Chapter 11
Industry and Energy

Industry and Energy: Key Issues

1. Where Is Industry Distributed?
2. Why Are Situation and Site Factors Important?
3. Why Do Industries Face Resource Challenges?
4. Why Are Industries Changing Locations?

Key Issue 1: Where Is Industry Distributed?

1.1 Introducing Industry and Energy

1.2 Industrial Regions

Introducing Industry and Energy

- Industrial Revolution led to innovations in
  - iron
  - transportation
  - textiles
  - chemicals
  - food processing
- Fossil fuels have become primary source of energy
  - coal
  - petroleum
  - natural gas

James Watt's Steam Engine

Figure 11-1: Watt's engine was effective at transforming heat energy into mechanical power.

Diffusion of the Industrial Revolution

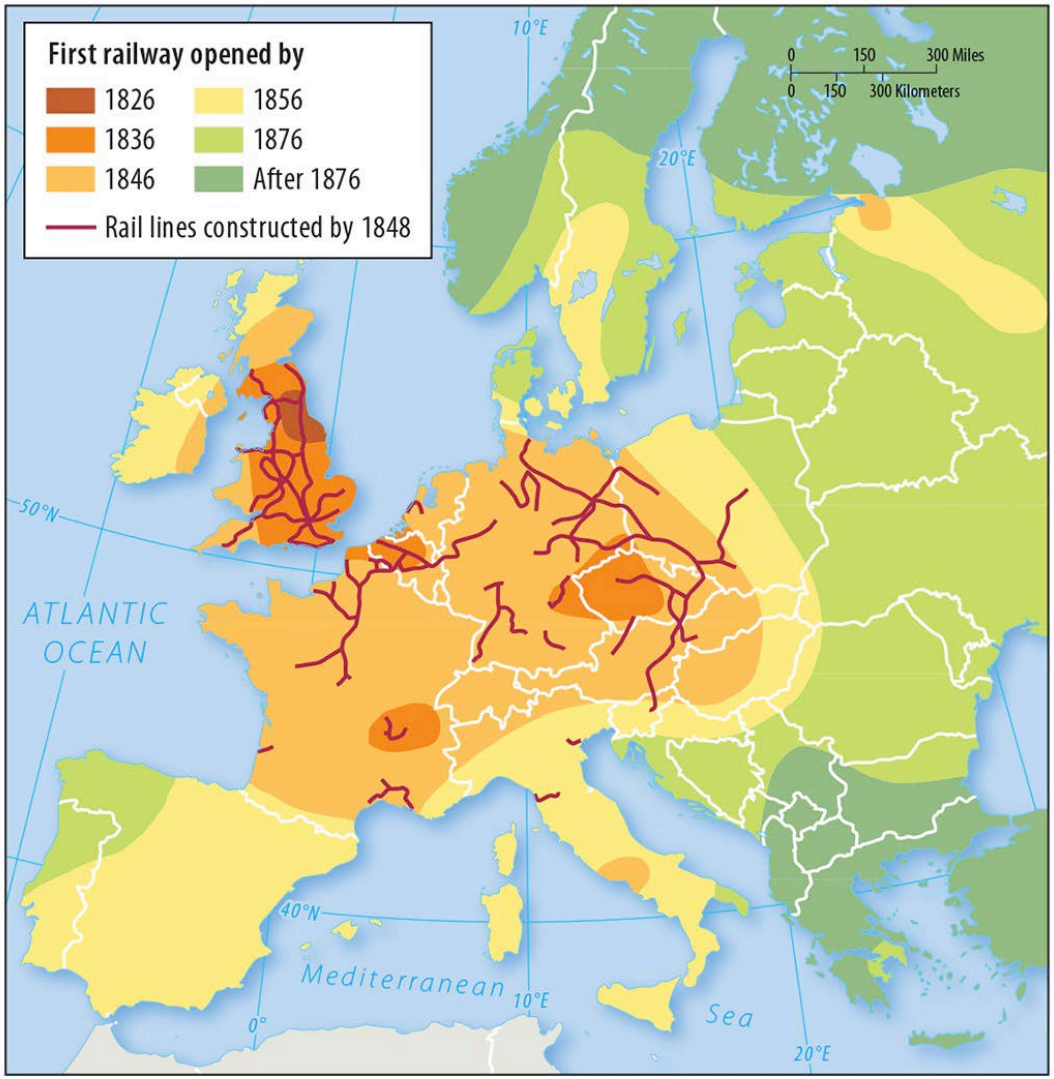


Figure 11-2: The development of railways traces the diffusion of the Industrial Revolution across Europe.

Energy Consumption

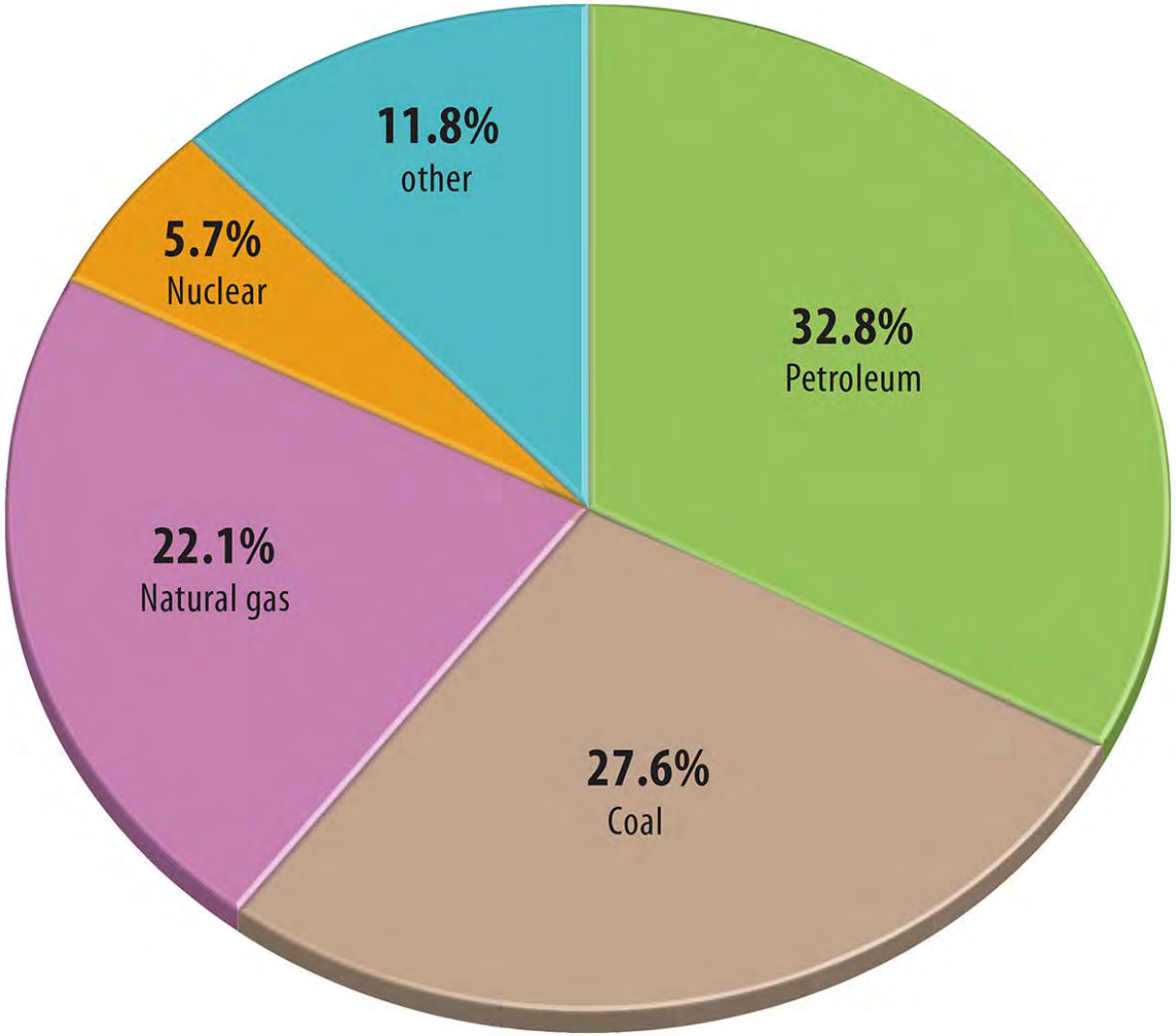


Figure 11-3: Petroleum, coal, and natural gas (fossil fuels) are together the largest sources of energy in the world.

Industrial Regions

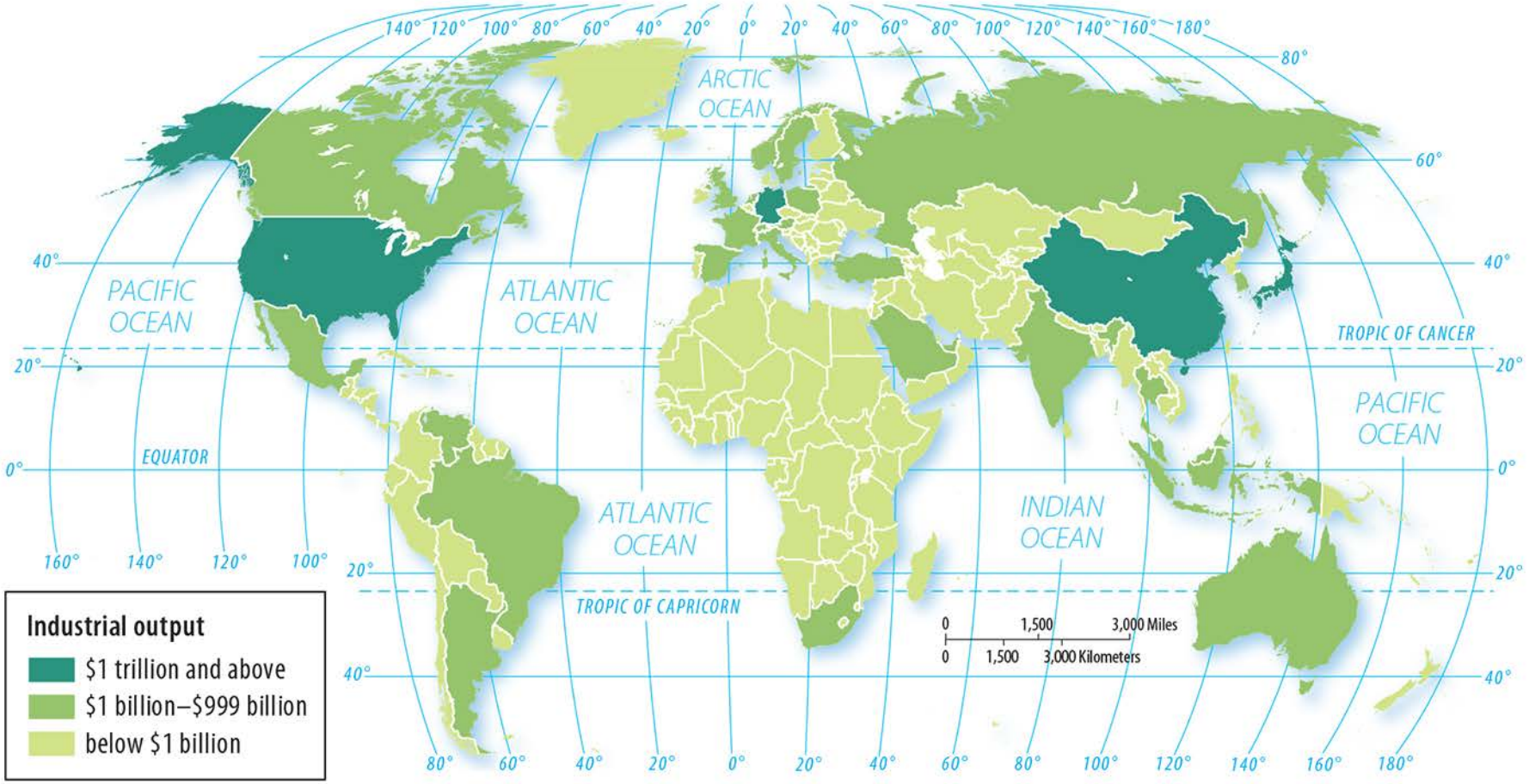


Figure 11-4: Industry is concentrated in Europe, North America, and East Asia.

Europe's Industrial Regions

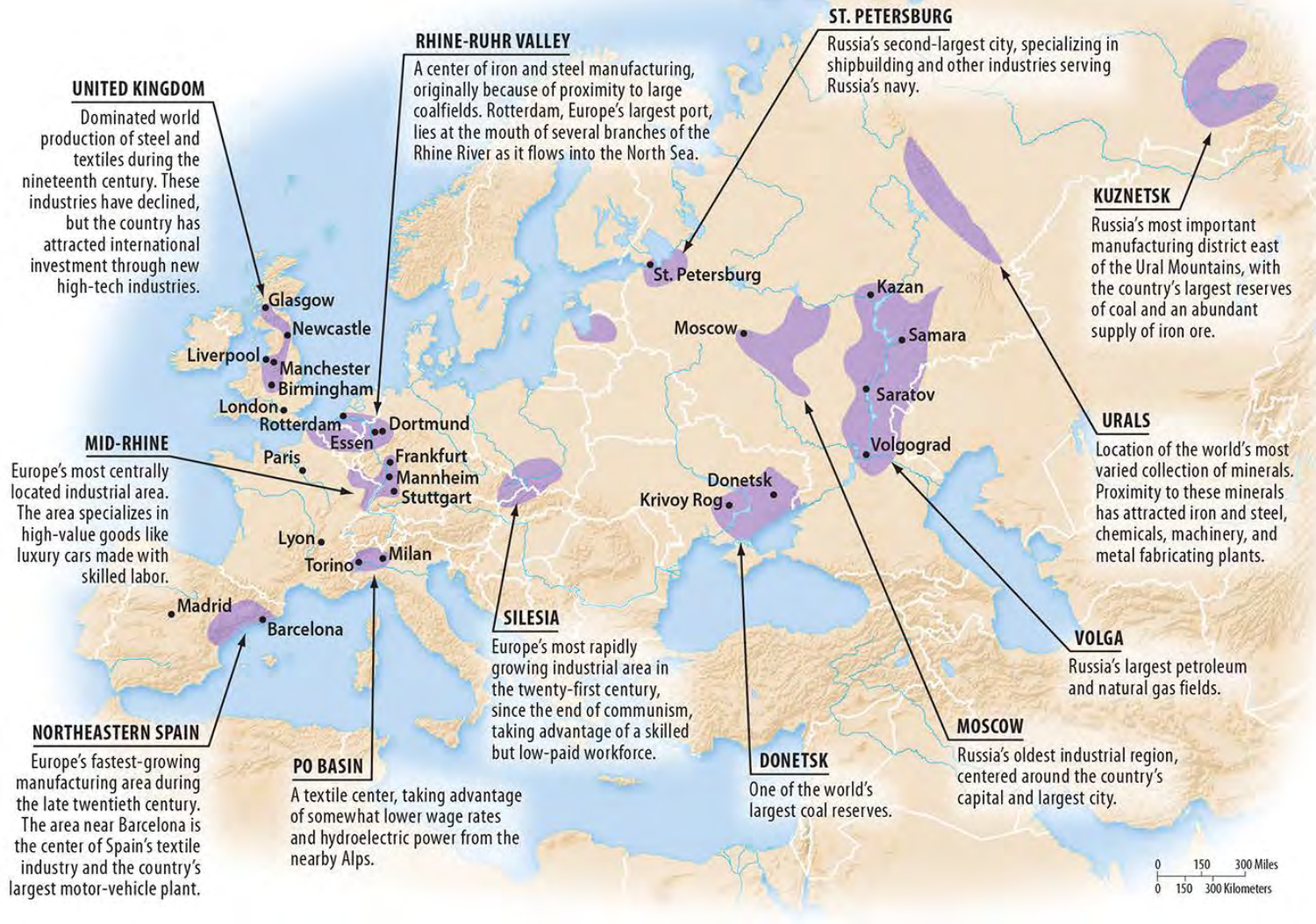


Figure 11-5

North America's Industrial Regions

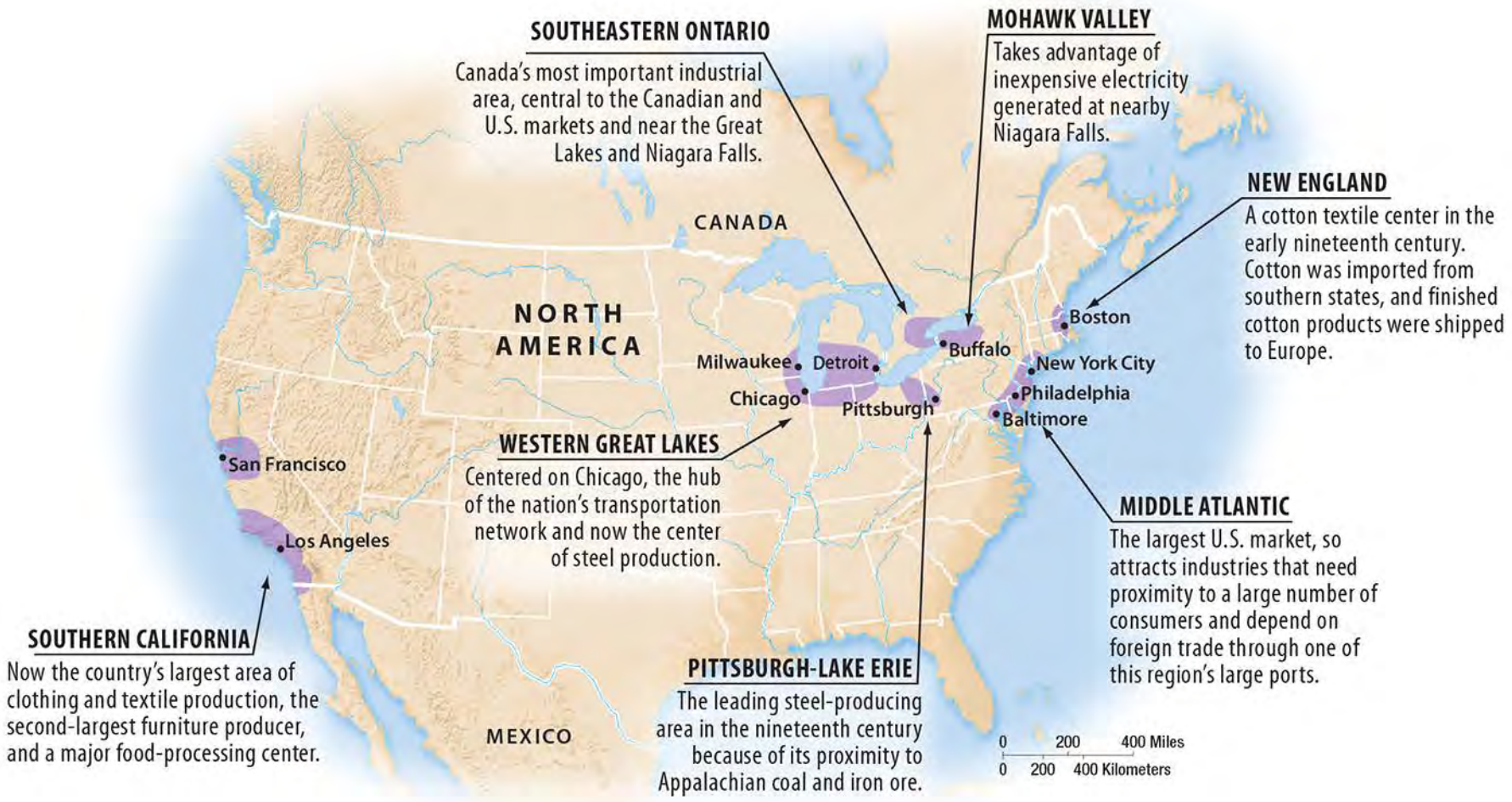


Figure 11-6

East Asia's Industrial Regions

Figure 11-7

Key Issue 2: Why Are Situation and Site Factors Important?

