and loans from banks and international organizations.

FOREIGN DIRECT INVESTMENT

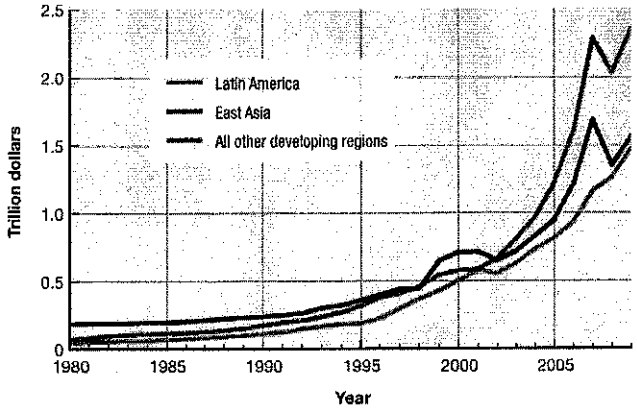
International trade requires corporations based in a particular country to invest in other countries. Investment made by a foreign company in the economy of another country is known as **foreign direct investment (FDI)**.

Foreign direct investment grew rapidly during the 1990s, from $130 billion in 1990 to $1.5 trillion in 2000 and 2010. FDI does not flow equally around the world (Figure 9-54). Only two-fifths of foreign investment in 2010 went from a developed country to a developing country; the other three-fifths went from one developed country to another. And FDI is not evenly distributed among developing countries. In 2010, nearly 40 percent of all FDI destined for developing countries went to China, and 20 percent went to Brazil, Russia, and Singapore.

The major sources of FDI are transnational corporations that invest and operate in countries other than the one in which the company headquarters are located. Of the 500 largest transnational corporations in 2011, 384 had headquarters in developed countries, including 133 in the United States and 164 in Europe. China was the location of 61 of the 116 with headquarters in developing countries.

Pause and Reflect 9.4.3

Fortune magazine names the 500 largest transnational corporations every year. What is the world's largest transnational corporation?



▲ **FIGURE 9-54 GROWTH IN FOREIGN DIRECT INVESTMENT** East Asia and Latin America have received the most FDI.

LOANS

The two major lenders to developing countries are the World Bank and the International Monetary Fund (IMF):

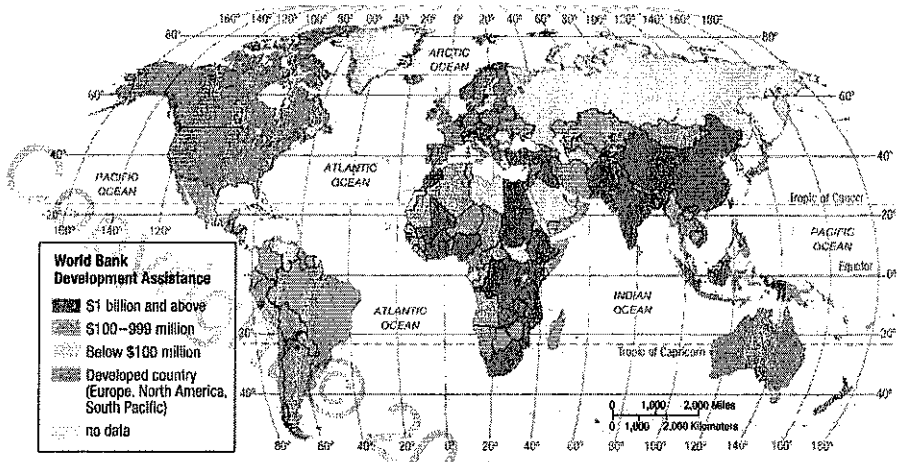
- **World Bank.** The World Bank includes the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The IBRD provides loans to countries to reform public administration and legal institutions, develop and strengthen financial institutions, and implement transportation and social service projects (Figure 9-55). The IDA provides support to poor countries considered too risky to qualify for IBRD loans. The IBRD has loaned about $400 billion since 1945, primarily in Europe and Latin America (Figure 9-56), and the IDA has loaned about $150 billion since 1960, primarily in Asia and Africa. The IBRD lends money raised from sales of bonds to private investors; the IDA lends money from government contributions.
- **International Monetary Fund (IMF).** The IMF provides loans to countries experiencing balance-of-payments problems that threaten expansion of international trade. IMF assistance is designed to help a country rebuild international reserves, stabilize currency exchange rates, and pay for imports without the imposition of harsh trade restrictions or capital controls that could hamper the growth of world trade. Unlike development banks, the IMF does not lend for specific projects. Funding of the IMF is based on each member country's relative size in the world economy.

The World Bank and IMF were conceived at a 1944 United Nations Monetary and Financial Conference in Bretton Woods, New Hampshire, to promote economic development and stability after the devastation of World War II and to avoid a repetition of the disastrous economic policies contributing to the Great Depression of the 1930s. The IMF and World Bank became specialized agencies of the UN when it was established in 1945.

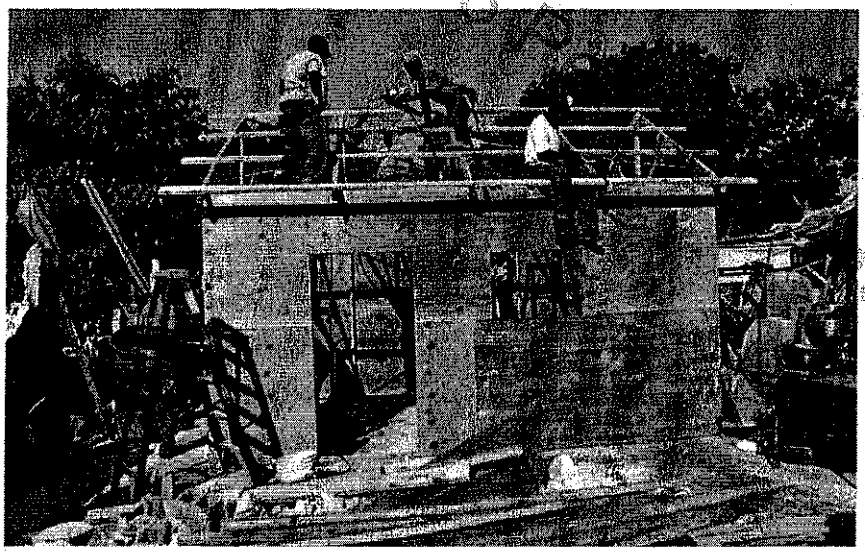
Developing countries borrow money to build new infrastructure, such as hydroelectric dams, electric transmission lines, flood-protection systems, water supplies, roads, and hotels. The theory is that new infrastructure will make conditions more favorable for domestic and foreign businesses to open or expand. After all, no business wants to be located in a place that lacks paved roads, running water, and electricity.

