PUBLIC TRANSIT

Learning Outcome 13.3.6

State the benefits and limitations of public transportation.

Because few people live within walking distance of their place of employment, urban areas are characterized by extensive commuting. The heaviest flow of commuters is into the CBD in the morning and out of it in the evening.

The intense concentration of people in the CBD during working hours strains transportation systems because a large number of people must reach a small area of land at the same time in the morning and disperse at the same time in the afternoon. As much as 40 percent of all trips made into or out of a CBD occur during four hours of the day—two in the morning and two in the afternoon. **Rush hour**, or peak hour, is the four consecutive 15-minute periods that have the heaviest traffic.

PUBLIC TRANSIT IN THE UNITED STATES. In the United States, public transit is used primarily for rush-hour commuting by workers into and out of the CBD. One-half of trips to work are by public transit in New York; one-third in Boston, San Francisco, and Washington; and one-fourth in Chicago and Philadelphia. But in most other cities, public transit service is minimal or nonexistent.

Despite the obvious advantages of public transportation for commuting, only 5 percent of work trips are by public transit in the United States. Overall, public transit ridership in the United States declined from 23 billion per year in the 1940s to 10 billion in 2011. The average American wastes 14 gallons of gasoline and loses 34 hours per year sitting in traffic jams, according to the Urban Mobility Report prepared by the Texas Transportation Institute. In the United States, the total cost of congestion is valued at $101 billion per year. But most Americans still prefer to commute by vehicle. Most people overlook these costs because they place higher value on the privacy and flexibility of schedule offered by a car.

Early in the twentieth century, U.S. cities had 50,000 kilometers (30,000 miles) of street railways and trolleys that carried 14 billion passengers a year, but only a few hundred kilometers of track remain. The number of U.S. and Canadian cities with trolley service declined from approximately 50 in 1950 to 8 in the 1960s. General Motors acquired many of the privately owned streetcar companies and replaced the trolleys with buses that the company made. Buses offer more flexible service than do trolleys because they are not restricted to fixed tracks. However, bus ridership in the United States declined from a peak of 11 billion riders annually in the late 1940s to 5 billion in 2011. Commuter railroad service, like trolleys and buses, has also been drastically reduced in most U.S. cities.

RAPID TRANSIT. The one exception to the downward trend in public transit in the United States is rapid transit. It is known to transportation planners as either fixed heavy rail (such as subways) or fixed light rail (such as streetcars). Cities such as Boston and Chicago have attracted new passengers through construction of new subway lines and modernization of existing service (Figure 13-38). Chicago has been a pioneer in the construction of heavy-rail rapid transit lines in the median strips of expressways. Entirely new subway systems have been built in recent years in U.S. cities, including Atlanta, Baltimore, Miami, San Francisco, and Washington.

The federal government has permitted Boston, New York, and other cities to use funds originally allocated for interstate highways to modernize rapid transit service instead. New York's subway cars, once covered with graffiti spray-painted by gang members, have been cleaned so that passengers can ride in a more hospitable environment. As a result of these improvements, subway ridership in the United States increased from 2 billion in 1995 to 3.6 billion in 2011.

The trolley—now known by the more elegant term fixed light-rail transit—was once relegated almost exclusively to a tourist attraction in New Orleans and San Francisco but is making a modest comeback in North America. New trolley lines have been built or are under construction in Baltimore, Buffalo, Calgary, Edmonton, Los Angeles, Portland

▲ **FIGURE 13-38 BOSTON PUBLIC TRANSIT** Boston's subway system, known as "the T," includes heavy rail (top) and light rail (borrom).

(Oregon), Sacramento, St. Louis, San Diego, and San Jose. Ridership in all cities combined was a half-billion in 2011.

California, the state that most symbolizes the automobile-oriented American culture, is the leader in construction of new fixed light-rail transit lines. San Diego has added more kilometers than any other city. One line that runs from the CBD south to the Mexican border has been irreverently dubbed the "Tijuana trolley" because it is heavily used by residents of nearby Tijuana, Mexico. Los Angeles—the city perhaps most associated with the motor vehicle—has planned the most extensive new light-rail system. The city had a rail network exceeding 1,600 kilometers (1,000 miles) as recently as the late 1940s, but the lines were abandoned when freeways were built to accommodate increasing automobile usage. Now Los Angeles wants to entice motorists out of their cars and trucks with new light-rail lines, but construction is very expensive, and the lines serve only a tiny percentage of the region.