2.1 Situation Factors: Proximity to Inputs

2.2 Situation Factors: Proximity to Markets

2.3 Changing Situation Factors: Steel

2.4 Truck, Train, Ship, or Plane?

2.5 Site Factors in Industry

2.6 Changing Site Factors: Clothing

Situation and Site Factors

- Situation factors: costs of transporting inputs vs. finished goods
  - location close to inputs or markets
- Site factors: labor, capital, and land characteristics
  - more important than situation factors for some industries

Location Close to Inputs: Copper

Figure 11-10: Only a fraction of ore mined is copper. A concentration mill is located close to the mine to increase the value per weight by removing non-copper rock from the ore.

Location Close to Inputs: Copper

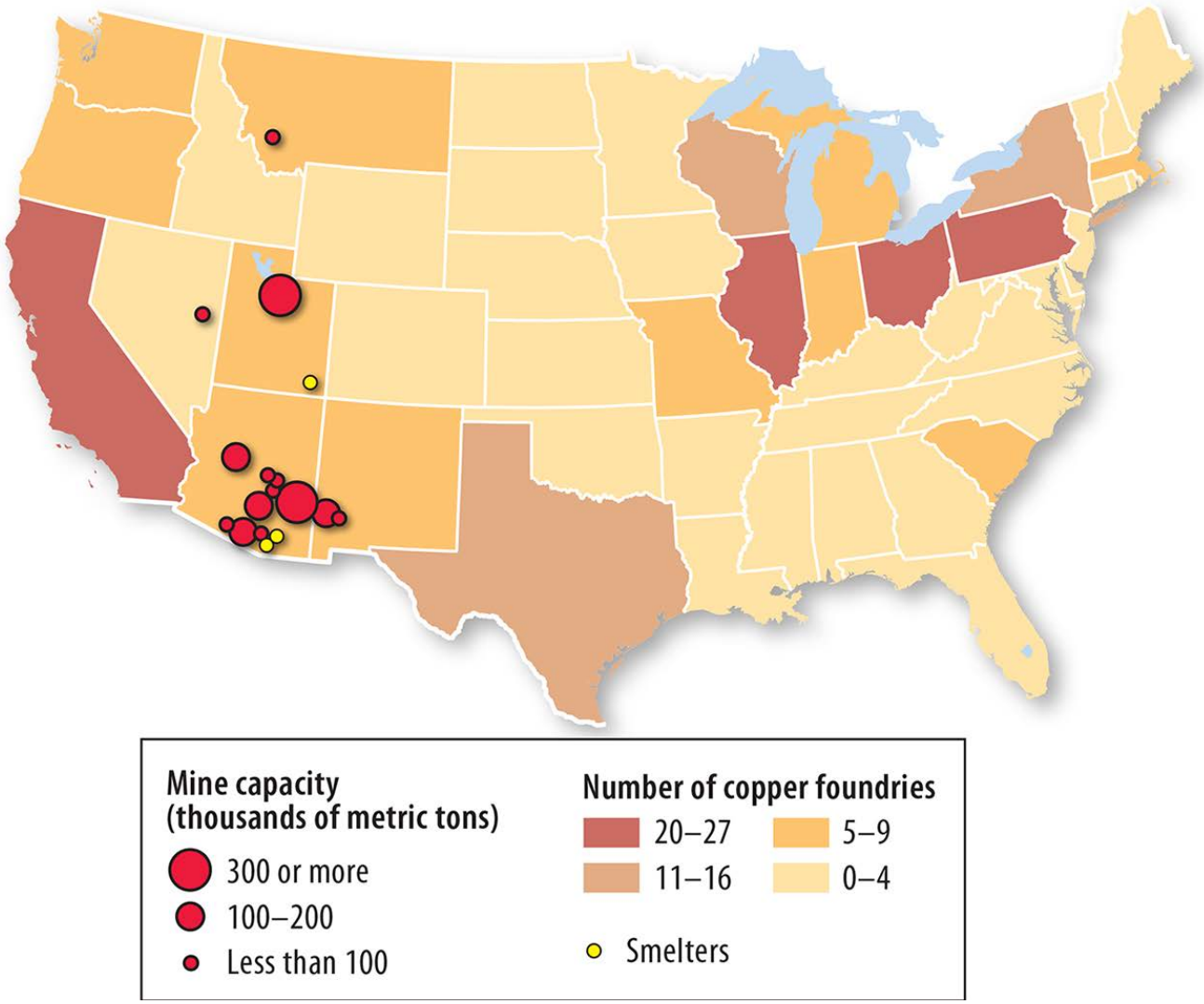


Figure 11-11: Concentration and smelting are located near mines because they reduce bulk and increase value per weight. Manufacturing in foundries is not bulk reducing.

Location Close to Markets

- Bulk-gaining industries: gain weight or bulk during production
- Location close to markets
  - single-market manufacturers
  - perishable products
  - motor vehicles

Bulk-gaining Industry: Beverage Production

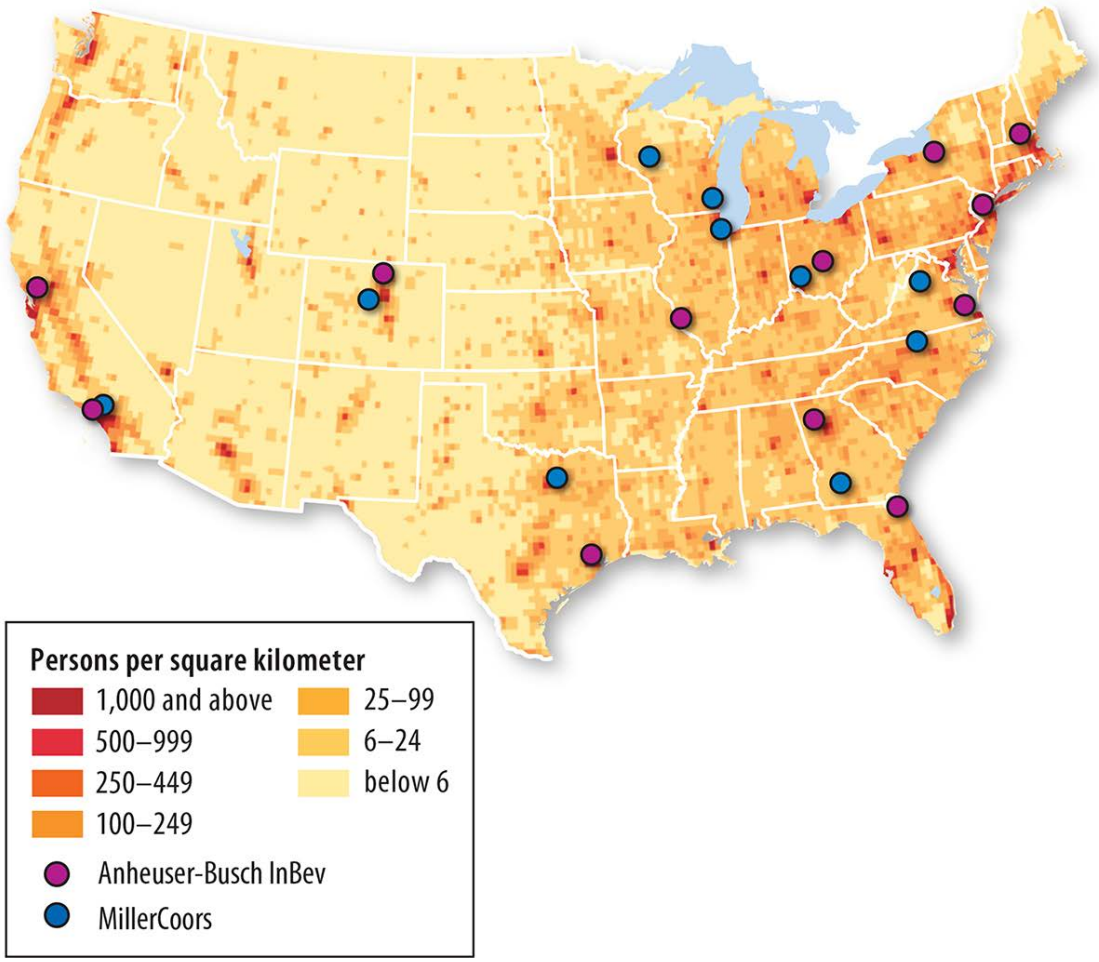
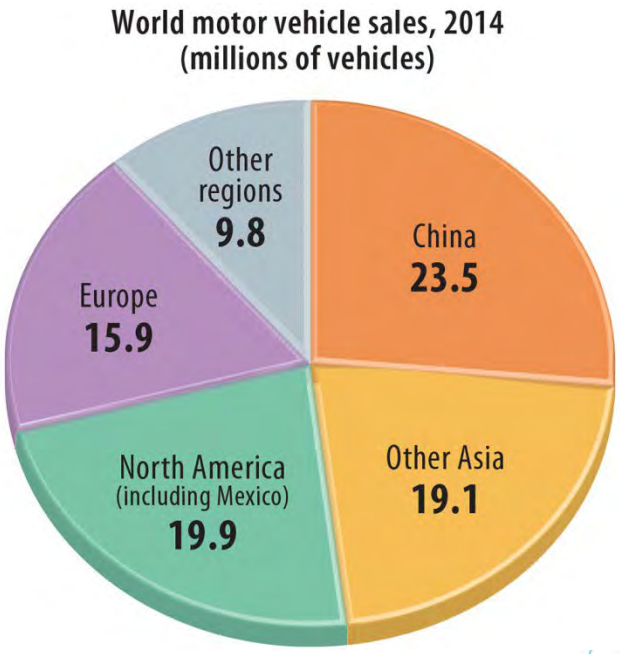
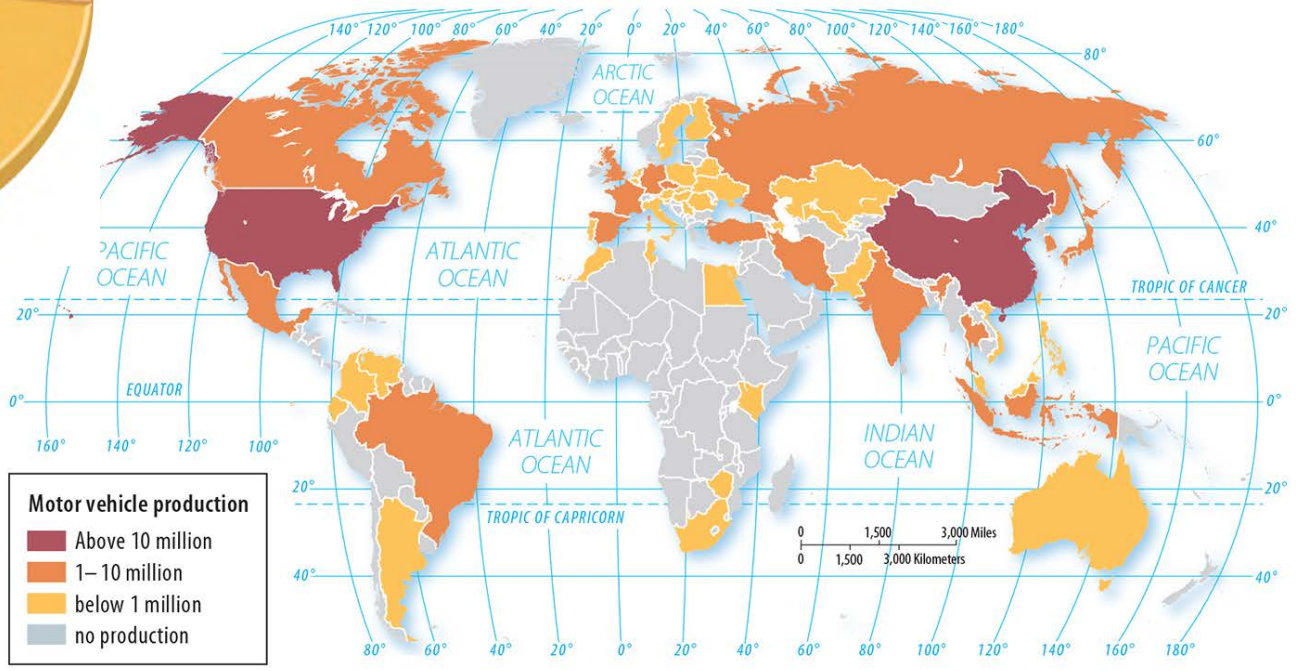


Figure 11-12: Beer production is a bulk-gaining industry, so bottling takes place near large population clusters.

Motor Vehicle Production and Sales





Figures 11-13 & 11-14: Vehicles are mostly produced (right) in areas where they are sold (top left), representing a bulk-gaining industry.

Motor Vehicle Production in North America

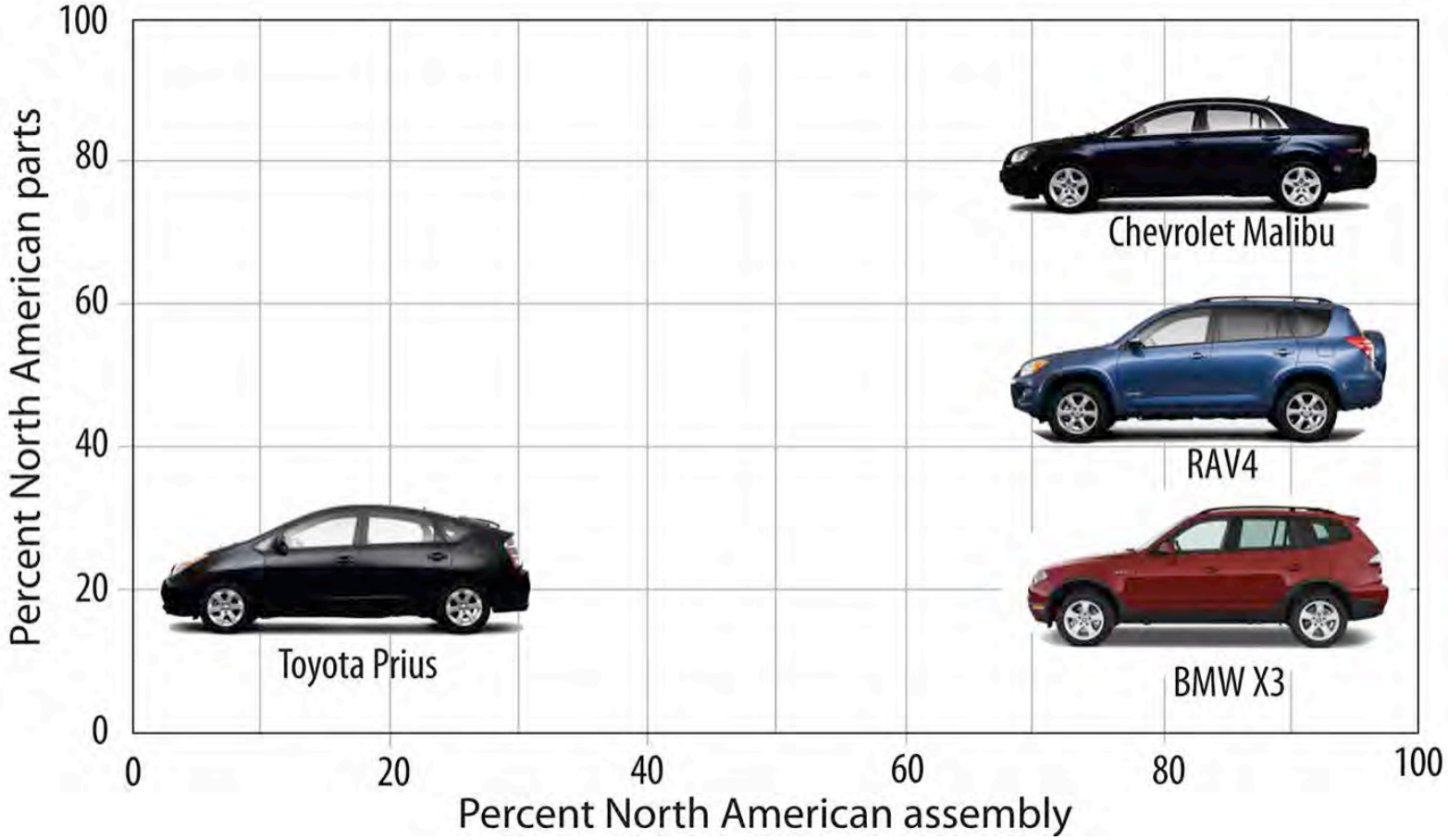


Figure 11-15: Cars sold in North America may not be assembled in North America, and those assembled in North America use different proportions of North American parts.

Changing Situation Factors: Steel

- Steel mills in the United States changed location based on changing sources of raw materials.
- Steel minimills now based on proximity to sources of recycled metal
- Worldwide, production has shifted to developing countries, especially China.

Changing Situation Factors: Steel

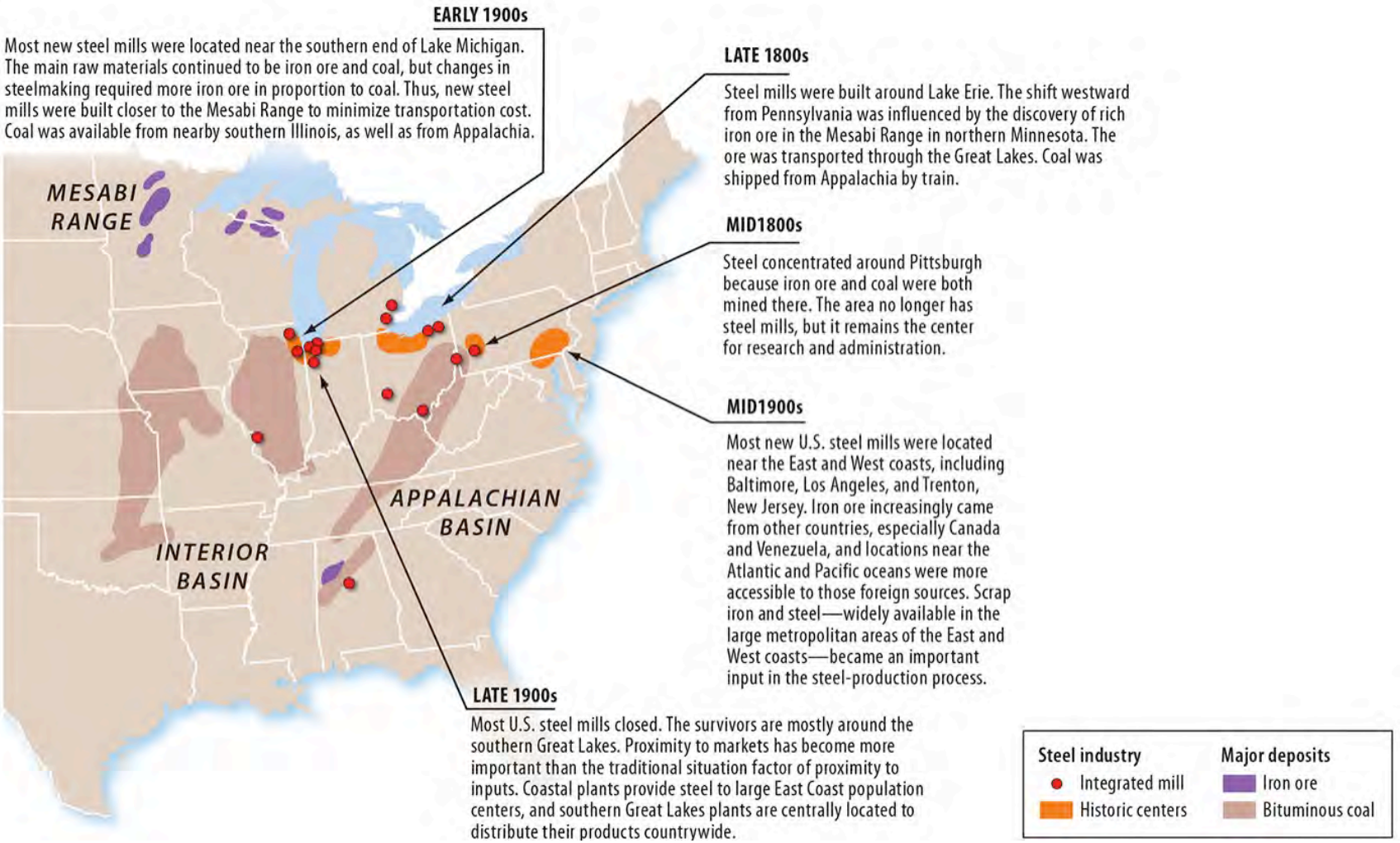


Figure 11-16: Integrated steel mills are clustered near the southern Great Lakes. Historically, steel mills were located near inputs to minimize transportation costs of raw materials.