In principle, new or expanded businesses are attracted to an area because improved infrastructure will contribute additional taxes that the developing country will use in part to repay the loans and in part to improve its citizens' living conditions. In reality, the World Bank itself has judged half of the projects it has funded in Africa to be failures. Common reasons include the following:

- Projects don't function as intended because of faulty engineering.
- Recipient nations squander or spend aid on armaments, or the aid is stolen.
- New infrastructure does not attract other investment.



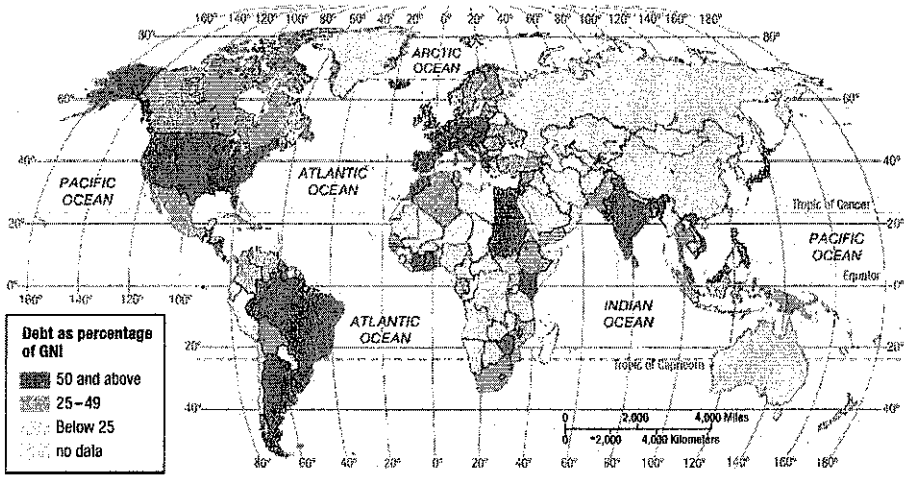
◀ **FIGURE 9-55 WORLD BANK DEVELOPMENT ASSISTANCE** Iraq and Afghanistan have been the leading recipients of aid.



▲ **FIGURE 9-56 WORLD BANK INVESTMENT PROJECT** The World Bank has assisted in the reconstruction of Haiti after the devastating earthquake in 2010.

Many developing countries have been unable to repay the interest on their loans, let alone the principal (Figure 9-57). Debt actually exceeds annual income in a number of countries. When these countries cannot repay their debts, financial institutions in developed countries refuse to make further loans, so construction of needed infrastructure stops. The inability of many developing countries to repay loans also damages the financial stability of banks in developed countries.

The economic downturn that started in 2008 also revealed that many developed countries also have extremely high debts. Among developed countries, especially high debts have been incurred by European countries, including Ireland, Italy, Greece, Portugal, and Spain.



◀ **FIGURE 9-57 DEBT AS A PERCENTAGE OF GNI**
Developed countries have joined developing countries in accumulating substantial debts.

FINANCING CHALLENGES IN DEVELOPING COUNTRIES

Learning Outcome 9.4.4
Explain problems with financing development in developing and developed countries.

The IMF, World Bank, and developed countries fear that granting, canceling, or refinancing debts without strings attached will perpetuate bad habits in developing countries. Therefore, to apply for debt relief, a developing country is required to prepare a Policy Framework Paper (PFP) outlining a **structural adjustment program**, which includes economic goals, strategies for achieving the objectives, and external financing requirements.

A structural adjustment program includes economic "reforms" or "adjustments." Requirements placed on a developing country typically include:

- Spending only what it can afford
- Directing benefits to the poor, not just the elite
- Diverting investment from military to health and education spending
- Investing scarce resources where they will have the most impact
- Encouraging a more productive private sector
- Reforming the government, including making the civil service more efficient, increasing accountability in accountable fiscal management, implementing more predictable rules and regulations, and disseminating more information to the public

Critics charge that poverty worsens under structural adjustment programs. By placing priority on reducing government spending and inflation, structural adjustment programs may result in the following:

- Cuts in health, education, and social services that benefit the poor
- Higher unemployment
- Loss of jobs in state enterprises and civil service
- Less support for those most in need, such as poor pregnant women, nursing mothers, young children, and elderly people

In short, structural reforms allegedly punish Earth's poorest people for actions they did not commit, such as waste, corruption, misappropriation, and military buildup.

International organizations respond that the poor suffer more when a country does not undertake reforms. Economic growth is what benefits the poor the most in the long run. Nevertheless, in response to criticisms, the IMF and the World Bank now encourage innovative programs to reduce poverty and corruption and consult more with average citizens. A safety net must be included to ease short-term pain experienced by poor people.

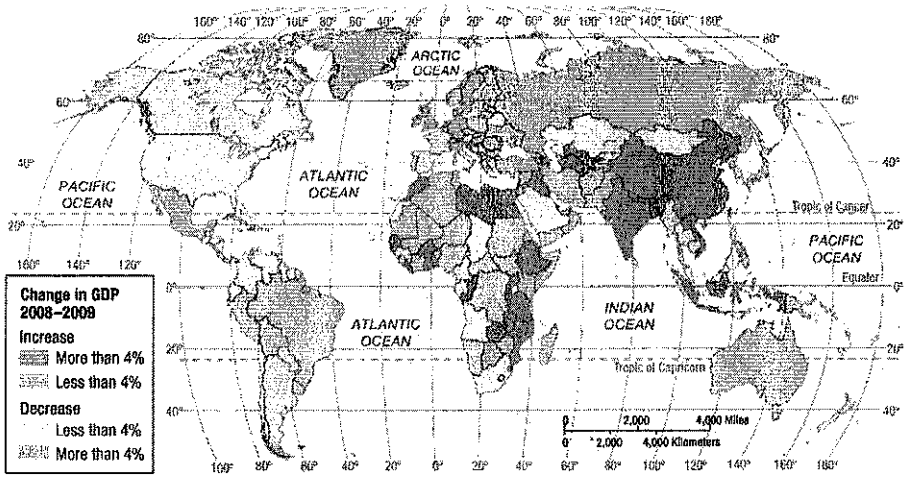
FINANCING CHALLENGES IN DEVELOPED COUNTRIES

Developed countries were especially hard hit by the severe economic downturn that began in 2008. GDP per capita declined between 2008 and 2009 in nearly all developed countries (Figure 9-58). The economic difficulties in developed regions spilled over into developing regions that were especially dependent on international trade, especially Latin America with North America and Southwest Asia with Europe. Citizens and political leaders in many developed countries questioned the benefits of orienting a country's economy to facilitate international trade, especially in Europe.