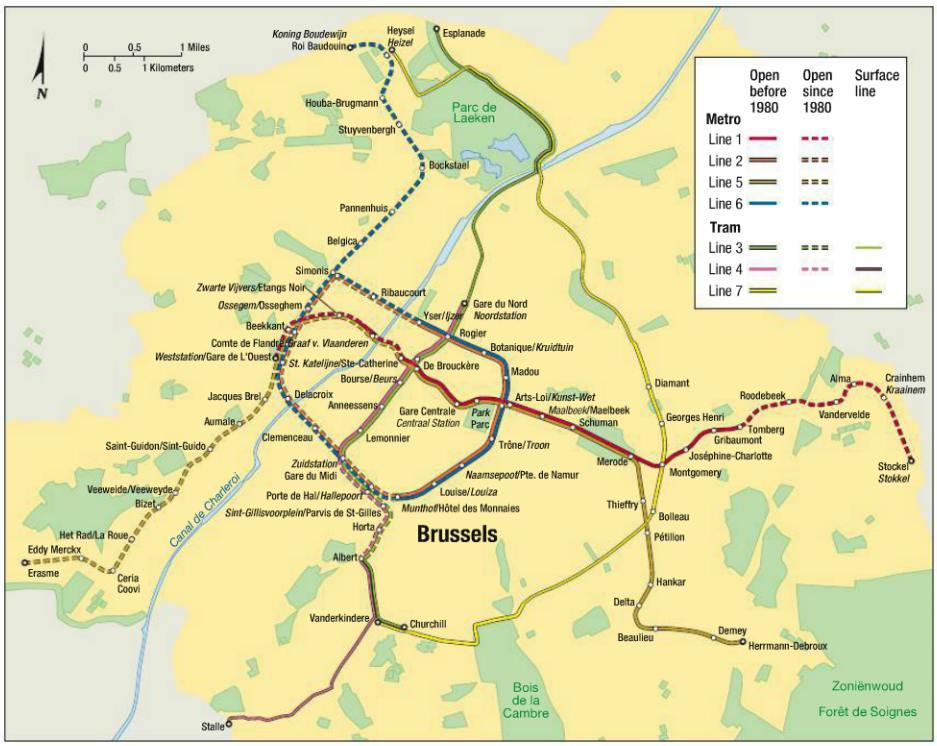
The minimal level of public transit service in most U.S. cities means that low-income people may not be able to reach places of employment. Low-income people tend to live in inner-city neighborhoods, but the job opportunities, especially those requiring minimal training and skill in personal services, are in suburban areas not well served by public transportation. Inner-city neighborhoods have high unemployment rates at the same time that suburban firms have difficulty attracting workers. In some cities, governments and employers subsidize vans to carry low-income inner-city residents to suburban jobs.

Pause and Reflect 13.3.6

What strategies are being used at your college or school district to reduce dependency on private motor vehicles?

PUBLIC TRANSIT IN OTHER COUNTRIES. In dozens of major cities around the world, extensive networks of bus, tram, and subway lines have been maintained, and funds for new construction have been provided in recent years (Figure 13-39). Smaller cities have shared the construction boom. In France, new subway lines have been built since the 1970s in Lille, Lyon, and Marseille, and hundreds of kilometers of entirely new tracks have been laid between the country's major cities to operate a high-speed train known as the TGV (Trains à Grande Vitesse). Growth in the suburbs has stimulated nonresidential construction, including suburban shops, industry, and offices.

Despite modest recent successes, public transit in the United States is caught in a vicious circle because fares do not cover operating costs. As patronage declines and expenses rise, the fares are increased, which drives away passengers and leads to service reduction and still higher fares. Public expenditures to subsidize construction and operating costs have increased, but the United States does not fully recognize that public transportation is a vital utility deserving of subsidy to the degree long assumed by governments in other developed countries, as well as developing countries.



◀ FIGURE 13-39 **BRUSSELS, BELGIUM, METRO AND TRAM** European cities such as Brussels have invested substantially in improving public transportation in recent years. Brussels provides a good example of a public transport system that integrates heavy rail (Métro) with light rail (trams). Trams initially used Métro tunnels, but the tunnels were large enough to convert to heavy-rail lines as funds became available.