Changing Situation Factors: Steel

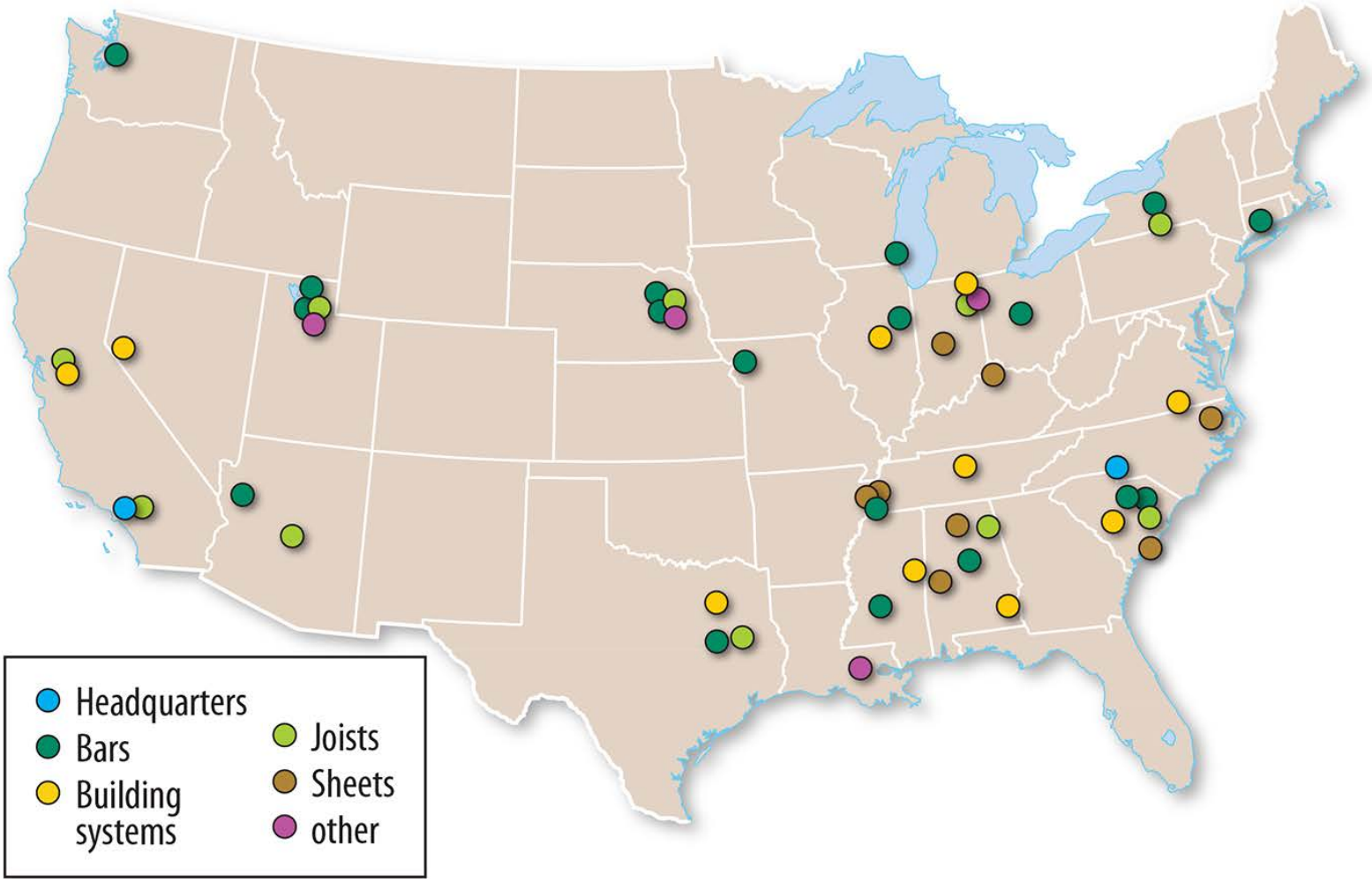


Figure 11-17: Steel minimills are located closer to markets, which also serve as a source of scrap metal.

Changing Situation Factors: Steel

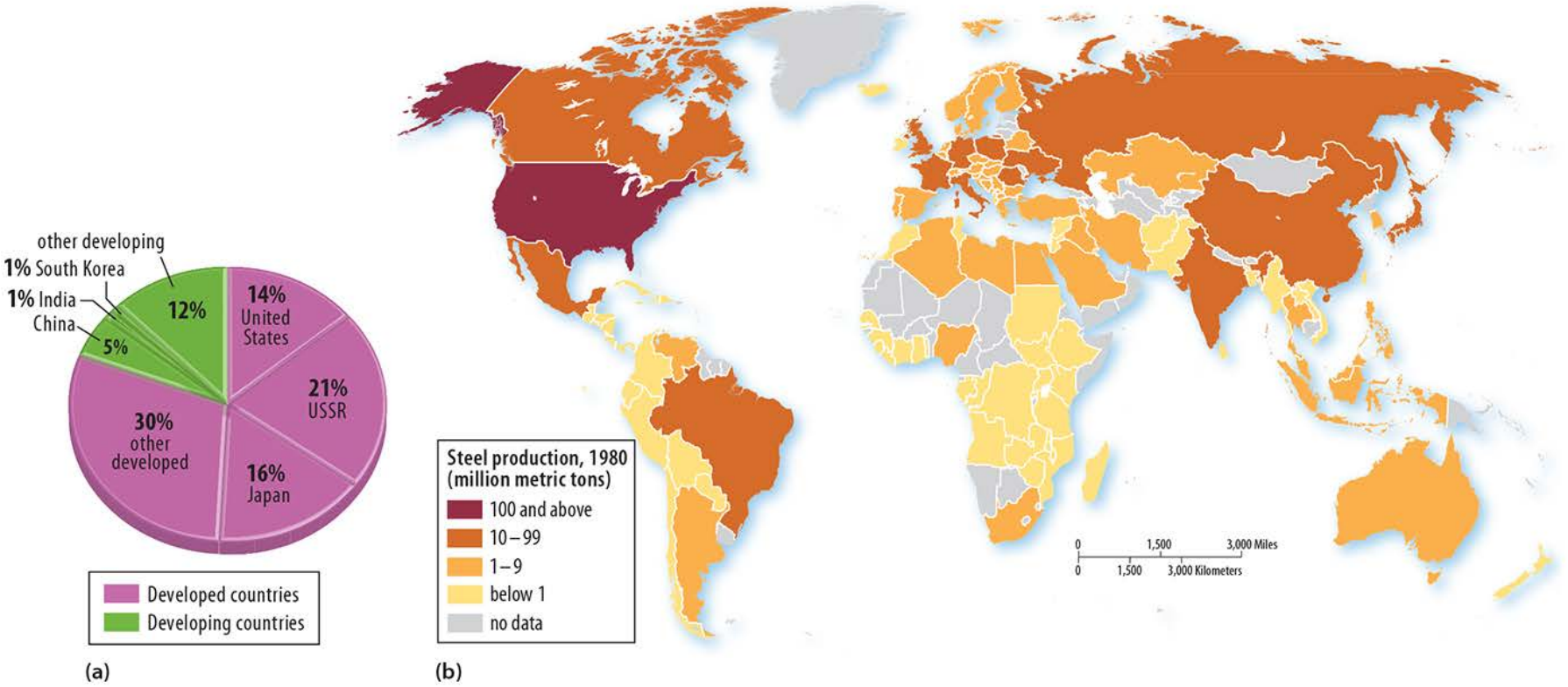


Figure 11-18: In 1980, world steel production was concentrated in developed countries.

Changing Situation Factors: Steel

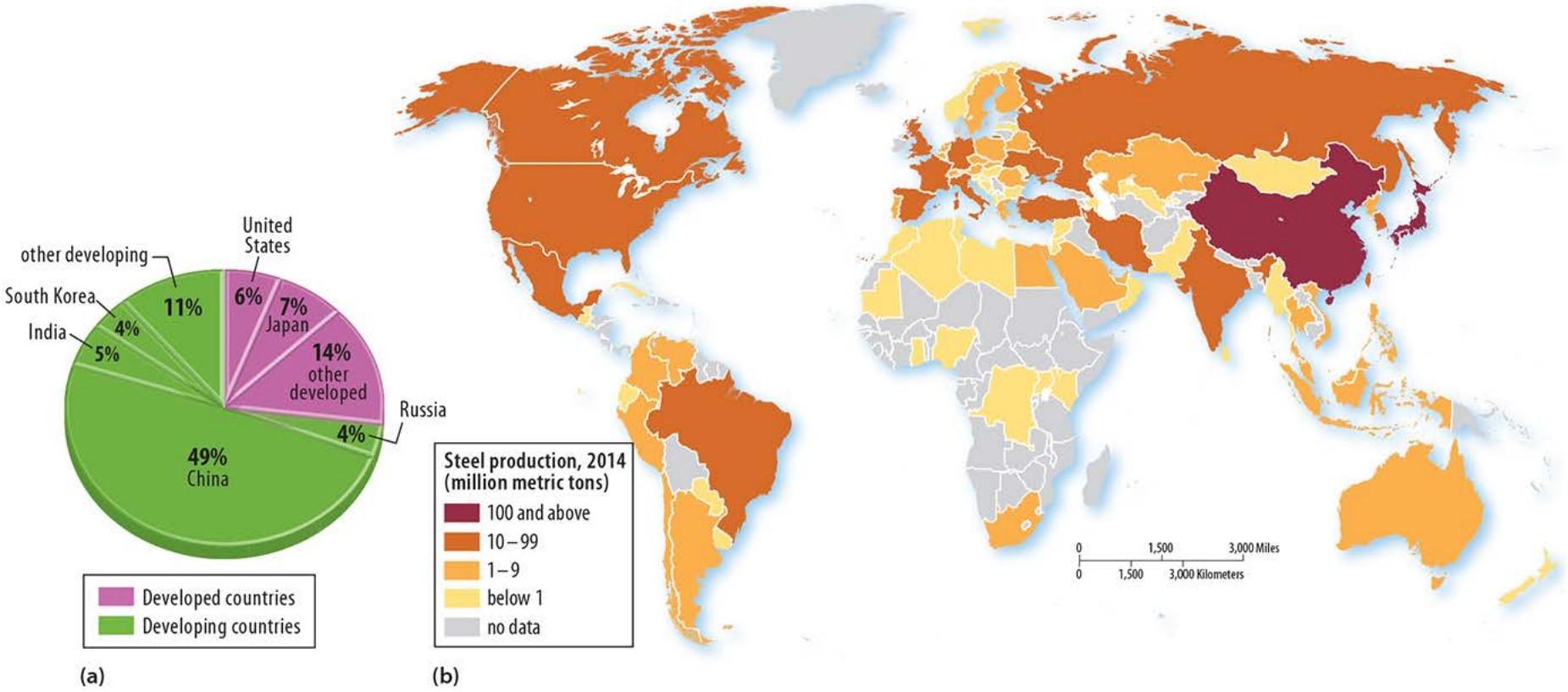


Figure 11-19: By 2013, world steel production had shifted to developing countries.

Truck, Train, Ship, or Plane?

- Trucks used for short-distance delivery (faster loading)
- Trains more efficient for longer distances
- Ships most cost efficient for very long distances
- Airplanes used for speed with high-value, low-bulk items
- Some industries located at break-of-bulk points
- Others located for just-in-time delivery

U.S. Truck Freight Corridors

Figure 11-20: Truck freight movements are concentrated in the eastern U.S.

U.S. Train Freight Corridors

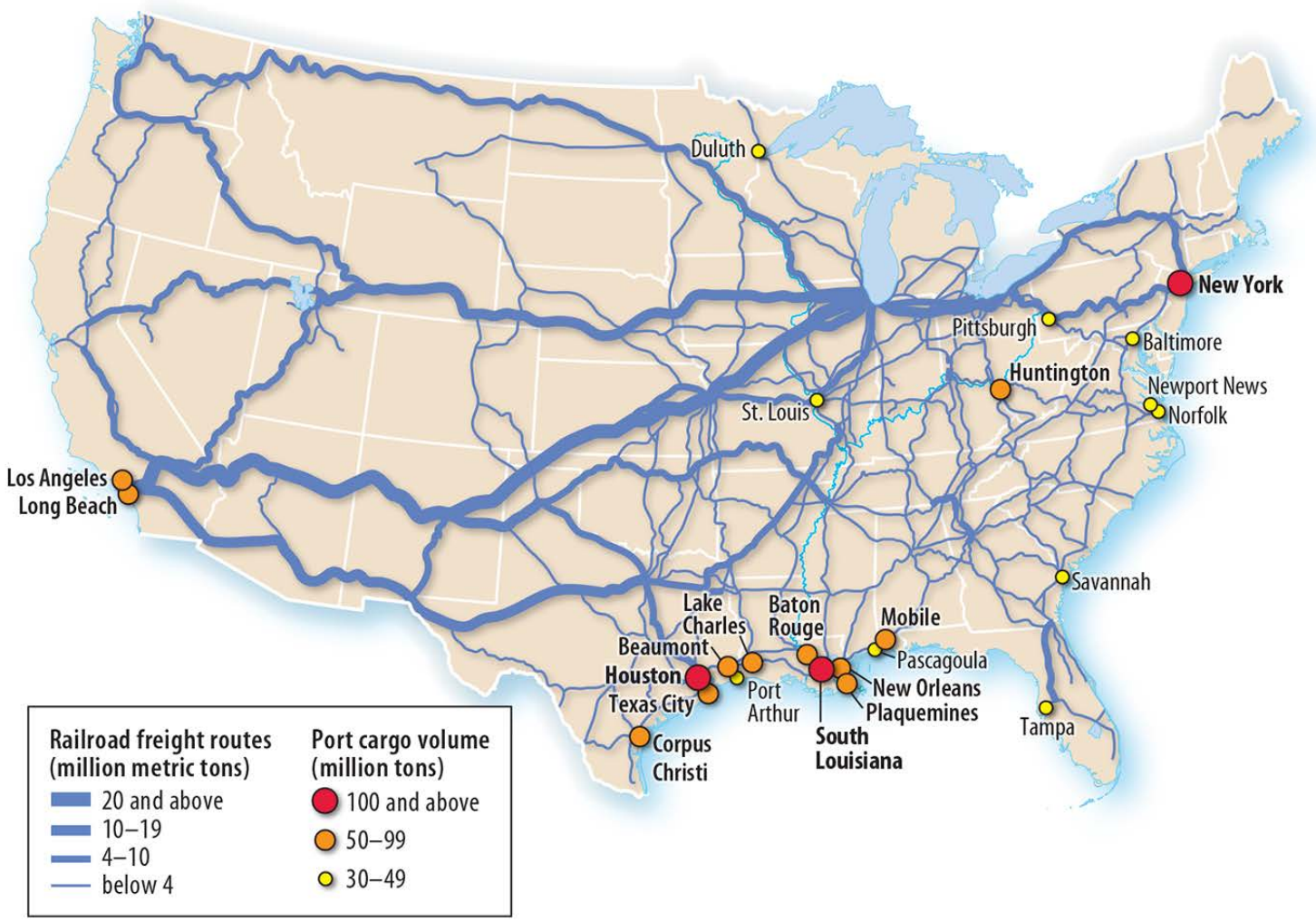


Figure 11-21: Most rail freight movements are between the East and West.

World Shipping Routes

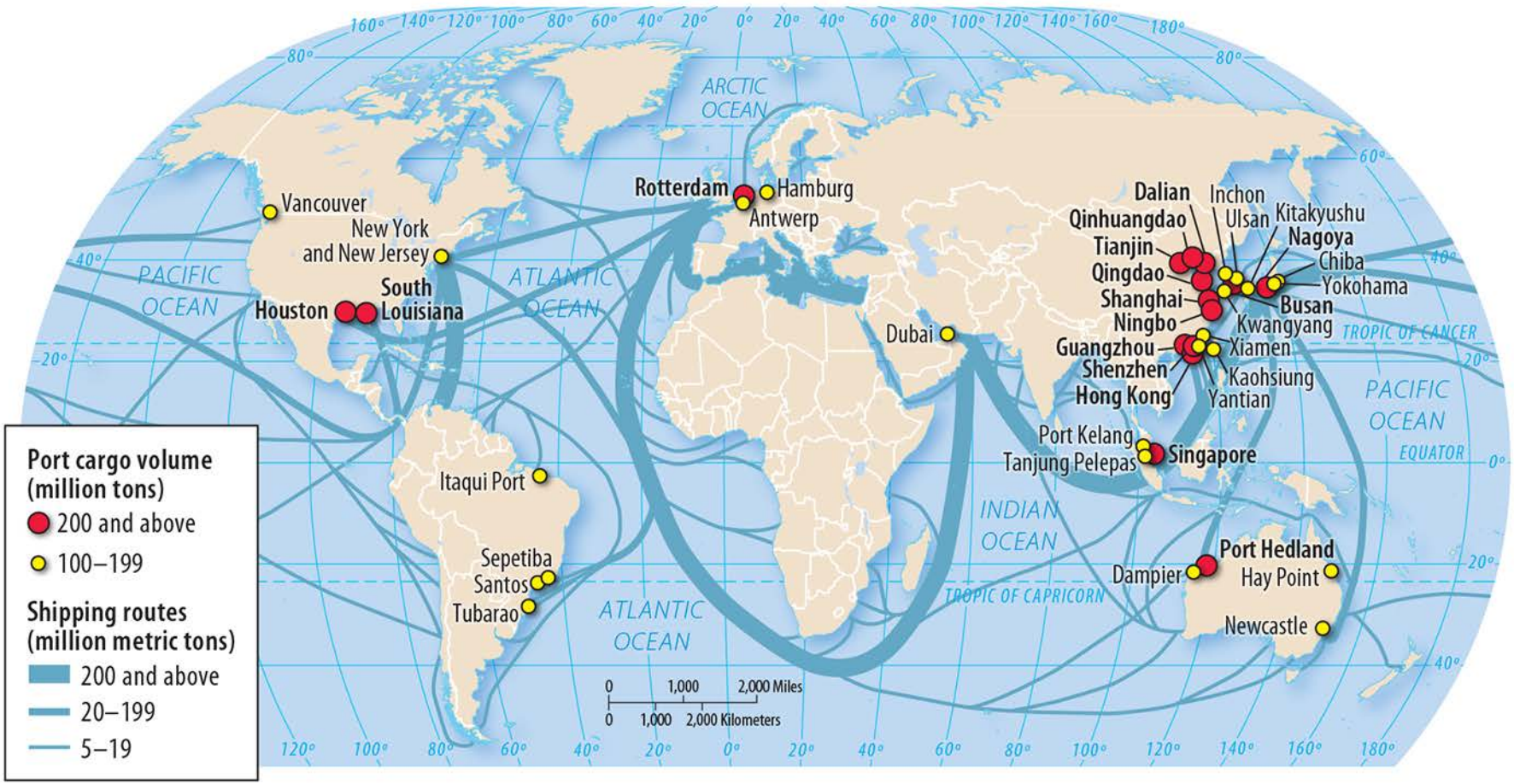


Figure 11-22: Shipping occurs between North America, Europe, and industrial centers in Asia.