WIDENING INEQUALITY. Through most of the twentieth century, the gap between rich and poor narrowed in developed countries. Inequality was reduced because developed countries used some of their wealth to extend health care and education to more people, and to provide some financial assistance to poorer people.

Since 1980, however, inequality has increased in most developed countries, including the United States and the United Kingdom (Figure 9-59). In 2010, the richest 1 percent of Americans held 20 percent of the wealth, and 421 billionaires (representing 0.0001 percent of the population) held more than 10 percent of the wealth in the United States.

The severe recession exacerbated an inequality trend that



▲ FIGURE 9-58 **GDP PER CAPITA CHANGE, 2008–2009** GNI per capita declined in nearly all developed countries. East and South Asia were the principal regions with increases.

had begun a quarter-century earlier. Many Americans perceived that it was unfair for very large banks to be rescued by the government and to quickly resume making substantial profits, at a time when the income of most Americans was stagnant or declining.

Pause and Reflect 9.4.4

What government policies have helped to increase the share of wealth held by the top 1 percent? What policies have tried to reduce that share?

STIMULUS OR AUSTERITY? Political leaders and independent analysts have been sharply divided on the optimal strategy for fighting the severe economic downturn:

- **Stimulus strategy.** Proponents of stimulus argue that during a downturn, governments should spend more money than they collect in taxes. Governments should stimulate the economy by putting people to work building bridges and other needed infrastructure projects. Once the economy recovers, they say, people and businesses will be in position to pay more taxes to pay off the debt.
- **Austerity strategy.** Proponents of austerity argue that government should sharply reduce taxes so that people and businesses can revive the economy by spending their tax savings. Spending on government programs should be sharply cut as well in order to keep the debt from swelling and hampering the economy in the future.

In the United States, the stimulus strategy was initially employed by Presidents Bush and Obama. After the success of Tea Party candidates in 2010, more attention was paid to the austerity strategy. European countries divided between supporting stimulus and austerity. The lack of agreement has led to serious difficulties in Europe and may possibly result in the demise of the euro currency.

EUROPE'S SOVEREIGN DEBT CRISIS. Europe has faced an especially difficult challenge in responding to the sharp economic slowdown of the early twenty-first century. Economic difficulties call into question the region's ability to continue supporting the international trade development path.

Most European countries had adopted the euro as their common currency in 1999. Europeans believed that if every country in the region operated with the same currency, trade within the region would be enhanced. In reality, once the severe economic downturn hit, having each country saddled with the same currency proved to be a burden for the countries in Europe that had weaker economies.

Consider Germany and Italy. Germany has a strong economy, with businesses producing cars, electronics, and other goods at higher quality and lower cost than can be done in Italy. If Germany and Italy had two different currencies, as in the past, Italy could lower the value of its currency so that German goods cost more and Italian goods cost less. But with both countries using the same currency, the euro, Italy no longer has that option.

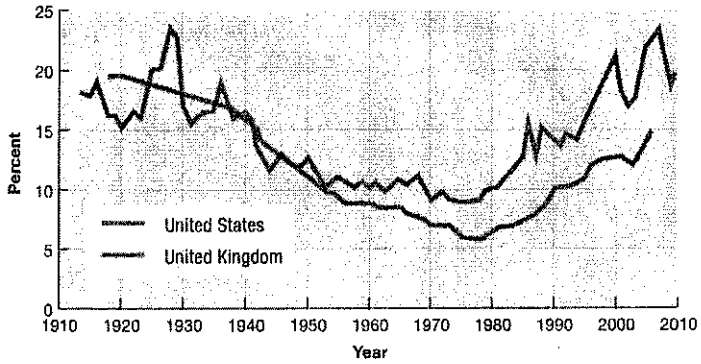
The Northern European countries argue that the Southern European countries with weaker economies need to adopt austerity programs, similar to those imposed on developing countries through structural adjustment programs. The Southern European countries argue that Northern European countries with stronger economies should fund stimulus programs that would in the long run lead to more prosperity through Europe as a whole.

HOUSING BUBBLE

The heart of the global economic crisis was the poor condition of many banks and other financial institutions in developed countries. A number of financial institutions closed or were rescued by governments in North America and Europe. The shaky status of many financial institutions resulted from making loans to businesses and individuals that could not be repaid, especially after the bursting of the housing bubble beginning in 2007.

As discussed in Chapter 1, a housing bubble is a rapid increase in the value of houses followed by a sharp decline in their value. In 1637, the world's first recorded bubble occurred in the Netherlands, when tulip bulbs rapidly increased greatly in price and just as suddenly decreased.

Refer ahead on the next page to Figure 9-60, which shows the housing bubble that occurred in the United States during the first decade of the twenty-first century. The price of an average house in the United States increased rapidly from 1998 to 2006 and then decreased rapidly between 2006 and 2009 down to the level in 2002. Most developed countries and some developing ones experienced housing bubbles during the first decade of the twenty-first century.



▲ FIGURE 9-59 TOP 1% INCOME SHARE The percent of national wealth held by the richest 1 percent of people in the United States and the United Kingdom declined during most of the twentieth century, but has increased since 1980.

FAIR TRADE

Learning Outcome 9.4.5
Explain the principles of fair trade.

Fair trade has been proposed as a variation of the international trade model of development that promotes sustainability. **Fair trade** is commerce in which products are made and traded according to standards that protect workers and small businesses in developing countries.