ADVANTAGES OF PUBLIC TRANSIT

Learning Outcome 13.3.7

Describe recent and possible future improvements in vehicles.

In larger cities, public transit is better suited than motor vehicles to moving large numbers of people because each transit traveler takes up far less space. Public transportation is cheaper, less polluting, and more energy efficient than privately operated motor vehicles. It also is particularly suited to rapidly bringing a large number of people into a small area. A bus can accommodate 30 people in the amount of space occupied by one car, whereas a double-track rapid transit line can transport the same number of people as 16 lanes of urban freeway.

Motor vehicles have costs beyond their purchase and operation—including delays imposed on others, increased need for highway maintenance, construction of new highways, and pollution. One-third of the high-priced central land is devoted to streets and parking lots, although multistory and underground garages also are constructed.

THE CAR OF THE FUTURE

Consumers in developed countries are reluctant to give up their motor vehicles, and demand for vehicles is soaring in developing countries. One of the greatest challenges to reducing pollution and conserving nonrenewable resources is reliance on petroleum as automotive fuel, so carmakers are scrambling to bring alternative-fuel vehicles to the market. The Department of Energy forecasts that around one-half of all new vehicles sold in the United States in 2020 will be powered by an alternative to the conventional gas engine. Alternative technologies include diesel, biofuel, hybrid, electric, and hydrogen.

DIESEL. Diesel engines burn fuel more efficiently, with greater compression, and at a higher temperature than conventional gas engines. Most new vehicles in Europe are diesel powered, where they are valued for zippy acceleration on crowded roads, as well as for high fuel efficiency. Diesels have made limited inroads in the United States, where they were identified with ponderous heavy trucks, poorly performing versions in the 1980s, and generation of more pollutants. Biodiesel fuel mixes petroleum diesel with biodiesel (typically 5 percent), which is produced from vegetable oils or recycled restaurant grease.

HYBRID. Sales of hybrids increased rapidly during the first decade of the twenty-first century, led by Toyota's success with the hybrid Prius. A gasoline engine powers the vehicle at high speeds, and at low speeds, when the gas engine is at its least efficient, an electric motor takes over. Energy that would otherwise be wasted in coasting and braking is also captured as electricity and stored until needed.

▲ **FIGURE 13-40 PLUG-IN HYBRID** Chevrolet Volt cars are being recharged outside the factory in Detroit where they are assembled.

ETHANOL. Ethanol is fuel made by distilling crops such as sugarcane, corn, and soybeans. Sugarcane is distilled for fuel in Brazil, where most vehicles run on ethanol. In the United States, corn has been the principal crop for ethanol, but this has proved controversial because the amount of fossil fuels needed to grow and distill the corn is comparable to—and possibly greater than—the amount saved in vehicle fuels. Furthermore, growing corn for ethanol diverts corn from the food chain, thereby allegedly causing higher food prices in the United States and globally. More promising is ethanol distilled from cellulosic biomass, such as trees and grasses.

FULL ELECTRIC. A full electric vehicle has no gas engine. When the battery is discharged, the vehicle will not run until the battery is recharged by plugging it into an outlet. Motorists can make trips in a local area and recharge the battery at night. Out-of-town trips are difficult because recharging opportunities are scarce. In large cities, a number of downtown garages and shopping malls have recharging stations, but few exist in rural areas.

PLUG-IN HYBRID. In a plug-in hybrid, the battery supplies the power at all speeds. It can be recharged in one of two ways: While the car is moving, the battery can be recharged by a gas engine or, when it is parked, the car can be recharged by plugging into an electrical outlet (Figure 13-40). The principal limitation of a full electric vehicle has been the short range of the battery before it needs recharging. Using a gas engine to recharge the battery extends the range of the plug-in hybrid to that of a conventional gas engine.

HYDROGEN FUEL CELL. Hydrogen forced through a PEM (polymer electrolyte membrane or proton exchange membrane) combines with oxygen from the air, producing an electric charge. The electricity can then be used to power an electric motor. Fuel cells are now widely used in small vehicles such as forklifts. Fuel cell vehicles are being used in a handful of large East Coast and West Coast cities, where hydrogen fueling stations have been constructed.

Pause and Reflect 13.3.7

Which alternative-fuel vehicles appear most likely to be successful at reducing dependency on fossil fuels? Which appear most successful at improving air pollution?