Site Factors in Industry

- Labor: price and skill level especially important for labor-intensive industries
- Capital: ability to borrow varies
- Land: price, access

Site Factors: Labor

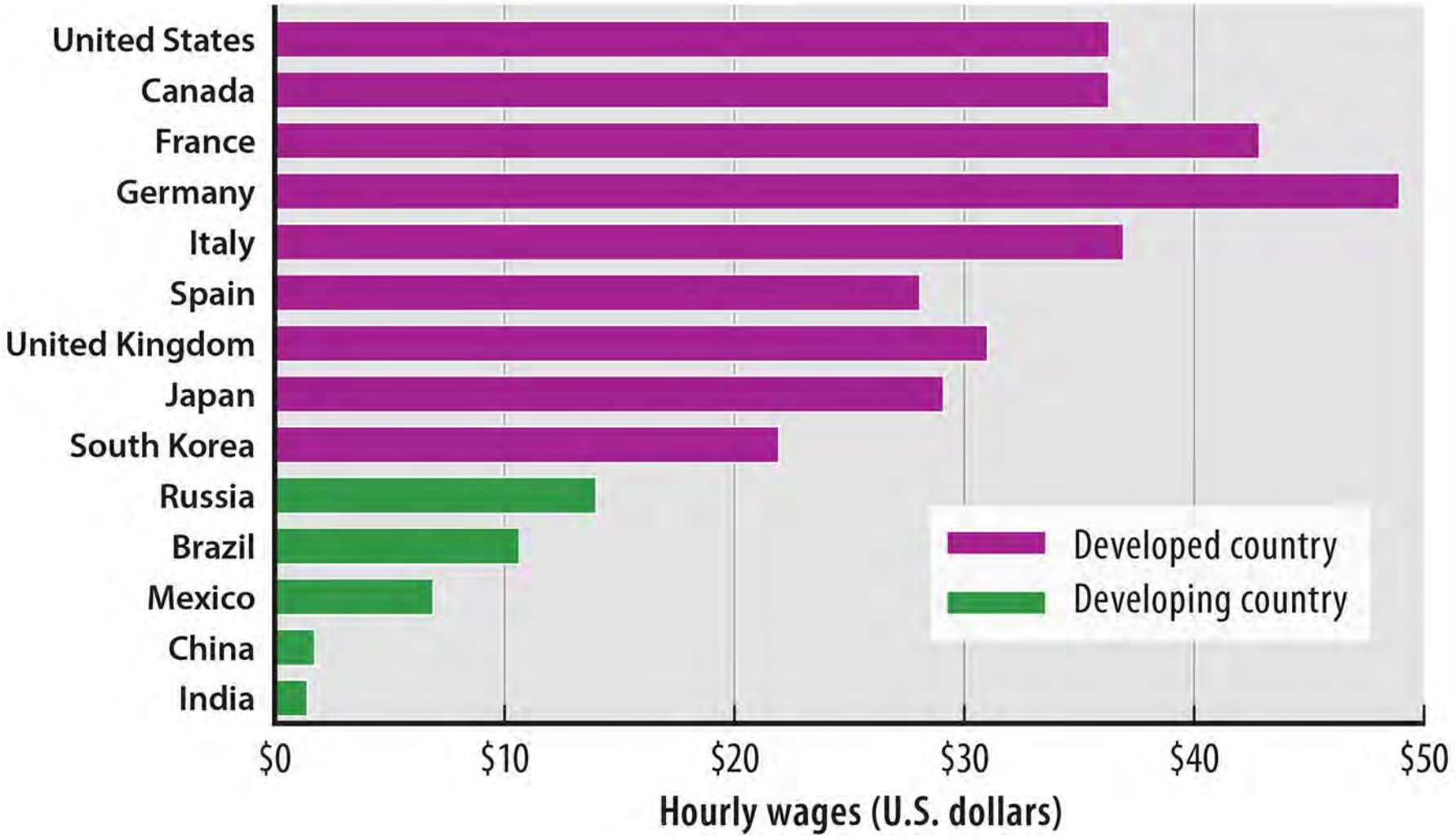


Figure 11-23: Average hourly manufacturing wages in 14 of the 15 largest industrial countries.

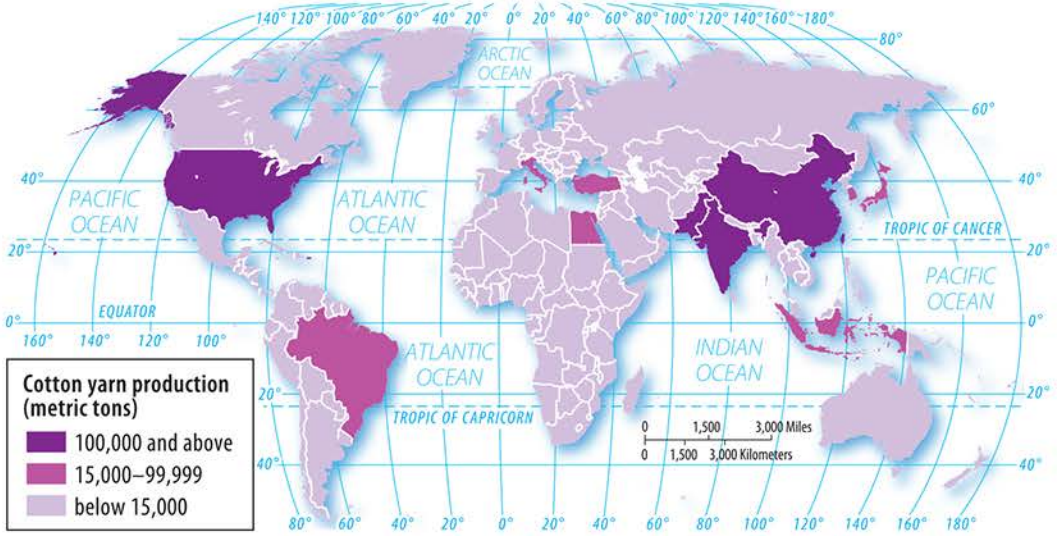
Site Factors: Land

Figure 11-26: This Honda assembly plant in Swindon, U.K., is one story and located outside of the city.

Changing Site Factors: Clothing

- Spinning yarn is labor-intensive, so increasingly done in developing countries
- Weaving yarn into fabric also labor-intensive
- Majority of assembly in developing countries, but developed countries play larger role

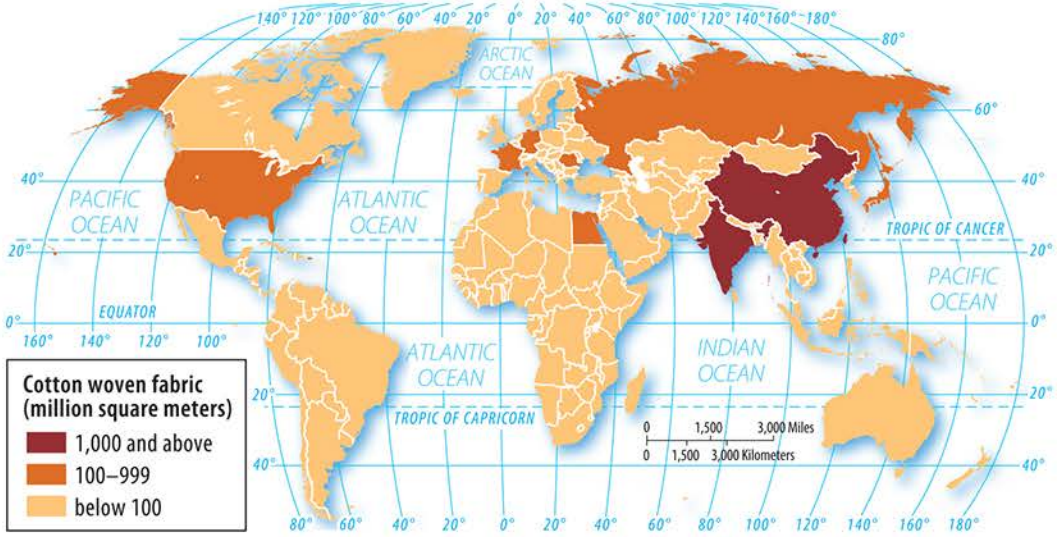
Cotton Spinning



(b)

Figure 11-27: Close to one-half of all cotton yarn is spun in China and India.

Cotton Weaving




(b)

Figure 11-28: Ninety percent of all cotton is woven in China and India.

Women's Blouse Production (Assembly)

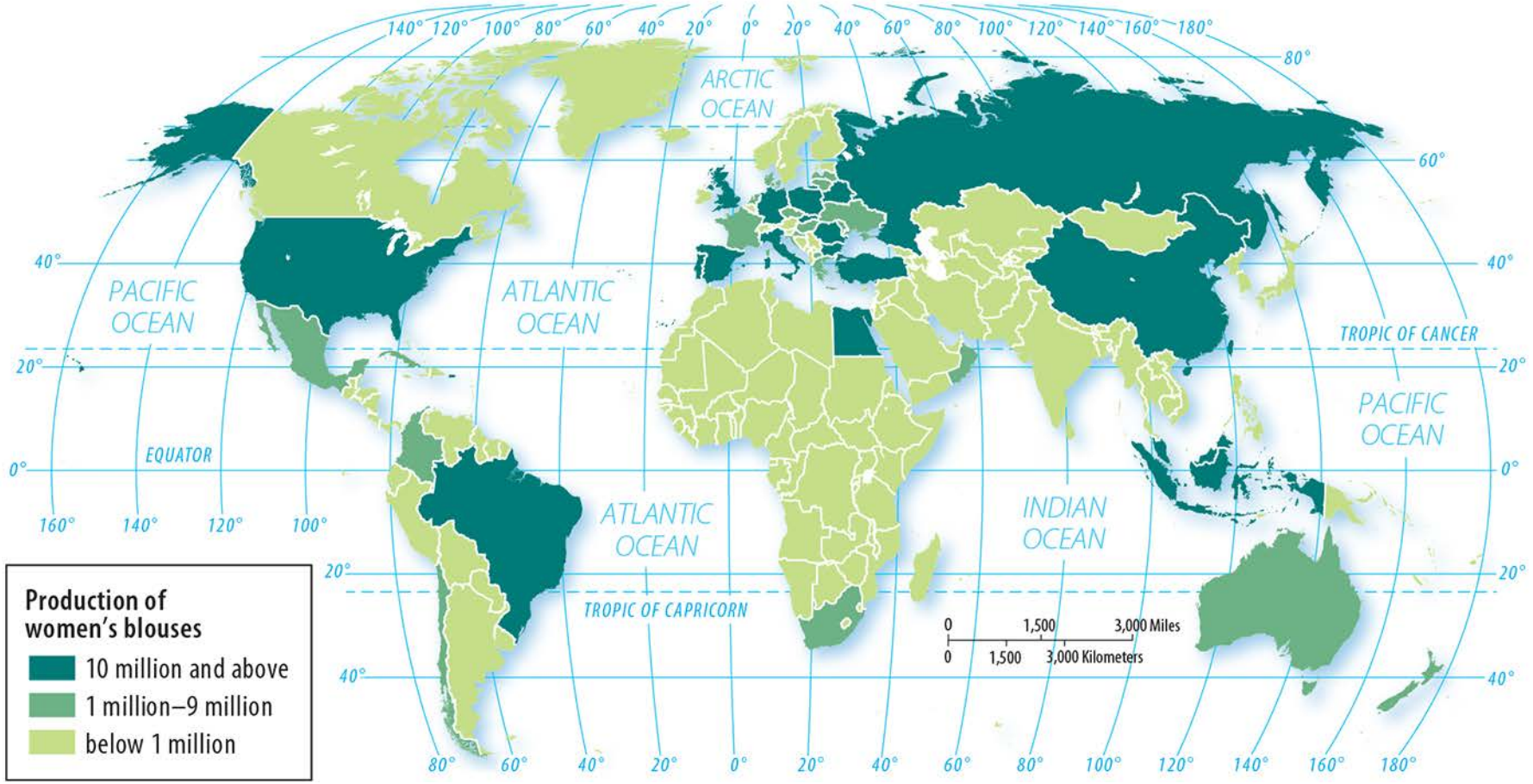


Figure 11-29: Proximity to markets is an important consideration for some clothing assembly.

Key Issue 3: Why Do Industries Face Resource Challenges?

3.1 Energy Supply

3.2 Demand for Energy

3.3 Fossil Fuel Reserves

3.4 Petroleum Futures

3.5 Nuclear Energy

3.6 Energy Alternatives

Key Issue 3: Why Do Industries Face Resource Challenges?

3.7 Solar Energy

3.8 Air Pollution

3.9 Water Pollution

3.10 Solid Waste Pollution

Energy Supply

- Fossil fuel resources are not uniformly distributed.
- Demand and supply not always spatially matched

Coal Production

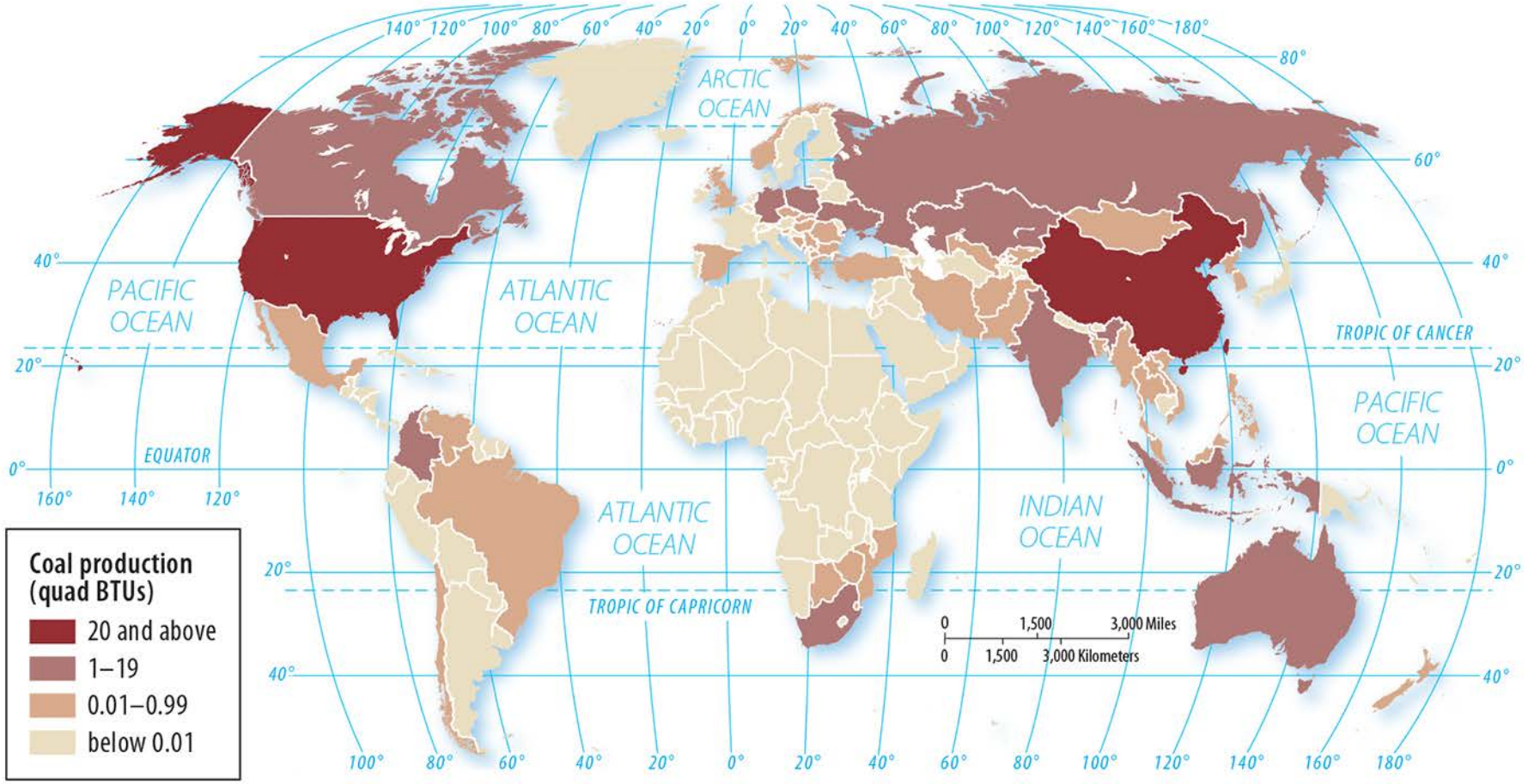


Figure 11-31: The United States and China lead in coal production.

Petroleum Production

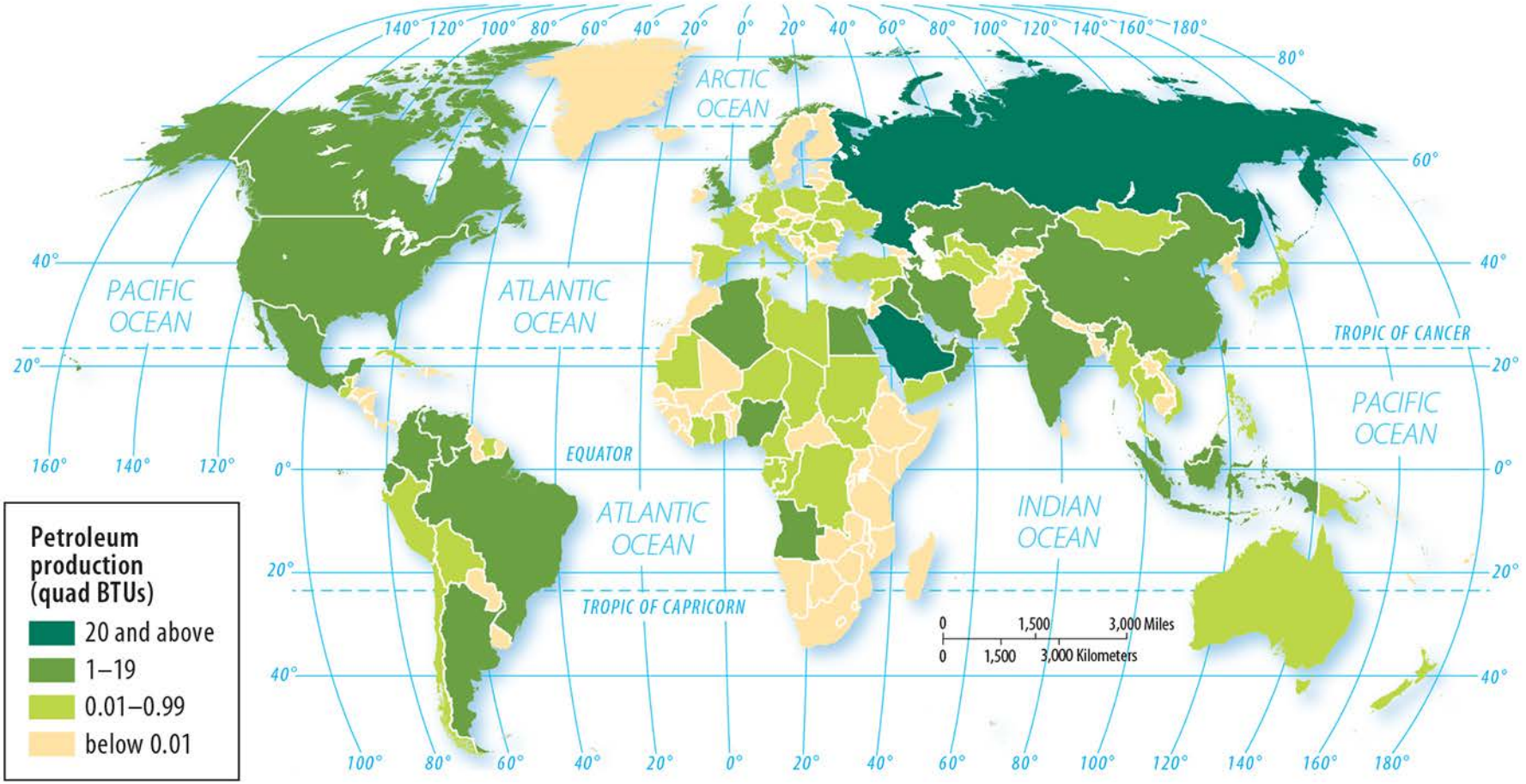


Figure 11-32: Russia, Saudi Arabia, and the United States are leading petroleum producers.