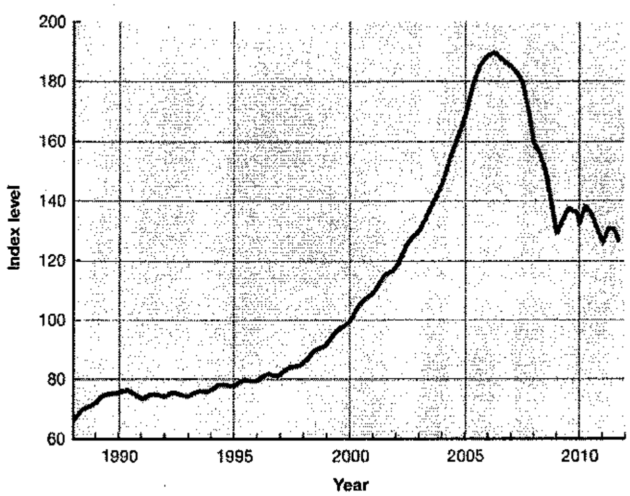
In North America, fair trade products have been primarily craft products such as decorative home accessories, jewelry, textiles, and ceramics. Ten Thousand Villages is the largest fair trade organization in North America, specializing in handicrafts. In Europe, most fair trade sales are in food, including coffee, tea, banana, chocolate, cocoa, juice, sugar, and honey products.

Two sets of standards distinguish fair trade. One set applies to workers on farms and in factories and the other applies to producers. Standards for fair trade are set internationally by Fairtrade Labelling Organizations International (FLO). A nonprofit organization, TransFair USA, certifies the products sold in the United States that are fair trade.

FAIR TRADE PRODUCER STANDARDS. Critics of international trade charge that only a tiny percentage of the price a consumer pays for a good reaches the individual in the developing country who is responsible for making or growing it. A Haitian sewing clothing for the U.S. market, for example, earns less than 1 percent of the retail price of the garment, according to the National Labor Committee. In contrast, fair trade returns on average one-third of the price to the producer in the developing country. The rest goes to the wholesaler who imports the item and for the retailer's rent, wages, and other expenses.

Fair trade advocates work with small businesses, especially worker-owned and democratically run cooperatives. Small-scale farmers and artisans in developing countries are unable to borrow from banks the money they need to invest in their businesses. By banding together, they can get credit, reduce their raw material costs, and maintain higher and fairer prices for their products. Cooperatives thus benefit the local farmers and artisans who are members rather than benefit absentee corporate owners interested only in maximizing profits. Because cooperatives are managed democratically, farmers and artisans learn leadership and organizational skills. The people who grew or made the products thereby have a say in how local resources are utilized and sold. Safe and healthy working conditions can be protected.

Consumers pay higher prices for fair trade coffee than for grocery store brands, but prices are comparable to those charged for gourmet brands. However, fair trade coffee producers receive a significantly higher price per pound than traditional coffee producers. North American consumers pay $4 to $11 a pound for coffee that is bought from growers for about 80 cents a pound. Growers who sell to fair trade organizations earn $1.12 to $1.26 a pound. Because fair trade organizations bypass distributors and work directly with producers, they can cut costs and return a greater percentage of the retail price to the producers. In some cases, the quality is higher because fair traders factor in the environmental cost of production (Figure 9-61). For instance, in the



▲ FIGURE 9-60 **HOUSING BUBBLE** House prices doubled in the United States between 1998 and 2006 and declined by one-third between 2006 and 2009. The graph displays price as an index set at 100 in 2000. For example, a house that sold for $100,000 in 2000 would have been sold for $80,000 in 1995, $190,000 in 2006, and $125,000 in 2012.

▼ FIGURE 9-61 **FAIR TRADE** Fair trade coffee is widely available.

case of coffee, fair trade coffee is usually organic and shade grown, which results in higher-quality coffee.

Pause and Reflect 9.4.5
Do you have any fair trade products?

FAIR TRADE WORKER STANDARDS. Protection of workers' rights is not a high priority in the international trade development approach, according to its critics. With minimal oversight by governments and international lending agencies, workers in developing countries allegedly work long hours in poor conditions for low pay. The workforce may include children or forced labor. Health problems may result from poor sanitation and injuries from inadequate safety precautions. Injured, ill, or laid-off workers are not compensated.

In contrast, fair trade requires employers to pay workers fair wages, permit union organizing, and comply with minimum environmental and safety standards. Under fair trade, workers are paid at least the country's minimum wage. Approximately two-thirds of the artisans providing fair trade hand-crafted products are women. Often these women are mothers and the sole wage earners in the home. Because the minimum wage is often not enough for basic survival, whenever feasible, workers are paid enough to cover food, shelter, education, health care, and other basic needs. Cooperatives are encouraged to reinvest profits back into the community, such as by providing health clinics, child care, and training.

Paying fair wages does not necessarily mean that products cost the consumer more. Because fair trade organizations bypass exploitative intermediaries and work directly with producers, they are able to cut costs and return a greater percentage of the retail price to the producers. The cost remains the same as for traditionally traded goods, but the distribution of the cost of the product is different because the large percentage taken by intermediaries is removed from the equation.

DEVELOPMENT THROUGH MICROFINANCE. Many would-be business owners in developing countries are too poor to qualify for regular bank loans. An alternative source of loans is **microfinance**, which is provision of small loans and other financial services to individuals and small businesses in developing countries that are unable to obtain loans from commercial banks (Figure 9-62).

A prominent example of microfinance is the Grameen Bank, which was established in 1977 (Figure 9-63). Based in Bangladesh, Grameen specializes in making loans to women, who make up three-fourths of the borrowers. Women have borrowed money to buy cows, make perfume, bind books, and sell matches, mirrors, and bananas. For founding the bank, Muhammad Yunus was awarded the Nobel Peace Prize in 2006.

The Grameen Bank has made several hundred thousand loans to women in Bangladesh and neighboring South Asian countries, and only 1 percent of the borrowers have failed to make their weekly loan repayments, an extraordinarily low percentage for a bank. Several million loans have also been provided to women by the Bangladesh Rural Advancement Committee. The average loan is about $60. The smallest loan the bank has made was $1, to a woman who wanted to sell plastic bangles door to door.

▲ **FIGURE 9-62 MICROFINANCE** Microfinance helped these women open a tailor shop in north Benin.

▲ **FIGURE 9-63 GRAMEEN BANK**
A representative of the Grameen Bank collects loan payments from women in Bangladesh.