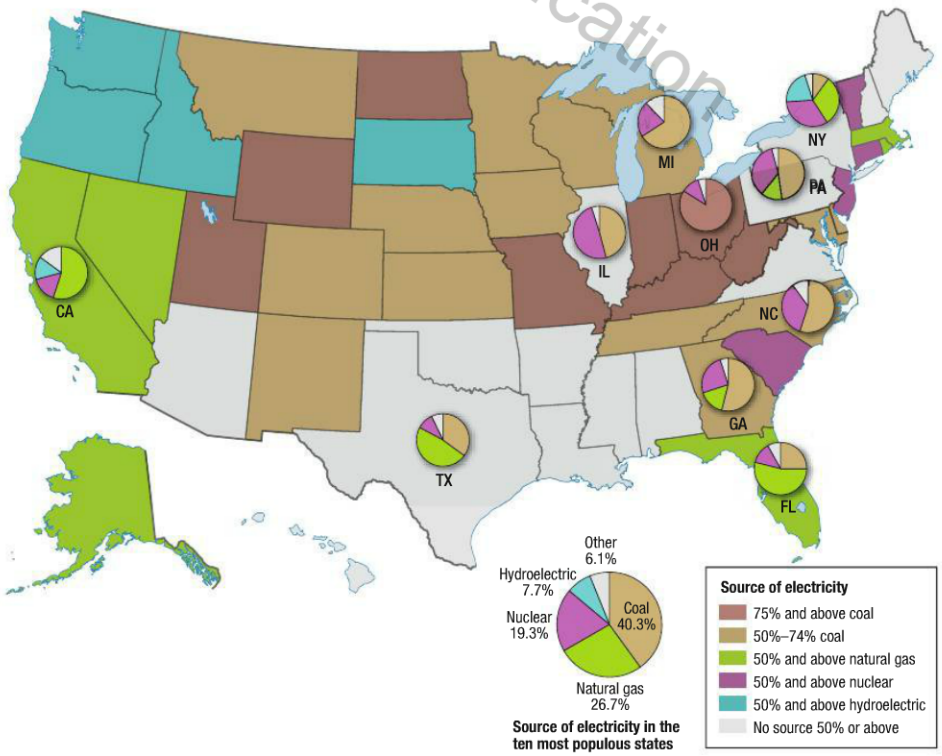
REGIONAL VARIATIONS IN ELECTRICITY. Electric-powered vehicles require recharging by being plugged into a source of electricity such as an outlet in the garage that ultimately comes from a power plant. Though fossil fuel is not being pumped directly into the tank of the electric-powered vehicle, fossil fuel is consumed to generate the electricity at the power plant. In fact, the United States as a whole generates around 40 percent of its electricity from coal-burning power plants and around 25 percent from natural gas. An electric vehicle does reduce consumption of an increasingly scarce and expensive resource—petroleum. But if the electricity is generated by natural gas, then plugging a vehicle into the electric grid may conserve petroleum at the expense of more rapid depletion of natural gas. If electricity is generated by coal, a plug-in may cause more air pollution.

Electricity is generated differently across the 50 U.S. states. In the Pacific Northwest, where hydroelectric is the leading source of electricity, recharging electric vehicles will have much less impact on air quality than will be the case in the Midwest (Figure 13-41). States that depend on farm production may benefit from increased use of ethanol. Thus, the "greenest" alternative varies by location.

CHECK-IN: KEY ISSUE 3

Why Are Urban Areas Expanding?

- ✓ **A city is an incorporated unit of government. An urban area includes a city and surrounding built-up suburbs. A metropolitan area includes an urban area and surrounding counties.**
- ✓ **In the northeastern United States, adjacent metropolitan areas form a continuous urban region called Megalopolis.**
- ✓ **U.S. cities once expanded by annexing surrounding land, but annexation is now less common; instead, cities are surrounded by numerous independent suburban jurisdictions.**
- ✓ **Sprawling suburbs surround U.S. cities; suburban sprawl consumes a lot of land and requires investment in a lot of new roads and utilities.**
- ✓ **Suburbs are segregated by social class and by land use activities.**
- ✓ **Suburban residents are dependent on motor vehicles to get to other places, whereas most cities offer forms of public transit.**



▲ **FIGURE 13-41 ELECTRICITY BY U.S. STATE** Dependency on nonrenewable and polluting fossil fuels to generate electricity varies widely among states.