Natural Gas Production

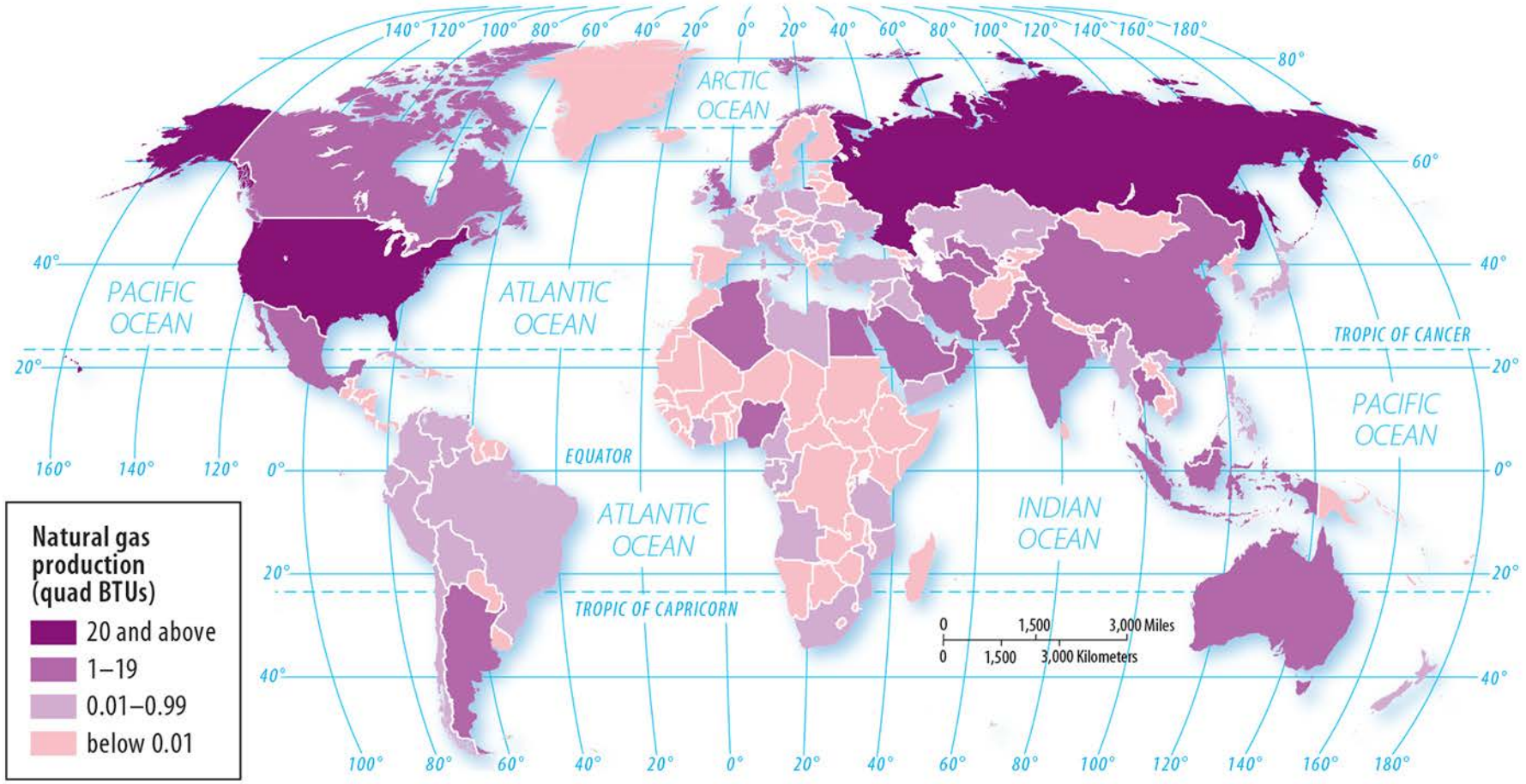


Figure 11-33: The United States and Russia are the leading producers of natural gas.

U.S. Energy Supply

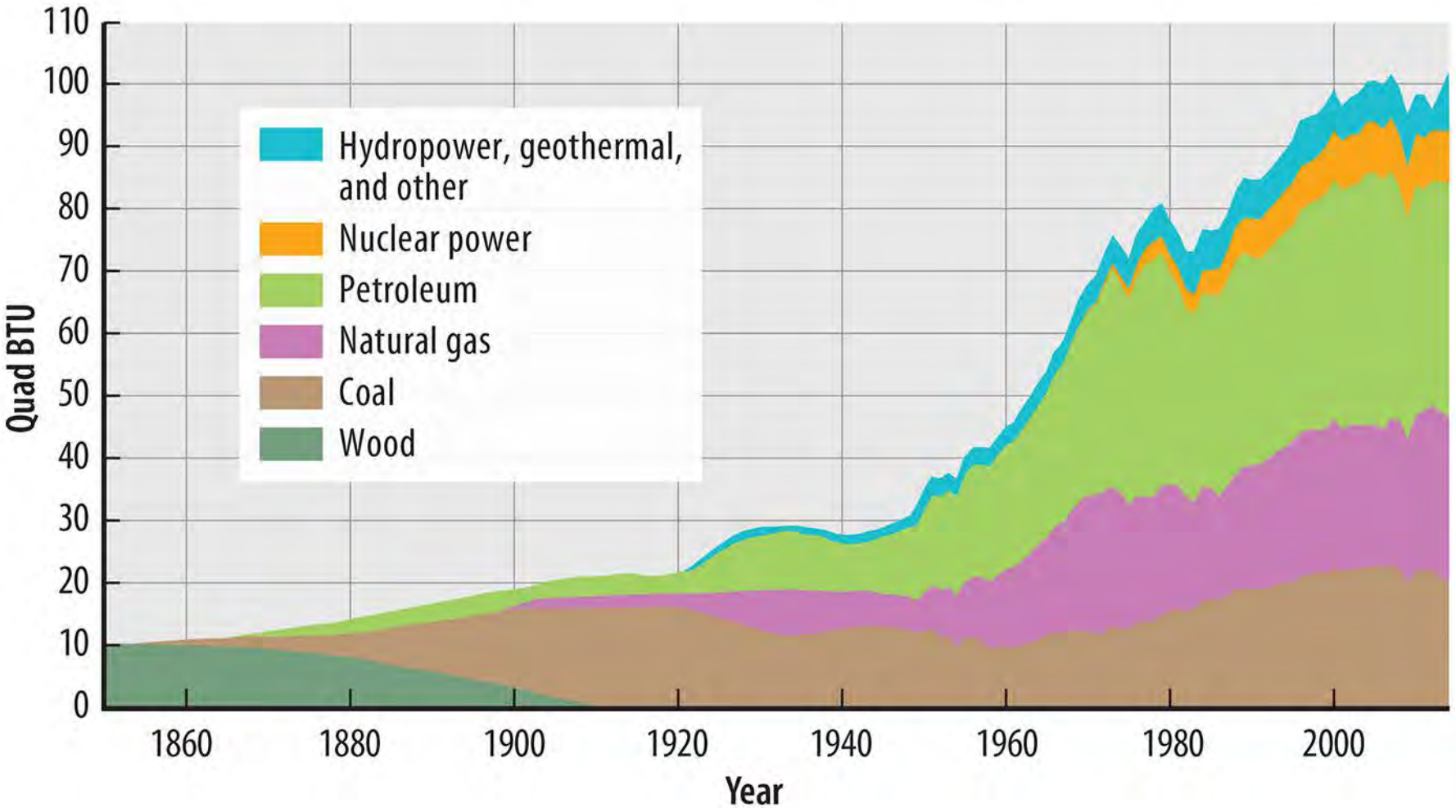


Figure 11-34: Fossil fuels make up about 90 percent of energy use in the United States.

World Energy Demand

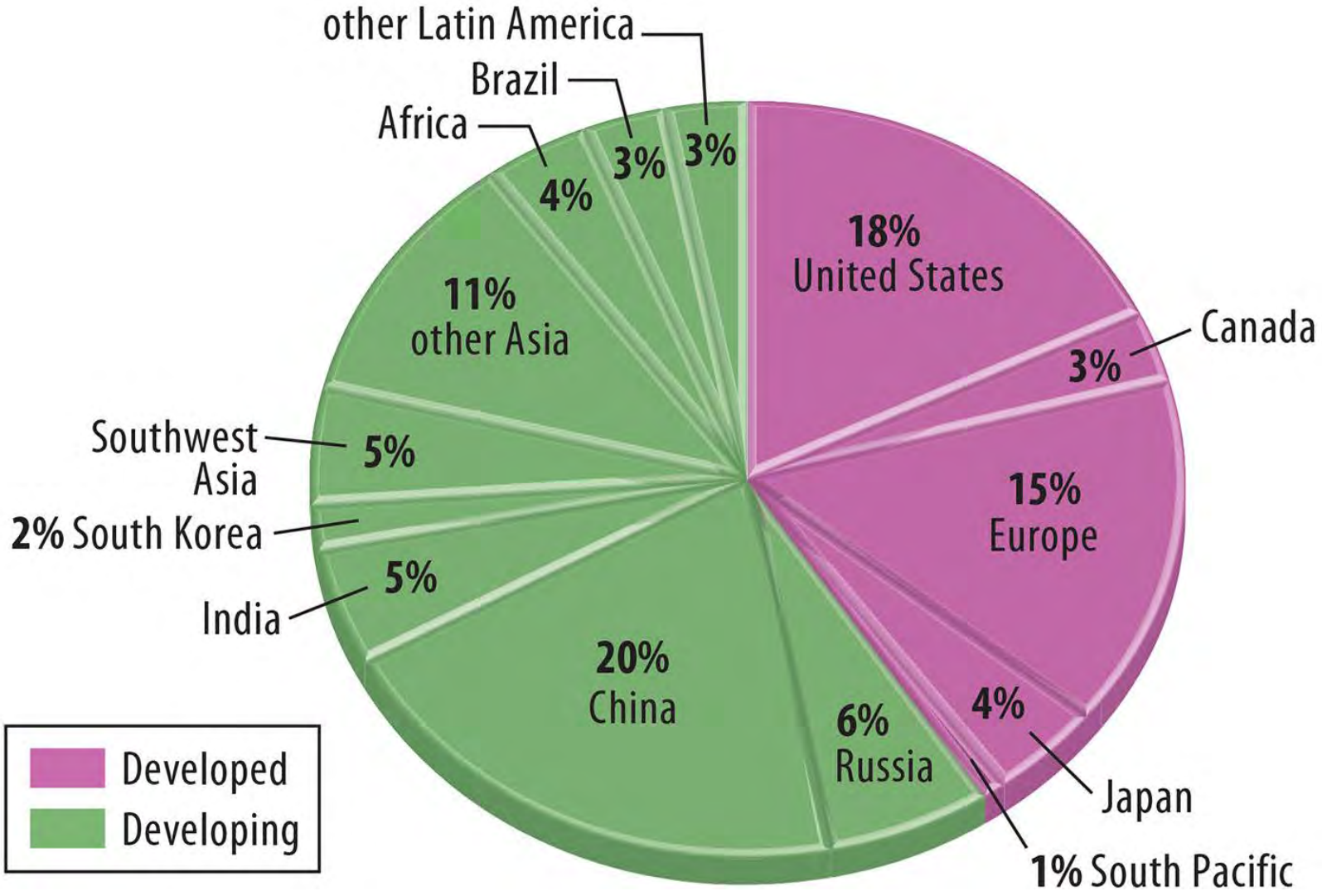


Figure 11-35: Developing countries consume less fossil fuels than their population would predict, but demand is growing.

World Energy Use Per Capita

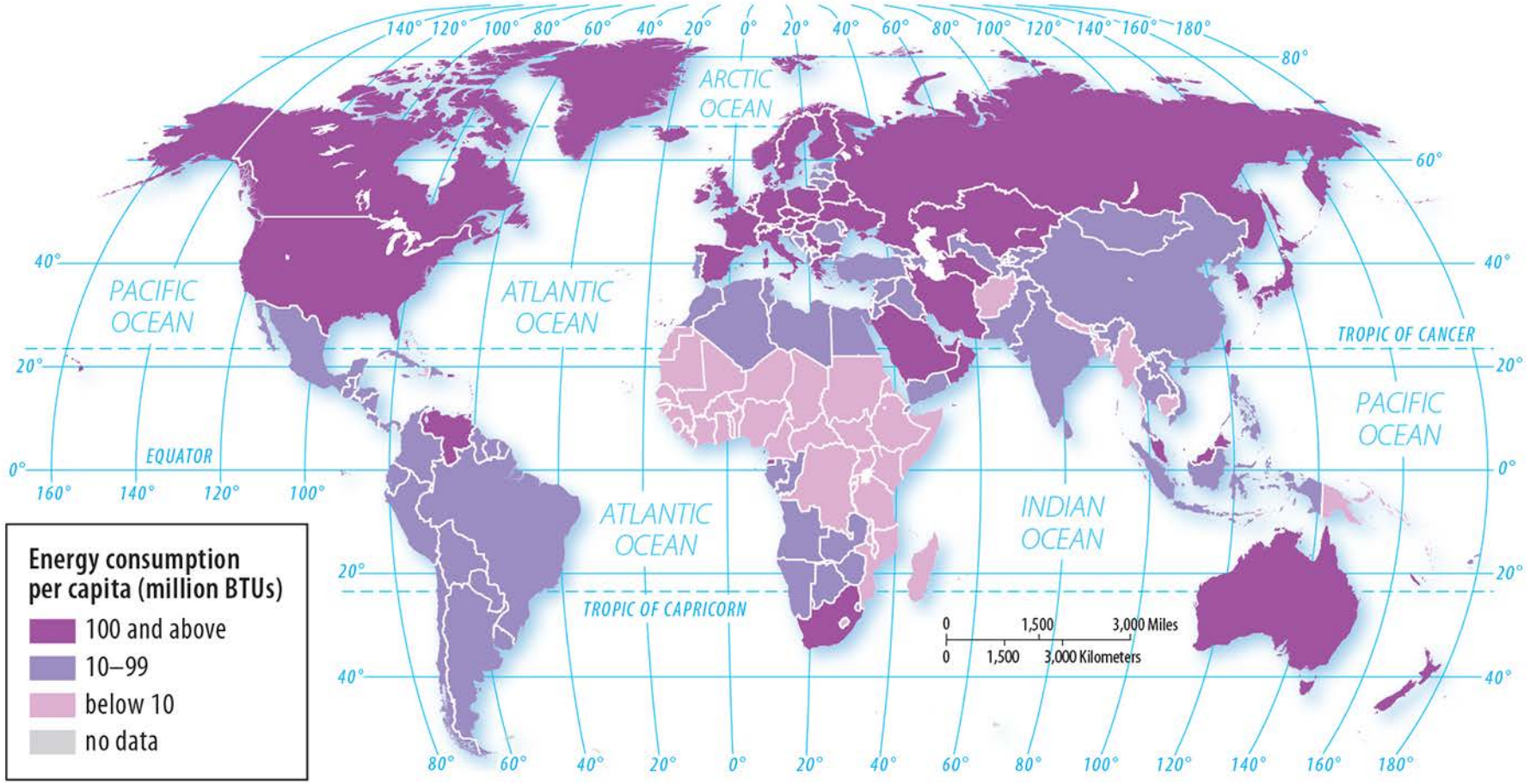


Figure 11-36: The developed world consumes the most energy resources on a per capita basis.

Future Energy Demand

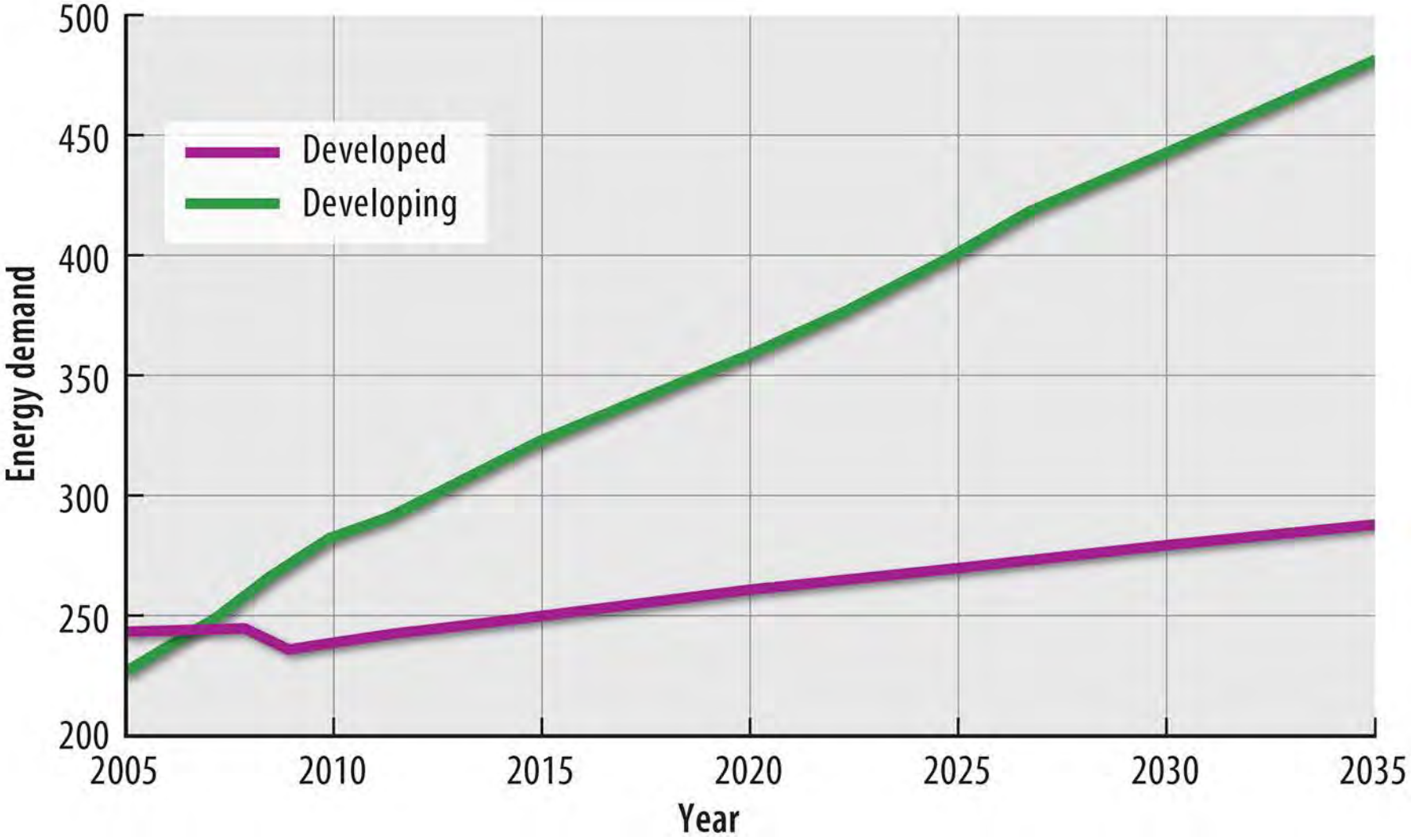


Figure 11-37: The developing world is projected to increase its energy demand faster than the developed world.