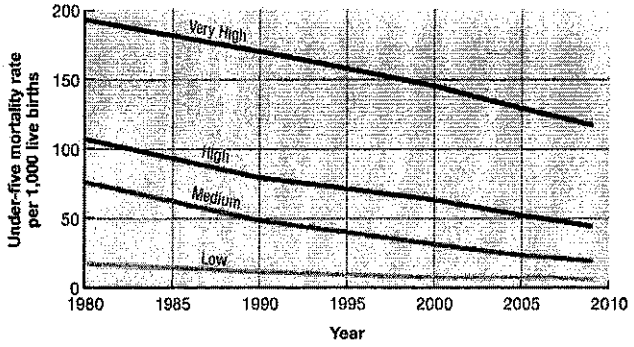
Making Progress in Development

Learning Outcome 9.4.6
Describe ways in which differences in development have narrowed or stayed wide.

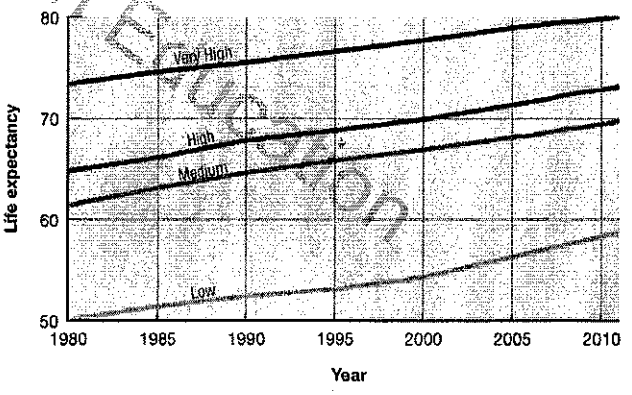
Since the UN began measuring HDI in 1980, both developed and developing regions have made progress (Figure 9-64). The overall HDI score has increased by about the same level in developed countries and in developing countries with high HDI scores (primarily Russia and countries in Latin America) and low HDI scores (primarily countries in sub-Saharan Africa). The HDI score for developing countries with medium HDI scores, which includes most of East and South Asia, has increased more rapidly than for the other regions.

Progress in reducing the gap in level of development between developed and developing countries varies depending on the variable. Consider differences among these three prominent variables:

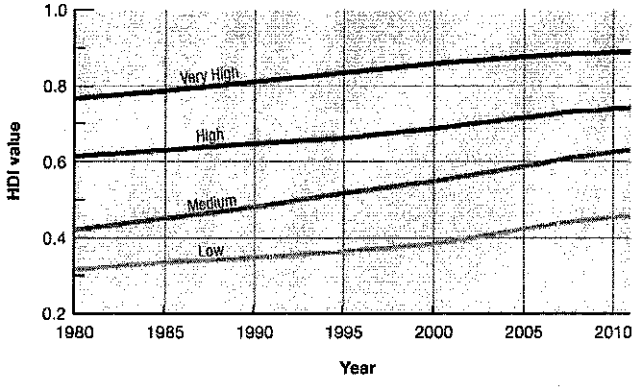
- **Infant mortality rate.** The gap between developed and developing countries has narrowed considerably since 1980. The infant mortality rate has decreased from 17 to 6 (per 1,000) in developed countries and from 107 to 44 in developing countries with medium HDI, which includes most of East and South Asia (Figure 9-65).
- **Life expectancy.** The number of years a baby is expected to live has increased by 8 years in developing countries (Figure 9-66). However, life expectancy at birth has increased by 7 years in developed countries. So the gap between developed and developing countries has not narrowed.
- **GNI per capita.** The gap in wealth between developed and developing countries has widened (Figure 9-67). Since 1980, GNI per capita has increased from $20,000 to $33,000 in developed countries and from $1,000 to $5,000 in developing countries with medium HDI. Progress in improving GNI per capita has been modest in developing countries with high HDI and developing countries with low HDI.



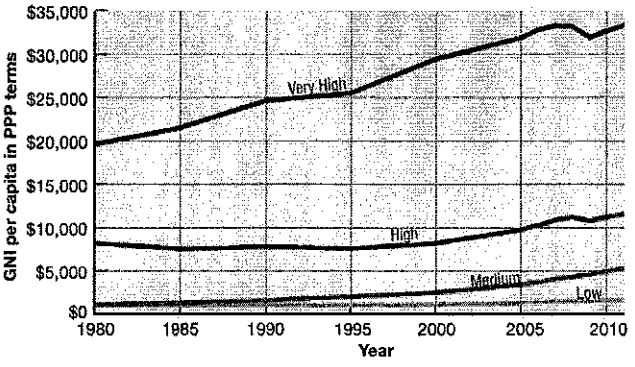
▲ **FIGURE 9-65 INFANT MORTALITY RATE CHANGE BY HDI LEVEL, 1980–2011**
Developing regions have closed the gap in infant mortality rates.



▲ **FIGURE 9-66 LIFE EXPECTANCY CHANGE BY HDI LEVEL, 1980–2011**
All regions have seen substantial progress in increasing life expectancy.



▲ **FIGURE 9-64 HDI CHANGE BY HDI LEVEL, 1980–2011** The HDI has improved relatively rapidly in developing countries with medium HDI scores.



▲ **FIGURE 9-67 GNI PER CAPITA CHANGE BY HDI LEVEL, 1980–2011**
The gap in wealth between developed and developing regions has increased.

MILLENNIUM DEVELOPMENT GOALS

To reduce disparities between developed countries and developing countries the UN has set eight so-called **Millennium Development Goals**, which all UN members have agreed to achieve by 2015. Table 9-1 displays the goals and the progress that has actually been made, according to the UN:

Pause and Reflect 9.4.6

Based on Table 9-1, which Millennium Development Goal appears to be making the most limited progress?

TABLE 9–1 MILLENNIUM DEVELOPMENT GOALS AND PROGRESS TOWARDS ACHIEVEMENT

Goal 1: Eradicate extreme poverty and hunger
• Prior to the severe recession, the depth of poverty had diminished in almost every region. The global economic crisis has slowed progress, as more workers found themselves and their families living in extreme poverty.
• One of the consequences of the severe recession was an increase in hunger, and progress to end hunger has been stymied. One in four children in developing countries is underweight.
Goal 2: Achieve universal primary education
• Sub-Saharan Africa and Southern Asia are home to the vast majority of children out of school, as shown in Figure 9-11. Although progress has been made, the UN concludes that the goal is not being achieved.
Goal 3: Promote gender equality and empower women
• The UN concludes that major barriers to gender equality remain, as discussed in Key Issue 2 of this chapter. The UN cites higher levels of poverty, fewer education opportunities, and lack of political representation. Top-level jobs still go to men, whereas women are relegated to jobs with low pay, limited benefits, and little security.
Goal 4: Reduce child mortality
• The UN concludes that child deaths are falling, but not quickly enough to reach the target. Infant mortality rates remain especially high in sub-Saharan Africa, as shown in Figure 9-65.
Goal 5: Improve maternal health
• Progress has been made in reducing maternal mortality, but as shown in Key Issue 2, giving birth is especially risky in Southern Asia and sub-Saharan Africa, where most women deliver without skilled care.
• Progress has stalled in reducing the number of teenage pregnancies, putting more young mothers at risk.
• Progress in expanding the use of contraceptives by women has slowed. Use of contraception is lowest among the poorest women and those with no education.
• Inadequate funding for family planning is a major failure in fulfilling commitments to improving women's reproductive health.
Goal 6: Combat HIV/AIDS, malaria, and other diseases
• The spread of HIV appears to have stabilized in most regions, as discussed in Chapter 2. Many young people still lack the knowledge to protect themselves against HIV, especially in sub-Saharan Africa. However, the rate of new HIV infections continues to outstrip the expansion of treatment.
• More drugs to fight malaria are being distributed. Expanded use of insecticide-treated bed nets is protecting communities from malaria, especially in sub-Saharan Africa.
• Tuberculosis prevalence is falling in most regions, but TB remains the second leading killer after HIV.
Goal 7: Ensure environmental sustainability
• The rate of deforestation is decreasing, but is still alarmingly high, and a decisive response to climate change is urgently needed, according to the UN.
• Key habitats for threatened species are not being adequately protected, and the number of species facing extinction is growing by the day, especially in developing countries.
• The world is on track to meet the drinking water target, though safe water supply remains a challenge in many parts of the world, especially in rural areas.
• With half the population of developing regions without sanitation, the 2015 target is out of reach, according to the UN.
• Slum improvements, though considerable, are failing to keep pace with the growing ranks of the urban poor, as discussed in Chapter 13.
Goal 8: Develop a global partnership for development
• Aid from developed countries continues to rise, but relatively little of it is reaching sub-Saharan Africa.

CORE AND PERIPHERY

The relationship between developed countries and developing countries is often described as a north-south split, because most of the developed countries are north of the equator, whereas many developing countries are south. Immanuel Wallerstein, a U.S. social scientist, depicted the relationship between developed and developing countries as one of "core" and "periphery." According to Wallerstein's world-systems analysis, in an increasingly unified world economy, developed countries form an inner core area, whereas developing countries occupy peripheral locations. As a result, global development patterns are sometimes referred to as **uneven development**, with countries at the core benefiting at the expense of countries on the periphery.

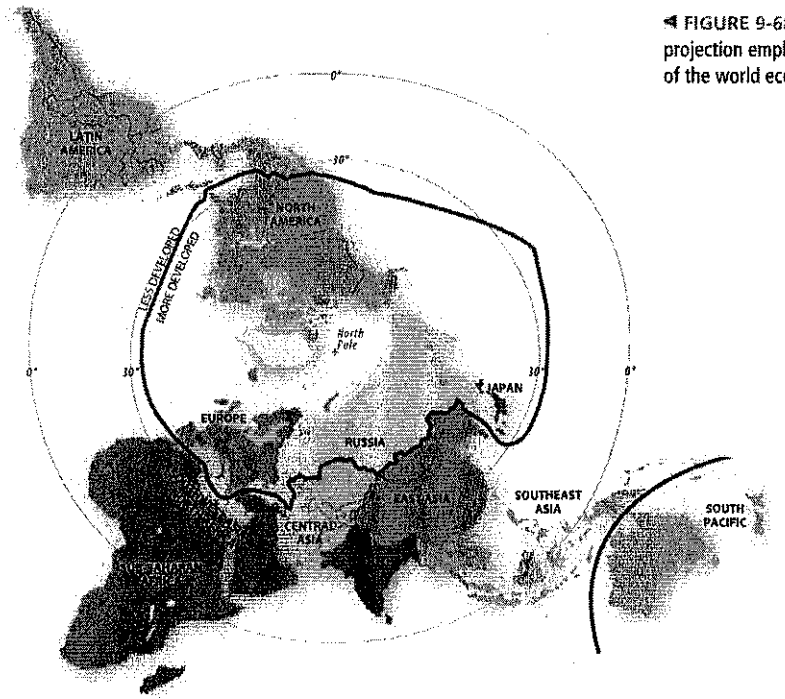
The unorthodox north polar map projection in Figure 9-68 emphasizes the central role that developed countries play in the world economy. North America, Europe, and Japan account for a high percentage of the world's economic activity and wealth. Developing countries in the periphery have less access to the world centers of consumption, communications, wealth, and power, which are clustered in the core.

The unorthodox projection in Figure 9-60 also shows connections between particular core and periphery regions. The development prospects of Latin America are tied to governments and businesses primarily in North America, those of Africa and Eastern Europe to Western Europe, and those of Asia to Japan and to a lesser extent Europe and North America. As countries like China, India, and Brazil develop, relationships between core and periphery are changing, and the line between core and periphery may need to be redrawn.

CHECK-IN: KEY ISSUE 4

Why Do Countries Face Obstacles to Development?

- ✓ **Two paths to development are self-sufficiency and international trade; international trade has become more important in recent decades.**
- ✓ **Development is financed through foreign direct investment by corporations and loans by governments and international organizations.**
- ✓ **The severe recession of the early twenty-first century has posed challenges to developing countries and developed countries to continue development policies.**
- ✓ **Progress has been made in achieving development in most regions.**



◀ FIGURE 9-68 **CORE AND PERIPHERY.** This unorthodox world map projection emphasizes the central role that developed countries play at the core of the world economy.

Summary and Review

KEY ISSUE 1

Why Does Development Vary among Countries?