U.S. Petroleum Supply and Demand

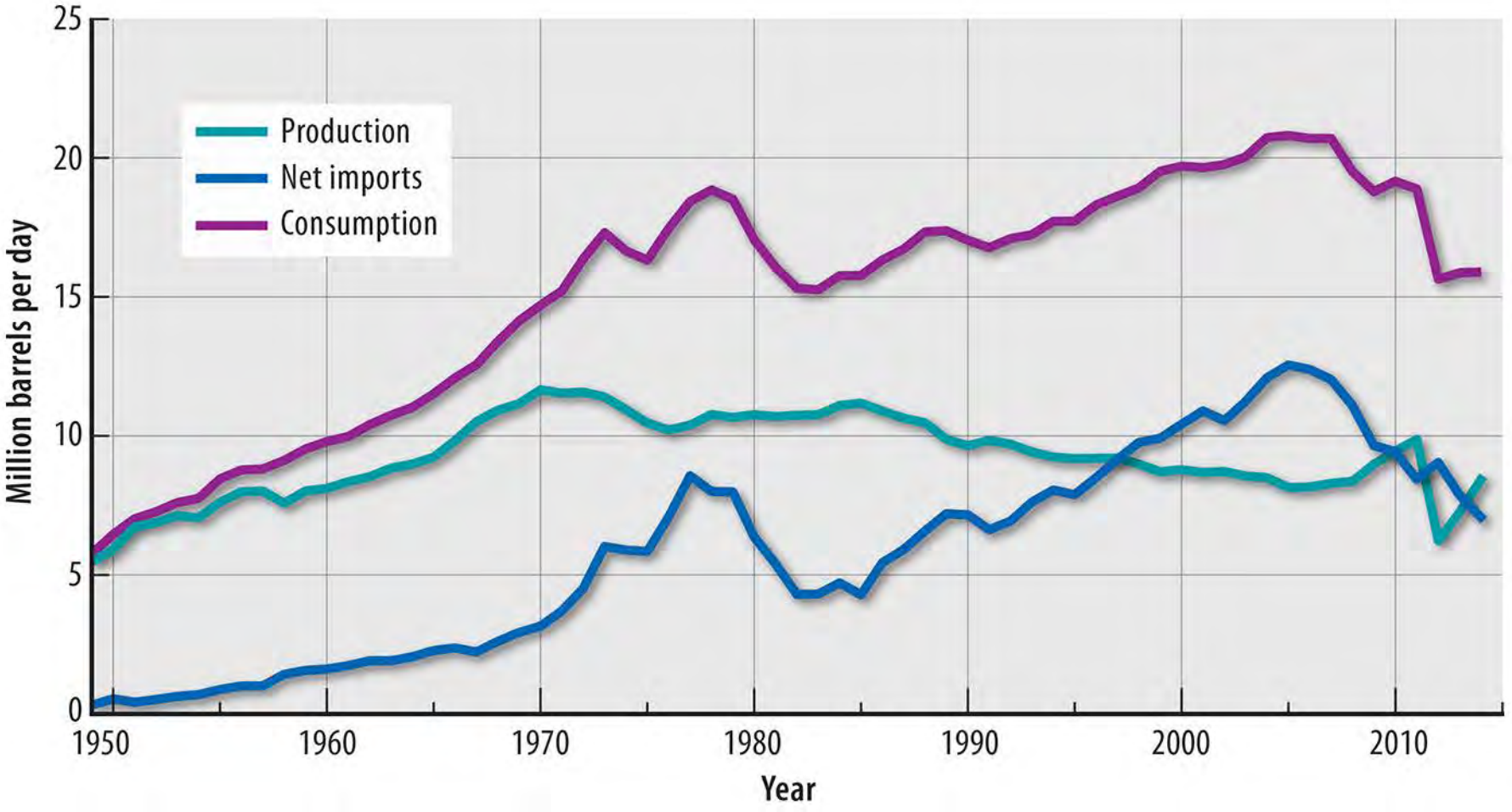


Figure 11-38: The United States has faced difficulty meeting its demand for petroleum with domestic production, relying instead on imports.

Fossil Fuel Reserves

- Proven reserves: already discovered
- Potential reserves: thought to exist
- Unconventional resources: not thought a resource until price and technology allow
  - oil sands
  - hydraulic fracturing

Proven Reserves: Coal

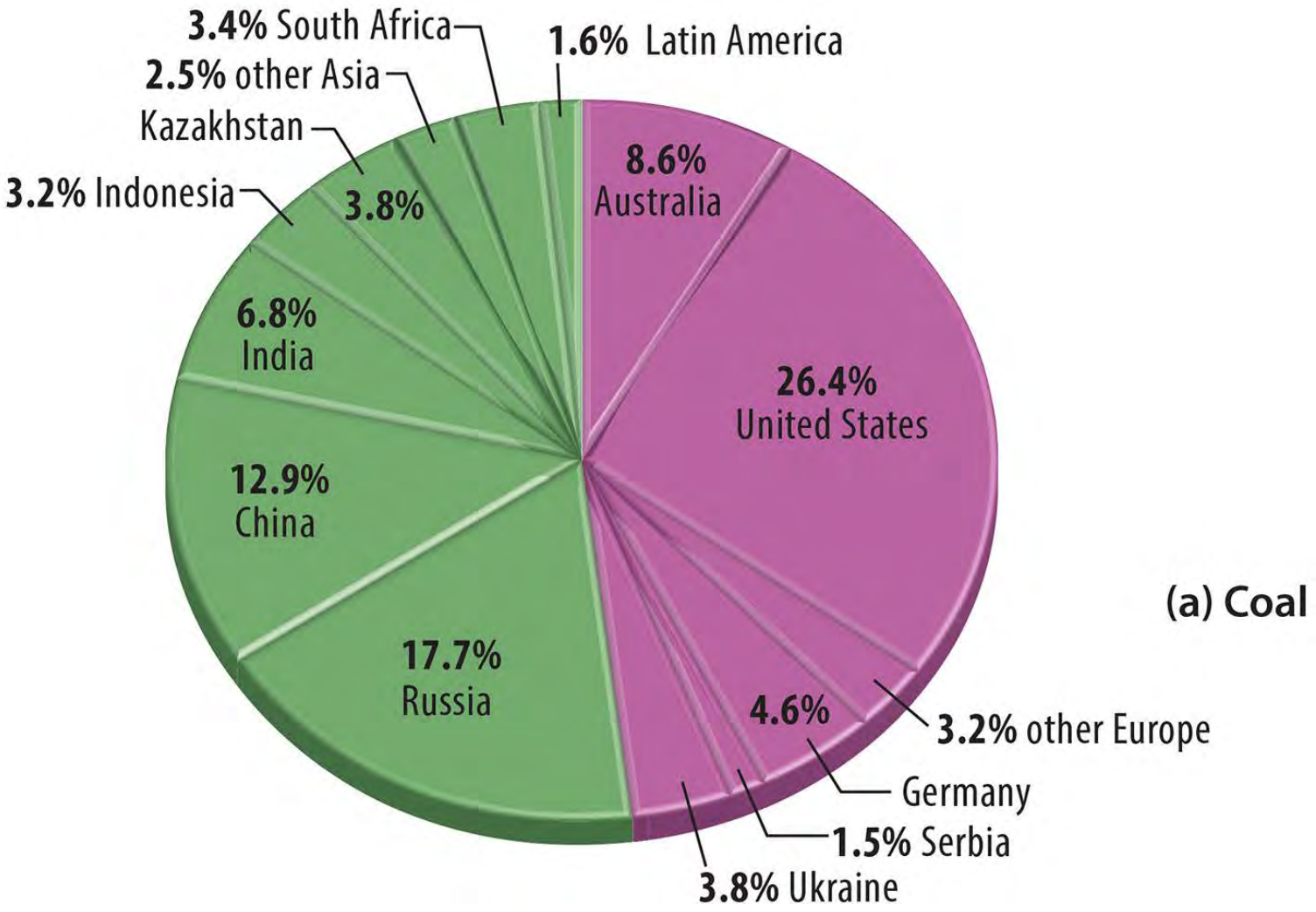


Figure 11-40(a): Proven reserves of coal are largest in the United States, Russia, and China.

Proven Reserves: Natural Gas

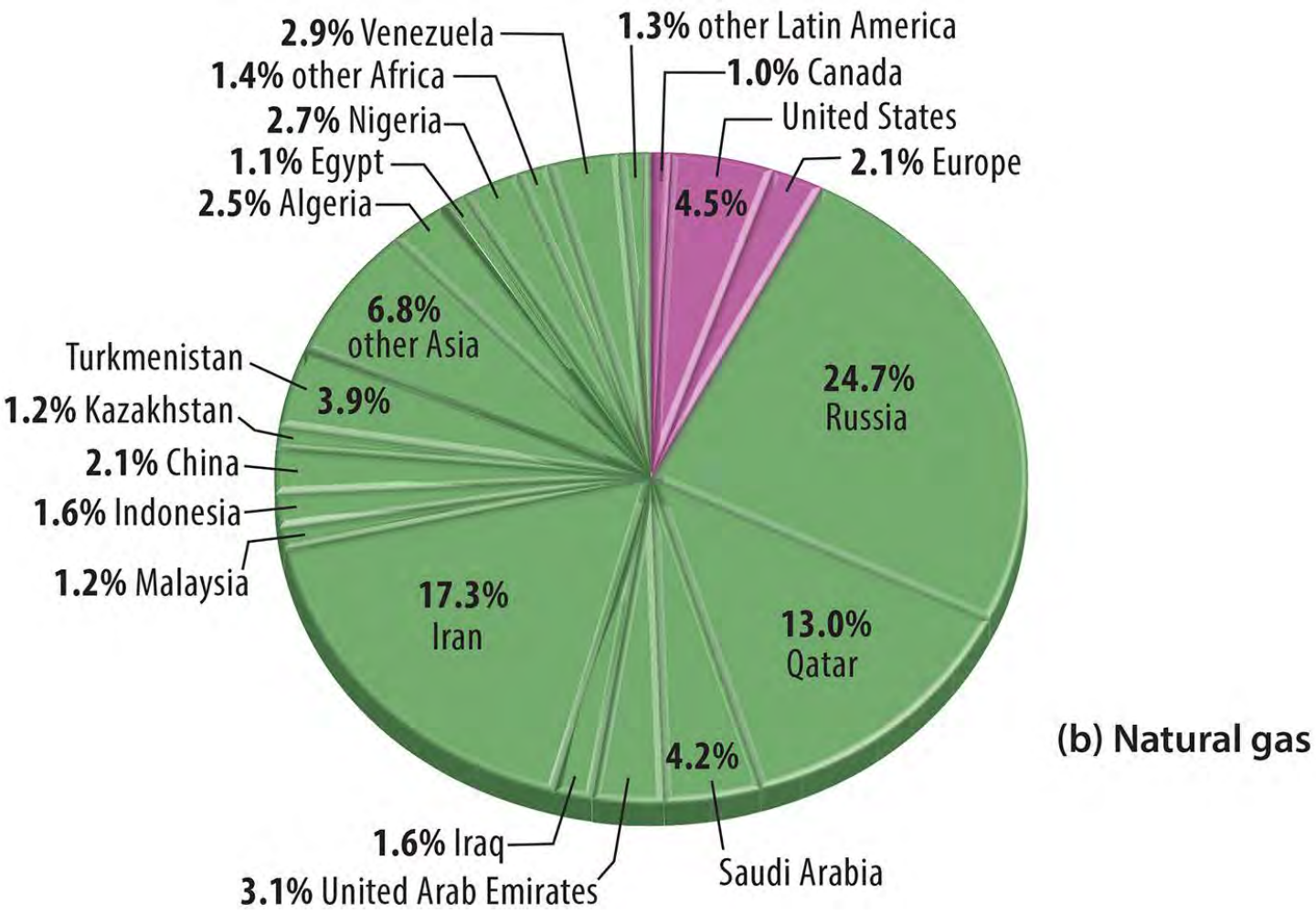


Figure 11-40(b): Proven reserves of natural gas are largest in Russia, Iran, and Qatar.

Proven Reserves: Petroleum

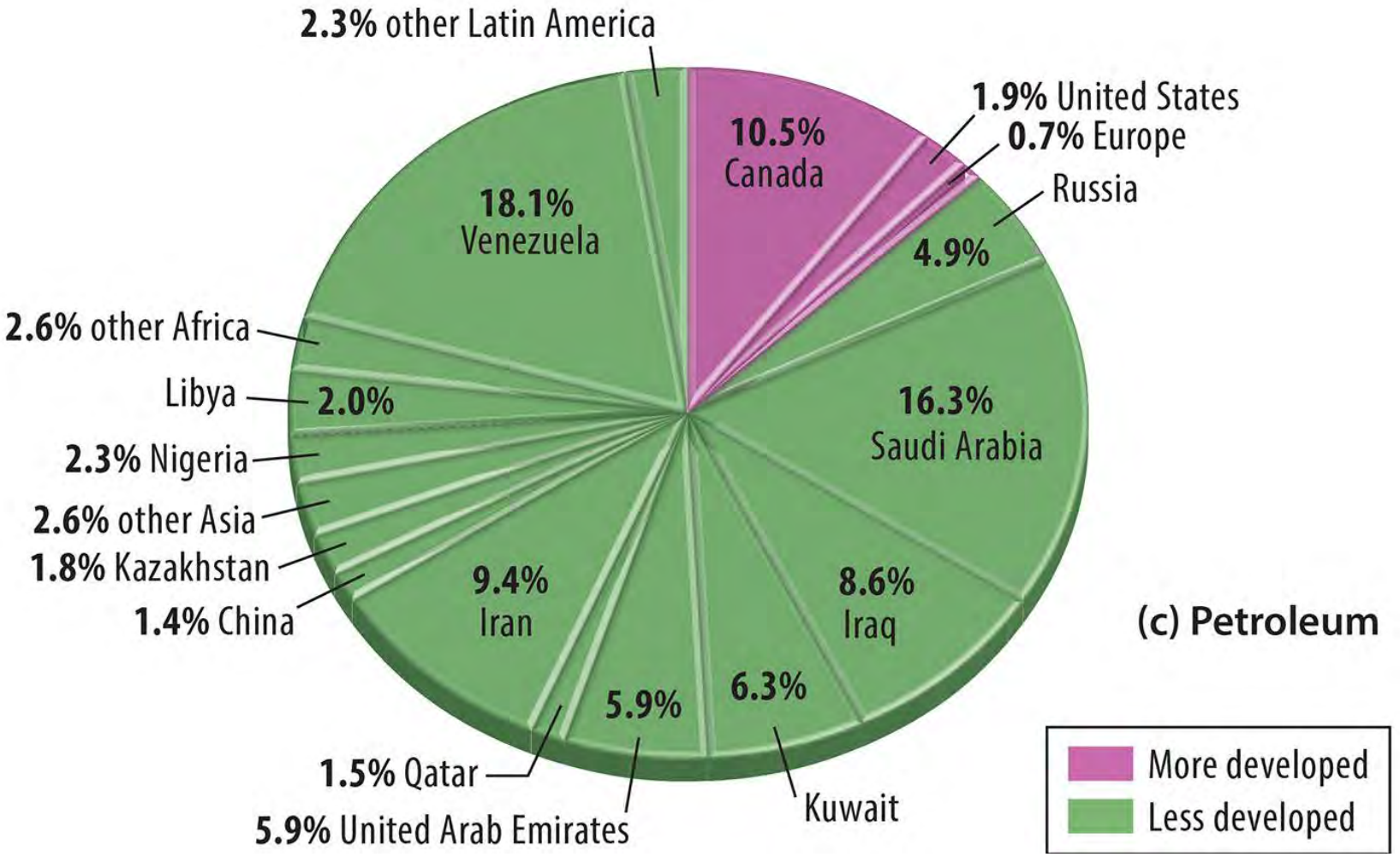


Figure 11-40(c): Proven reserves of petroleum are largest in Venezuela, Saudi Arabia, Iran, and Iraq.

Petroleum Production Outlook

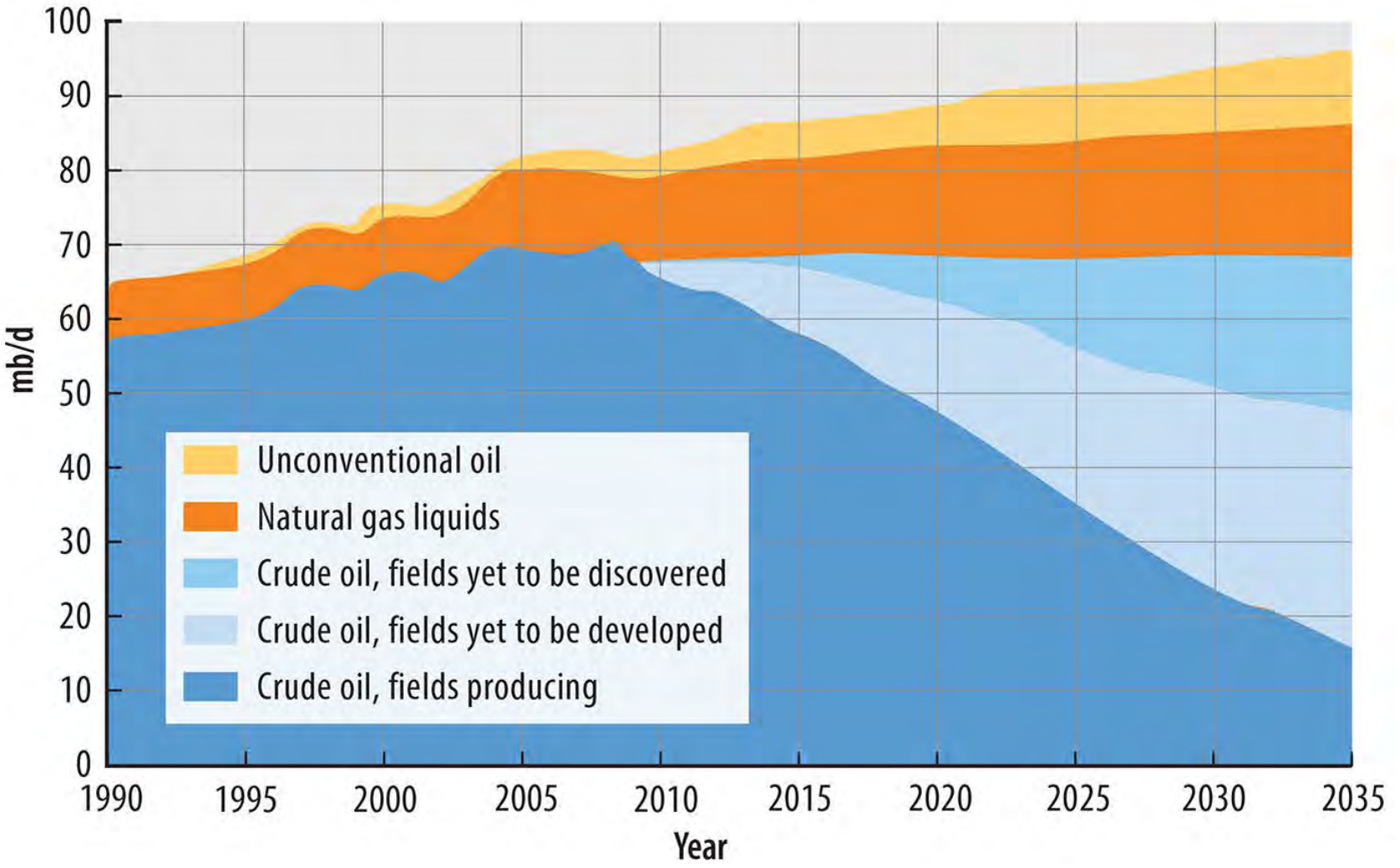


Figure 11-41: Growth in petroleum production is forecast from potential reserves.