Development is the process by which the material conditions of a country's people are improved. The world is divided into developed countries and developing ones. Developed and developing countries can be compared according to a number of indicators.

LEARNING OUTCOME 9.1.1: Identify the HDI standard of living factor.

- The HDI, which measures the level of development of each country, is calculated by combining three measures.
- Standard of living is measured through gross national income per capita at purchasing power parity.

LEARNING OUTCOME 9.1.2: Identify the HDI health factor.

- The HDI health factor is life expectancy at birth.

LEARNING OUTCOME 9.1.3: Identify the HDI access to knowledge factor.

- The HDI knowledge factors are years of schooling and expected years of schooling.

LEARNING OUTCOME 9.1.4: Describe variations in level of development within countries and regions.

- Some developing countries, especially larger ones, have large variations among regions in level of development.

THINKING GEOGRAPHICALLY 9.1: In what ways would you expect the severe recession of the early twenty-first century to change some of the development indicators?

GOOGLE EARTH 9.1: Vehicle ownership rates are extremely low in Kenya, yet if you zoom into the center of Nairobi, what is the volume of traffic on the roads?

KEY ISSUE 2

Why Does Development Vary by Gender?

The UN has not found a single country in the world where the women are treated as well as the men.

LEARNING OUTCOME 9.2.1: Describe the UN's measures of gender inequality.

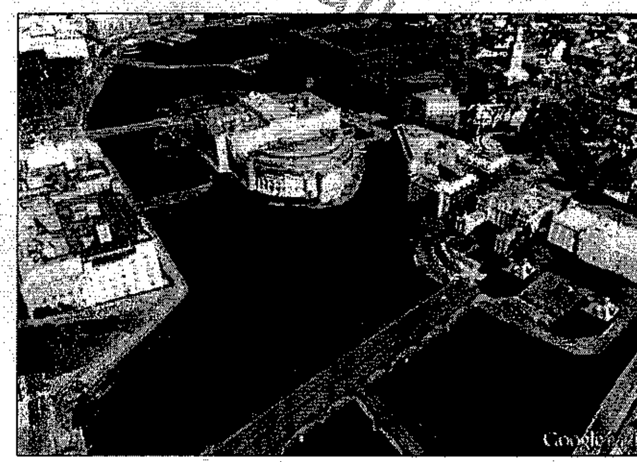
- The GII measures the extent of gender inequality.
- The GII combines measures of empowerment, labor force participation, and reproductive rights.

LEARNING OUTCOME 9.2.2: Describe changes since the 1990s in gender inequality.

- Gender inequality has declined in most countries since 1990, although not in the United States.

THINKING GEOGRAPHICALLY 9.2: Review the major economic, social, and demographic characteristics that contribute to a country's level of development. Which indicators can vary significantly by gender within countries and between countries at various levels of development? Why?

GOOGLE EARTH 9.2: Women comprise nearly one-half of Sweden's Parliament. Fly to Parliament of Sweden, Stockholm. What is the distinctive physical site on which the Parliament is located?



Key Terms

Active solar energy systems (p. 326) Solar energy systems that collects energy through the use of mechanical devices such as photovoltaic cells or flat-plate collectors.

Adolescent fertility rate (p. 312) The number of births per 1,000 women ages 15 to 19.

Biomass fuel (p. 324) Fuel that derives from plant material and animal waste.

Breeder reactor (p. 323) A nuclear power plant that creates its own fuel from plutonium.

Demand (p. 314) The quantity of something that consumers are willing and able to buy.

Developed country (more developed country [MDC] or relatively developed country) (p. 300) A country that has progressed relatively far along a continuum of development.

Developing country (less developed country [LDC]) (p. 300) A country that is at a relatively early stage in the process of economic development.

Development (p. 300) A process of improvement in the material conditions of people through diffusion of knowledge and technology.

Fair trade (p. 336) An alternative to international trade that emphasizes small businesses and worker-owned and democratically run

KEY ISSUE 3

Why Are Energy Resources Important for Development?

Development depends on abundant low-cost energy.

LEARNING OUTCOME 9.3.1: Explain the principal sources of demand for fossil fuels.

- Most energy is supplied by three fossil fuels: coal, petroleum, and natural gas.
- Developed countries and developing countries each consume approximately half of the world's energy.

LEARNING OUTCOME 9.3.2: Describe the distribution of production of the three fossil fuels.

- Fossil fuels are not distributed uniformly around the world, and they are nonrenewable sources of energy.

LEARNING OUTCOME 9.3.3: Analyze the distribution of reserves of fossil fuels and differentiate between proven and potential reserves.

- Reserves are divided into proven (fields already discovered) and potential (fields thought to exist).
- Proven reserves are not distributed uniformly.

LEARNING OUTCOME 9.3.4: Describe the role of OPEC and changes in the price and availability of petroleum.

- Much of the world's petroleum reserves are located in countries that belong to OPEC.
- The United States has increased its dependence on petroleum imported from neighbors in the Western Hemisphere.

LEARNING OUTCOME 9.3.5: Describe the distribution of nuclear energy and challenges in using it.

- Nuclear is the principal source of energy other than the three fossil fuels in the United States and a couple dozen other countries.
- Numerous problems limit the use of nuclear power, including threat of accidents, disposal of waste, use in making weapons, limited reserves, and high costs.

LEARNING OUTCOME 9.3.6: Identify challenges to increasing the use of alternative energy sources.

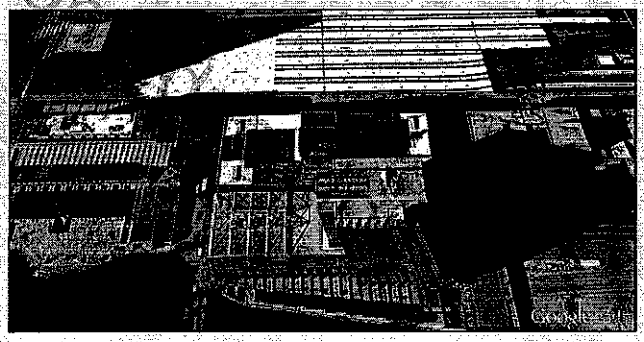
- Leading renewable energy sources include biomass, hydroelectric, geothermal, wind, and solar.

LEARNING OUTCOME 9.3.7: Compare and contrast between passive and active solar energy.

- Active solar energy captures energy with special devices, such as photovoltaic cells, whereas passive solar energy does not.

THINKING GEOGRAPHICALLY 9.3: The average American consumes approximately 500 gallons of gas a year in his or her car. Does your family use more or less than the average? To answer this, you need to know how many miles your or your family's vehicles are driven and the vehicles' fuel efficiency (average miles per gallon). The fuel efficiency can be found by Googling "fuel efficiency" plus the vehicle model and year.

GOOGLE EARTH 9.3: If you fly to 1301 W 120 St., Chicago, what type of energy is being supplied by the large rectangular feature?



cooperatives and requires employers to pay workers fair wages, permit union organization, and comply with minimum environmental and safety standards.

Female labor force participation rate (p. 311) The percentage of women holding full-time jobs outside the home.

Fission (p. 322) The splitting of an atomic nucleus to release energy.

Foreign direct investment (FDI) (p. 332) Investment made by a foreign company in the economy of another country.

Fossil fuel (p. 314) An energy source formed from the residue of plants and animals buried millions of years ago.

Fracking (hydraulic fracturing) (p. 319) The pumping of water at high pressure to break apart rocks in order to release natural gas.

Fusion (p. 325) Creation of energy by joining the nuclei of two hydrogen atoms to form helium.

Gender Inequality Index (GII) (p. 310) A measure of the extent of each country's gender inequality.

Geothermal energy (p. 325) Energy from steam or hot water produced from hot or molten underground rocks.

Gross domestic product (GDP) (p. 302) The value of the total output of goods and services produced in a country in a given time period (normally one year).

Gross national income (GNI) (p. 302) The value of the output of goods and services produced in a country in a year, including money that leaves and enters the country.

Housing bubble (p. 335) A rapid increase in the value of houses followed by a sharp decline in their value.

Human Development Index (HDI) (p. 301) An indicator of the level of development for each country, constructed by the United Nations, that is based on income, literacy, education, and life expectancy.

Hydroelectric power (p. 324) Power generated from moving water.

Inequality-adjusted HDI (IHDI) (p. 303) Modification of the HDI to account for inequality within a country.

Literacy rate (p. 307) The percentage of a country's people who can read and write.

Maternal mortality ratio (p. 312) The number of women who die giving birth per 100,000 births.

Microfinance (p. 337) Provision of small loans and other financial services to individuals and small businesses in developing countries.

Millennium Development Goals (p. 339) Eight international development goals that all members of the United Nations have agreed to achieve by 2015.

KEY ISSUE 4

Why Do Countries Face Obstacles to Development?

To develop more rapidly, developing countries must adopt policies that successfully promote development and find funds to pay for it.

LEARNING OUTCOME 9.4.1: Summarize the two paths to development.

- To promote development, developing countries choose either the self-sufficiency path or the international trade path.

LEARNING OUTCOME 9.4.2: Analyze shortcomings of the two development paths and give reasons international trade has triumphed.

- Self-sufficiency has protected inefficient businesses.
- International trade has increased dependency on declining resources and developed countries.
- Most countries have adopted international trade because of evidence that it promotes more rapid development.

LEARNING OUTCOME 9.4.3: Identify the main sources of financing development.

- Finance comes from direct investment by transnational corporations and loans from banks and international organizations.

LEARNING OUTCOME 9.4.4: Explain problems with financing development in developing and developed countries.

- Developing countries have been required to adopt structural adjustment programs.
- Developed countries have had to choose between policies that promote short-term growth and those that promote austerity.

LEARNING OUTCOME 9.4.5: Explain the principles of fair trade.

- Fair trade attempts to protect workers and small businesses in developing countries.
- Fair trade involves a combination of producer and worker standards.

LEARNING OUTCOME 9.4.6: Describe ways in which differences in development have narrowed or stayed wide.

- Developing countries have closed the gap with developed countries in some respects, such as health, but not in other respects, such as income.

THINKING GEOGRAPHICALLY 9.4: Some developing countries claim that the requirements placed on them by lending organizations such as the World Bank impede rather than promote development. Should developing countries be given a greater role in deciding how much the international organizations should spend and how such funds should be spent? Why or why not?

GOOGLE EARTH 9.4: A portion of the Trans-African Highway can be seen in the center of Voi, Kenya, running east-west in a curving arc immediately south of the center. Drag to street view, exit street view, and rotate so that north is to the right. For approximately what distance is the highway divided?

Nonrenewable energy (p. 317) A source of energy that has a finite supply capable of being exhausted.

Passive solar energy systems (p. 326) Solar energy systems that collect energy without the use of mechanical devices.

Photovoltaic cell (p. 326) A solar energy cell, usually made from silicon, that collects solar rays to generate electricity.

Potential reserve (p. 319) The amount of a resource in deposits not yet identified but thought to exist.

Primary sector (p. 302) The portion of the economy concerned with the direct extraction of materials from Earth's surface, generally through agriculture, although sometimes by mining, fishing, and forestry.

Productivity (p. 303) The value of a particular product compared to the amount of labor needed to make it.

Proven reserve (p. 318) The amount of a resource remaining in discovered deposits.

Purchasing power parity (PPP) (p. 302) The amount of money needed in one country to purchase the same goods and services in another country; PPP adjusts income figures to account for differences among countries in the cost of goods.

Radioactive waste (p. 322) Materials from a nuclear reaction that emit radiation; contact with such particles may be harmful or lethal to people; therefore, the materials must be safely stored for thousands of years.

Renewable energy (p. 317) A resource that has a theoretically unlimited supply and is not depleted when used by humans.

Secondary sector (p. 302) The portion of the economy concerned with manufacturing useful products through processing, transforming, and assembling raw materials.

Structural adjustment program (p. 334) Economic policies imposed on less developed countries by international agencies to create conditions encouraging international trade, such as raising taxes, reducing government spending, controlling inflation, selling publicly owned utilities to private corporations, and charging citizens more for services.

Supply (p. 314) The quantity of something that producers have available for sale.

Tertiary sector (p. 302) The portion of the economy concerned with transportation, communications, and utilities, sometimes extended to the provision of all goods and services to people, in exchange for payment.

Uneven development (p. 340) Development of core regions at the expense of those on the periphery.

Value added (p. 303) The gross value of a product minus the costs of raw materials and energy.