Natural Gas Fields in the United States

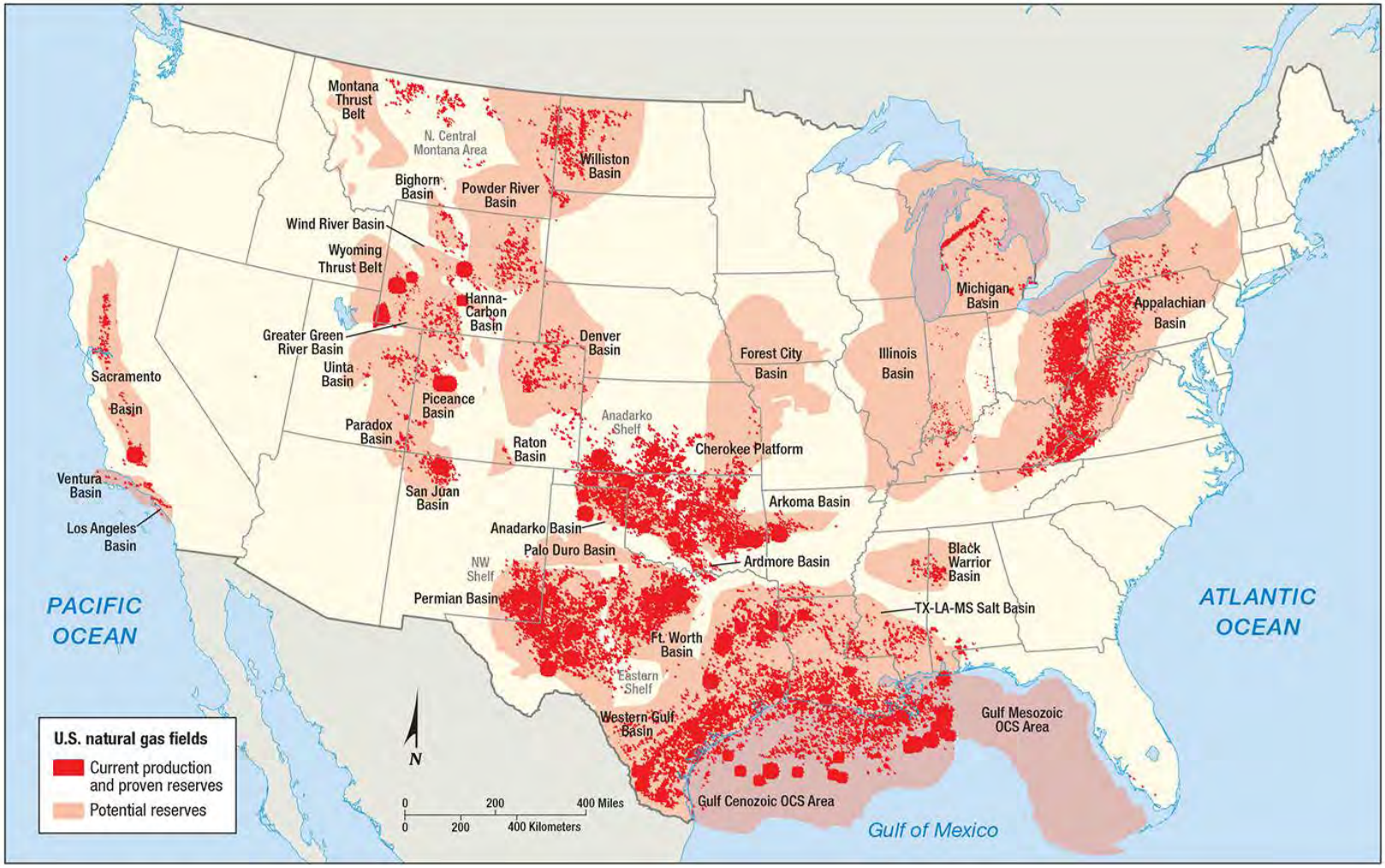


Figure 11-42: Natural gas production has increased through the development of fracking technology.

Petroleum Trade

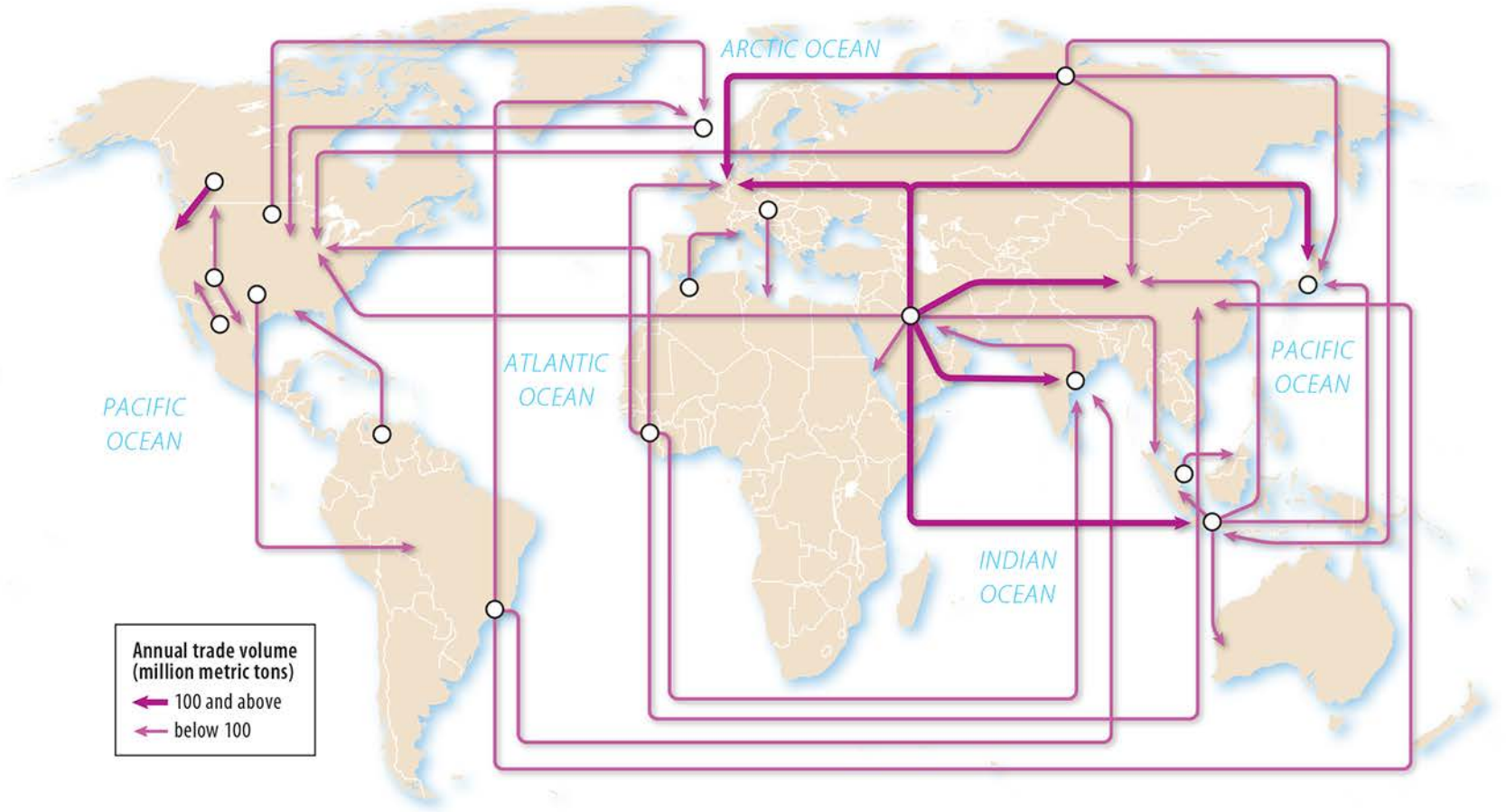


Figure 11-44: The largest flows of petroleum internationally are out of Southwest Asia and into other parts of Asia and into Europe.

U.S. Petroleum Sources

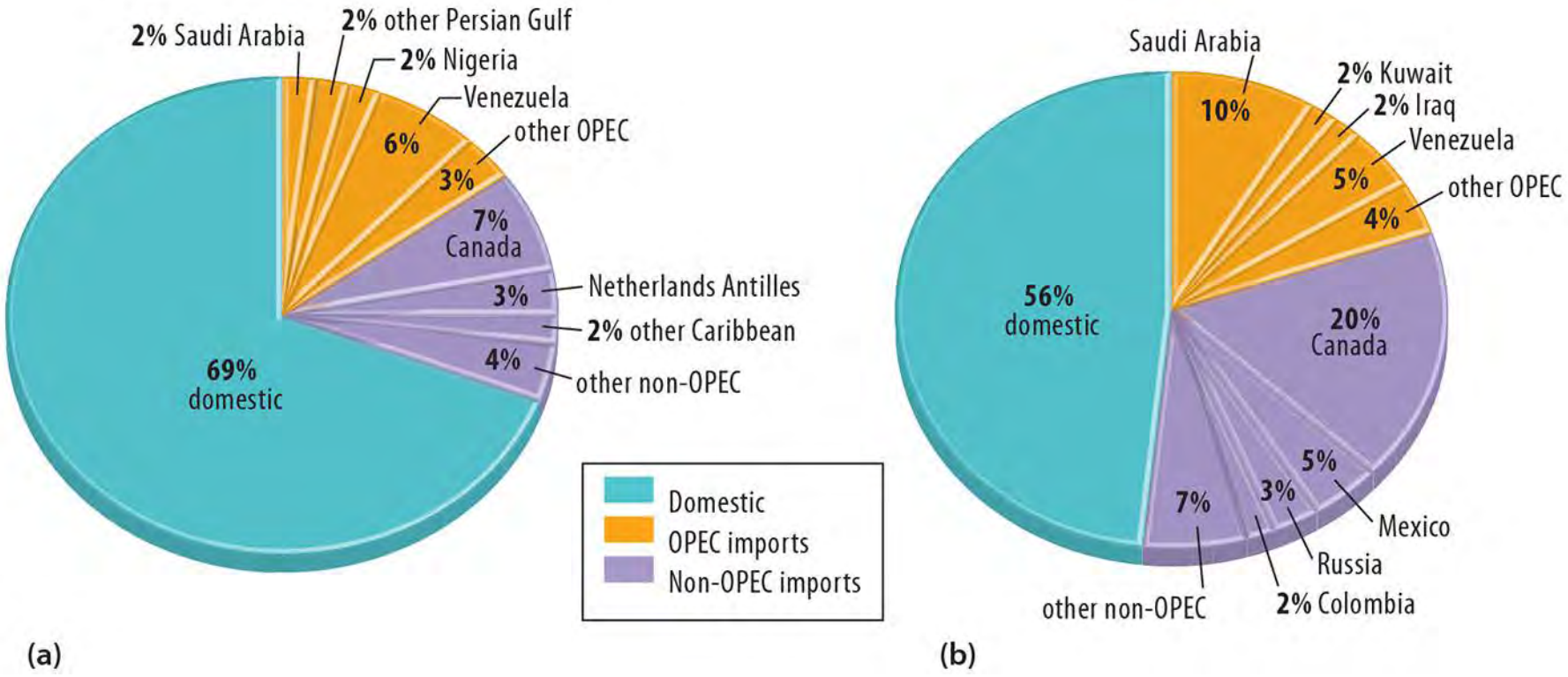


Figure 11-45: The United States has become more reliant on imported petroleum (b) than in the 1970s (a).

Petroleum Prices

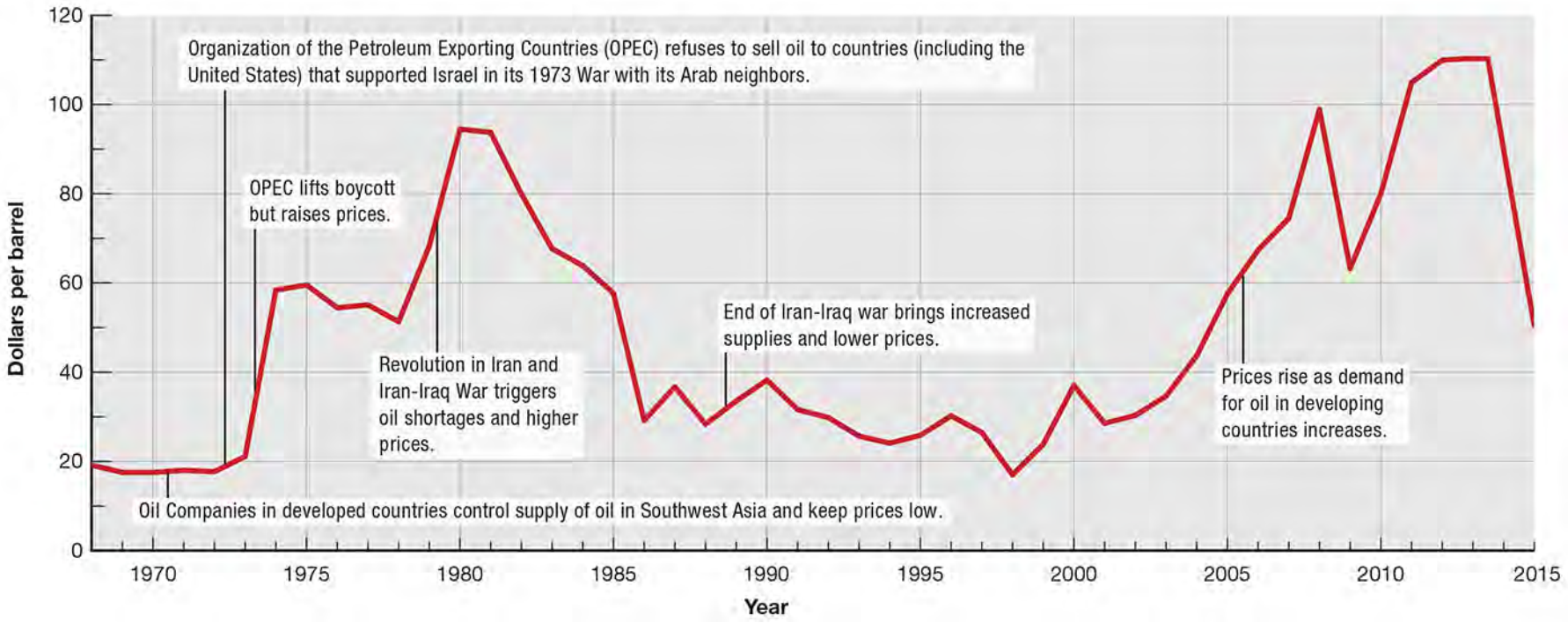


Figure 11-46: Oil prices reflect demand and international events; declining demand due to conservation has reduced the price of oil.

Nuclear Energy

Concerns over nuclear power including

- Potential accidents
- Safe disposal of nuclear waste
- Bomb material
- Limited reserves
- High cost

Nuclear Energy

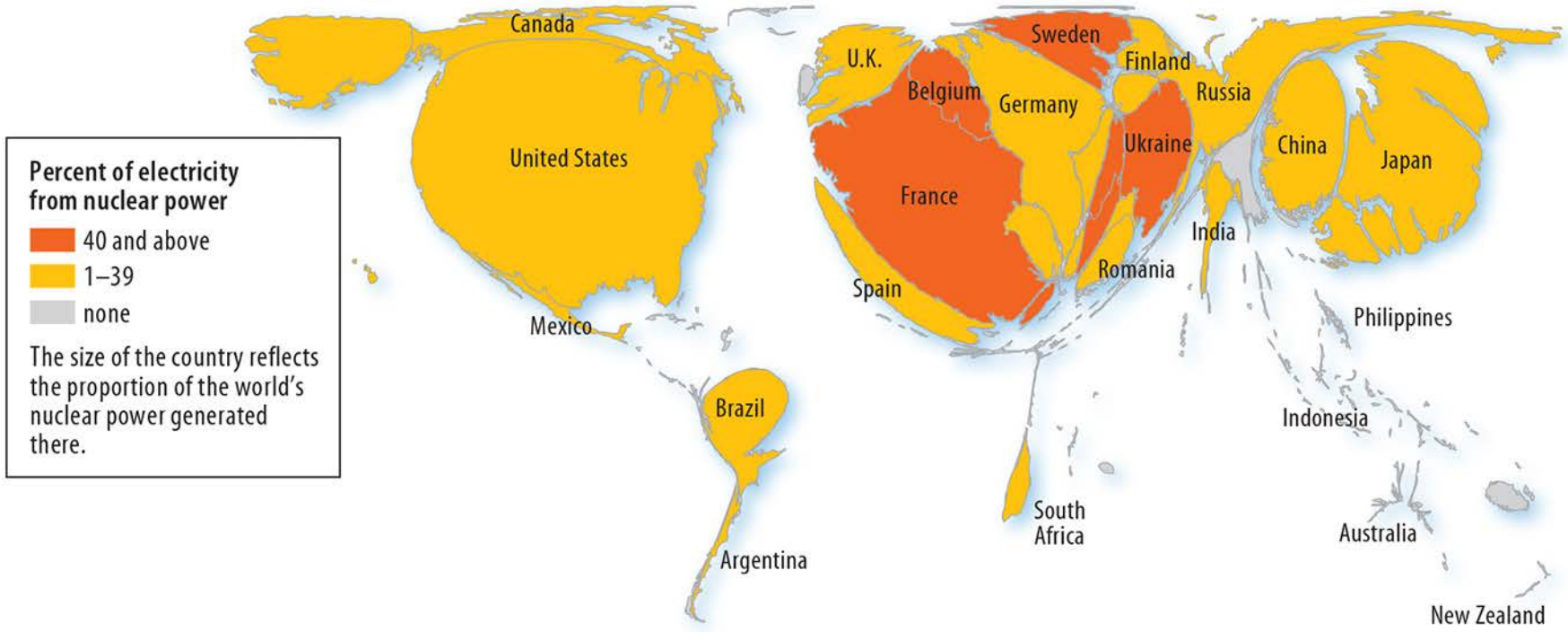


Figure 11-47: Europe, Japan, and the United States account for the majority of the world's nuclear power.

Energy Alternatives

- Hydroelectric power
- Biomass
- Wind power
- Geothermal energy

Energy Alternatives: Hydroelectric

Figures 11-50 and 11-51: The production of hydroelectric power depends in part on the availability of acceptable sites.

Energy Alternatives: Wind

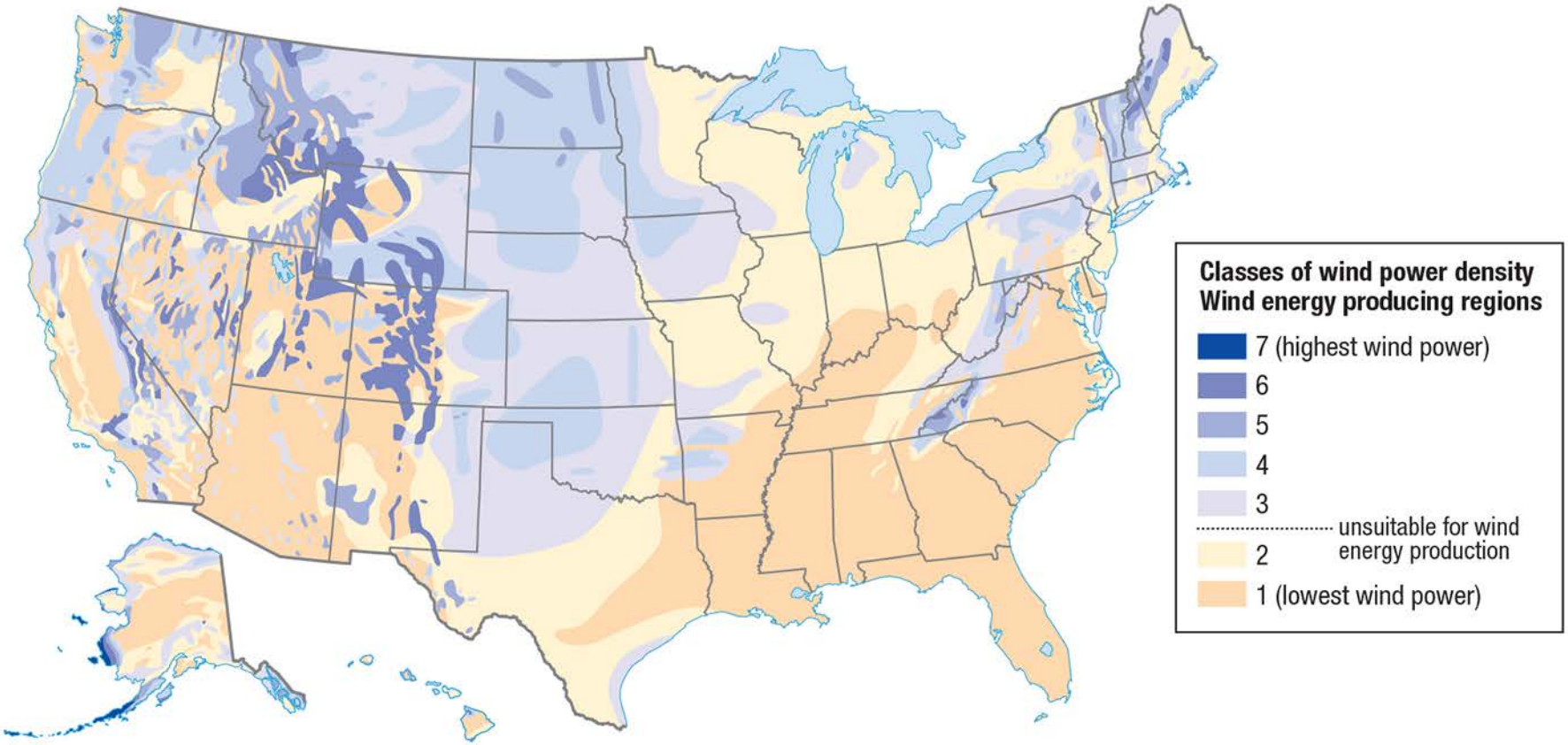


Figure 11-52: Wind power potential is high in the Rocky Mountains and Great Plains.

Energy Alternatives: Geothermal

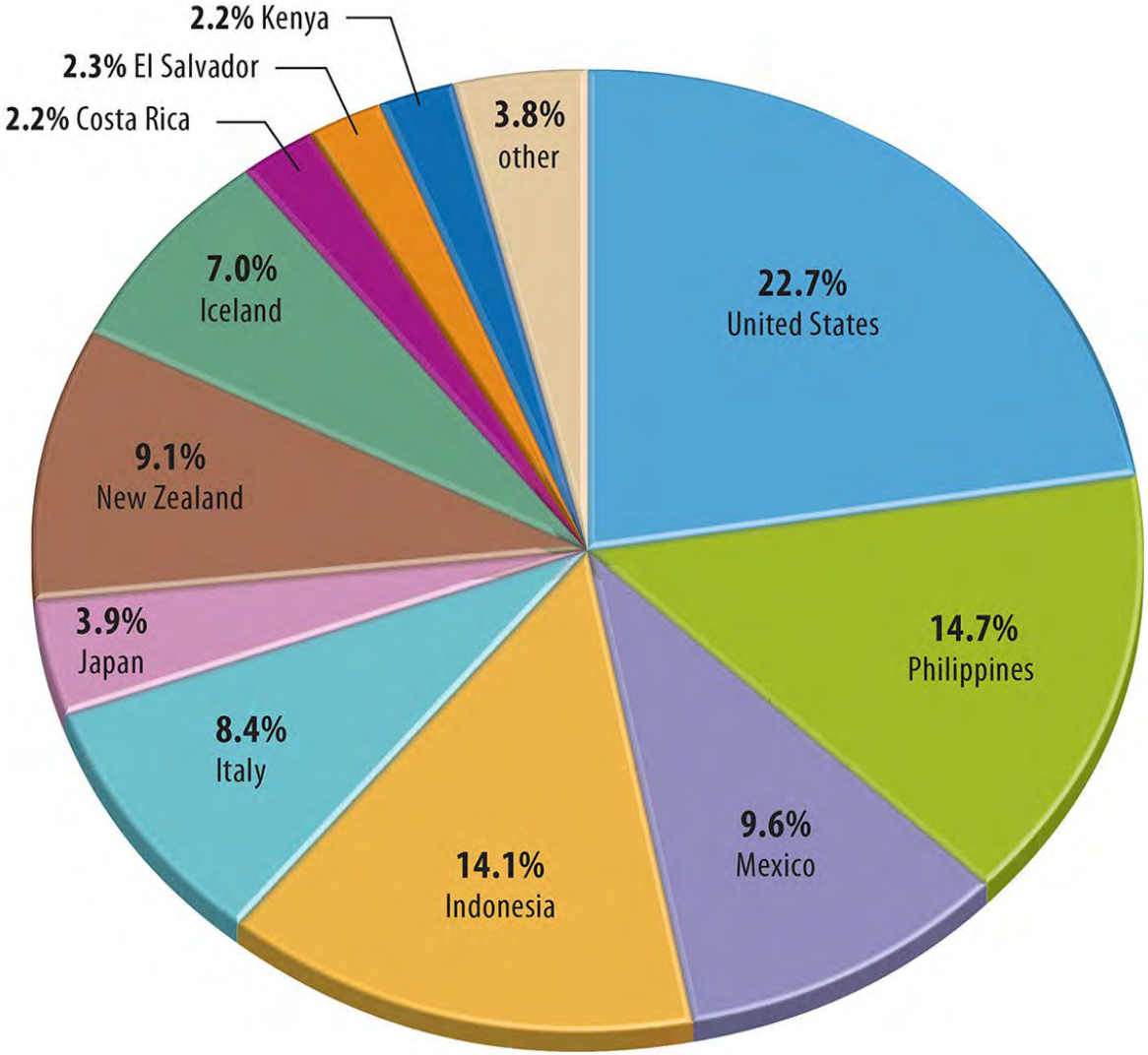


Figure 11-54: Geothermal energy requires appropriate geologic conditions.

Solar Energy

- Passive solar: using Sun energy for heating
- Active solar: converting Sun energy to electricity
- Solar power can charge electric cars, electrify remote villages

Solar Energy

Figure 11-56: Solar energy heats water on this rooftop in Jerusalem.

Air Pollution

- Global scale: climate change, ozone damage
- Regional scale: acid deposition
- Local scale: urban air pollution

Air Pollution: Climate Change

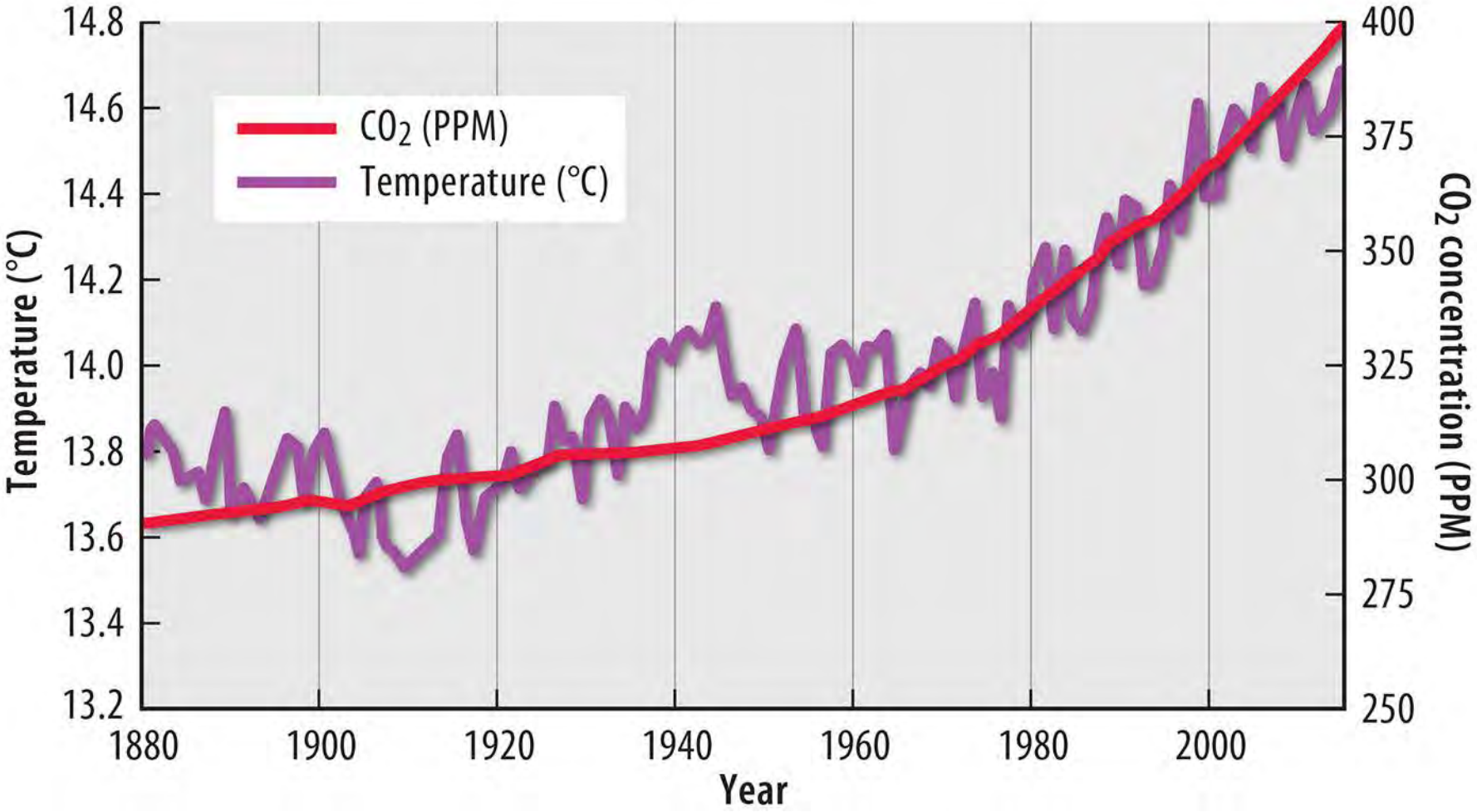


Figure 11-57: Human-caused increases of carbon dioxide have increased global temperatures.

Air Pollution: Acid Deposition

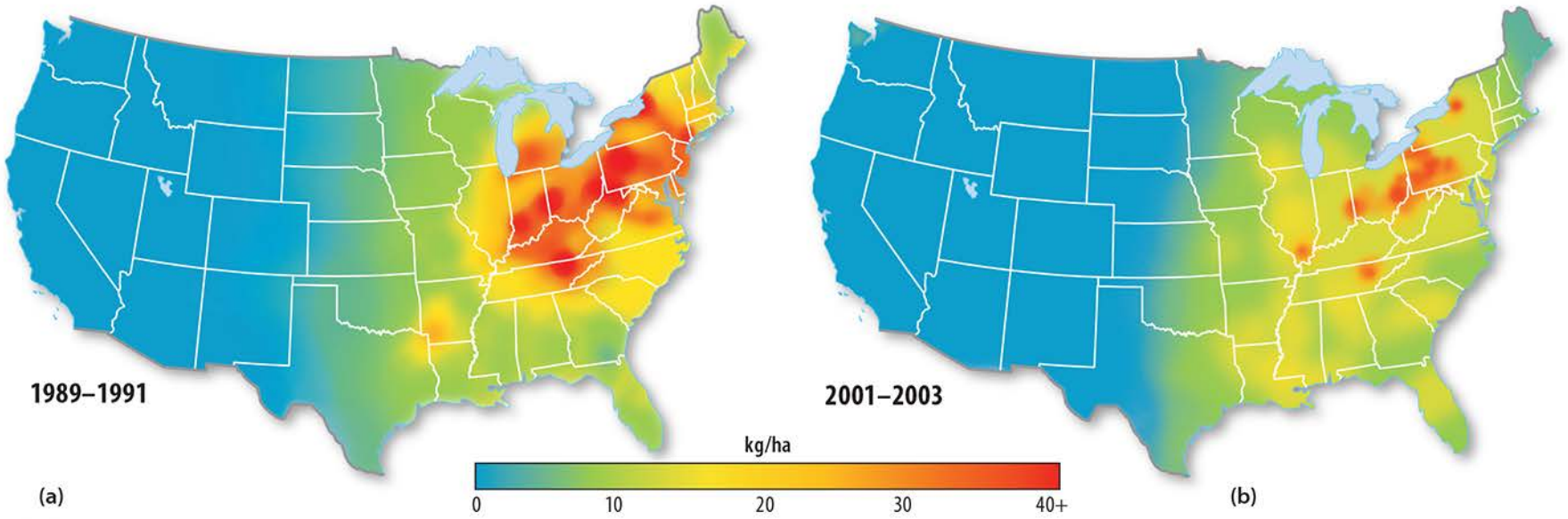


Figure 11-59: Acid deposition was increasing in the United States until the 1990s.

Urban Air Pollution

Figures 11-60 and 11-61: Urban air pollution is worst in South Asia, like in Delhi, India (right).

Water Pollution

Water uses

- Nonconsumptive: returned as liquid
- Consumptive: evaporates, e.g., agriculture

Polluted water

- Point source: from specific location
- Nonpoint source: from diffuse area

Water Use

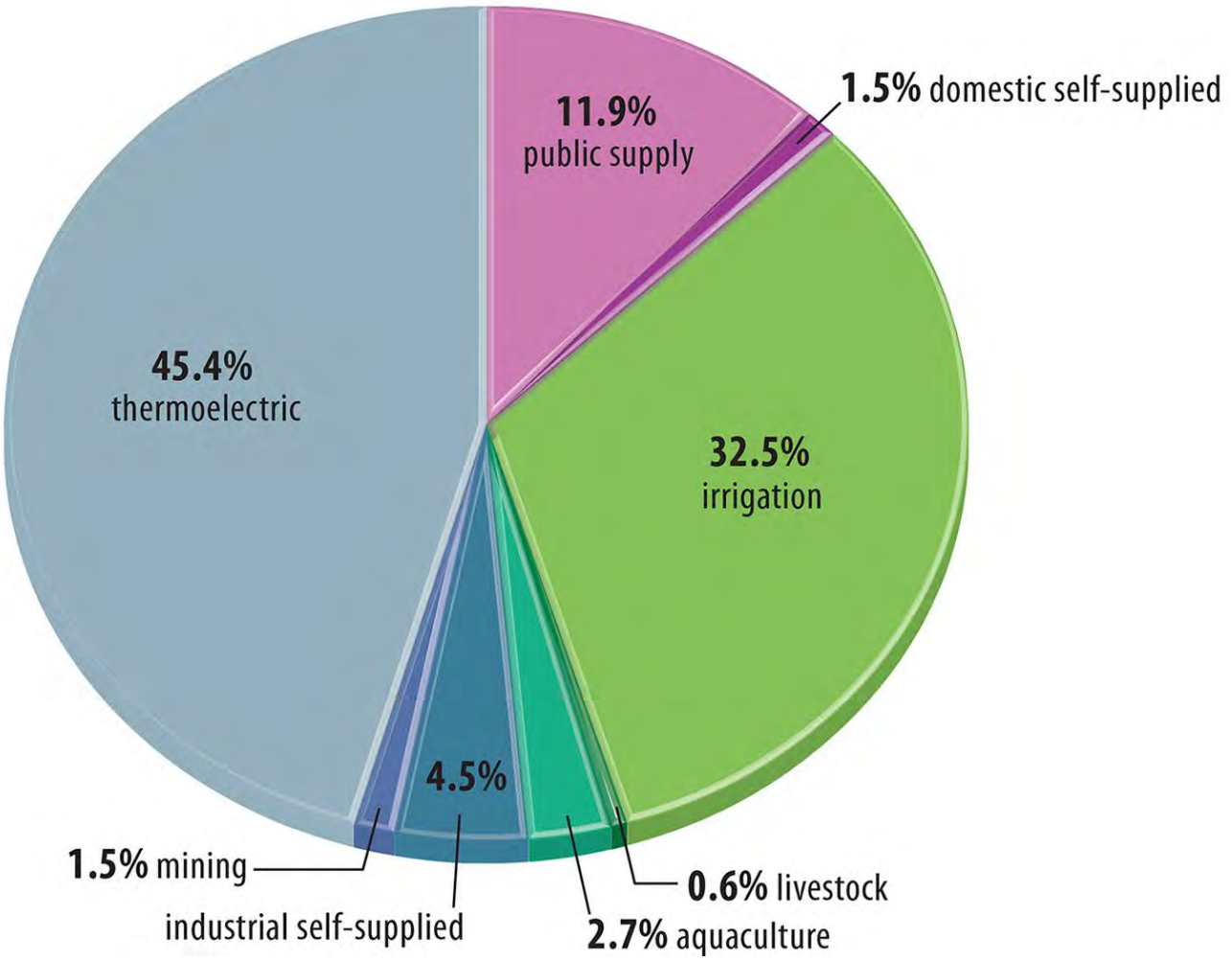


Figure 11-62: water withdrawal by use

Per Capita Water Use by World Region

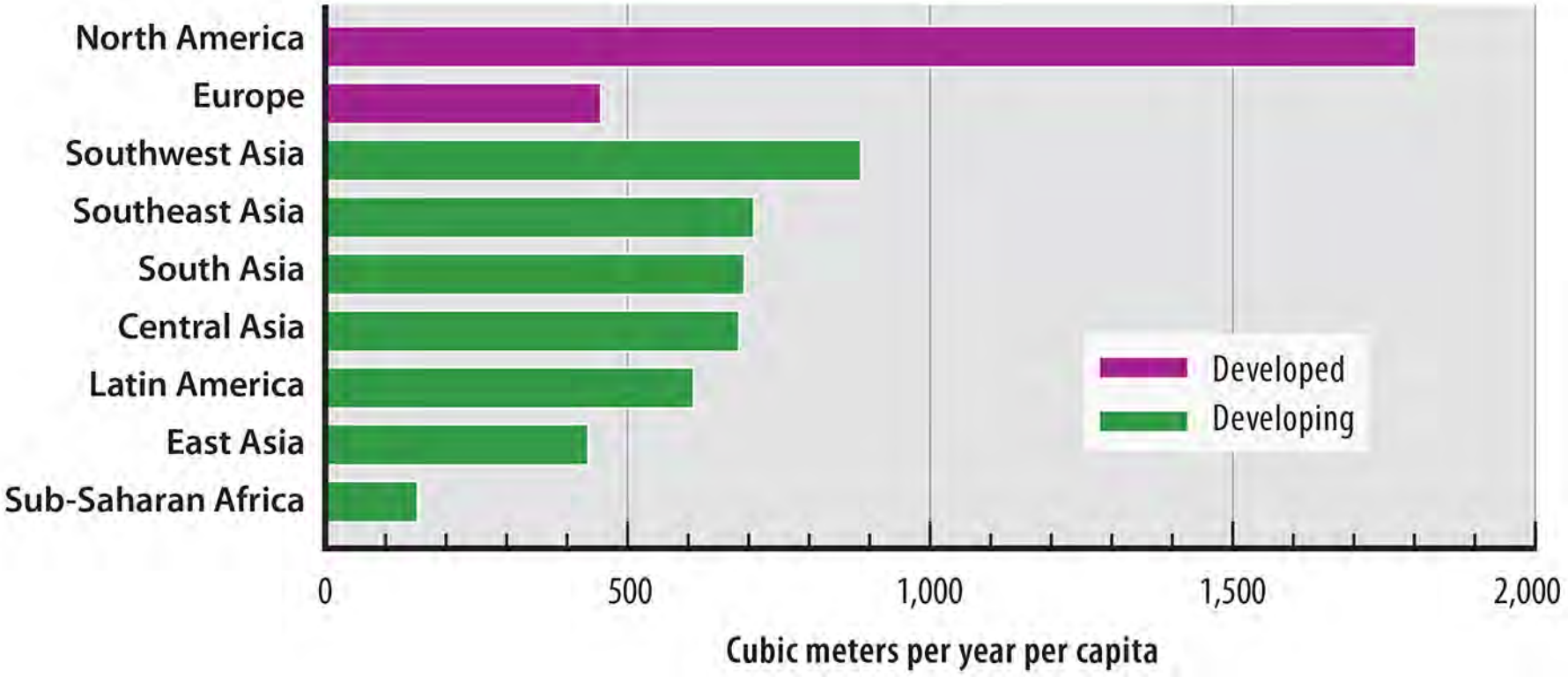


Figure 11-63: per capita water withdrawal for world regions

Point Source Pollution

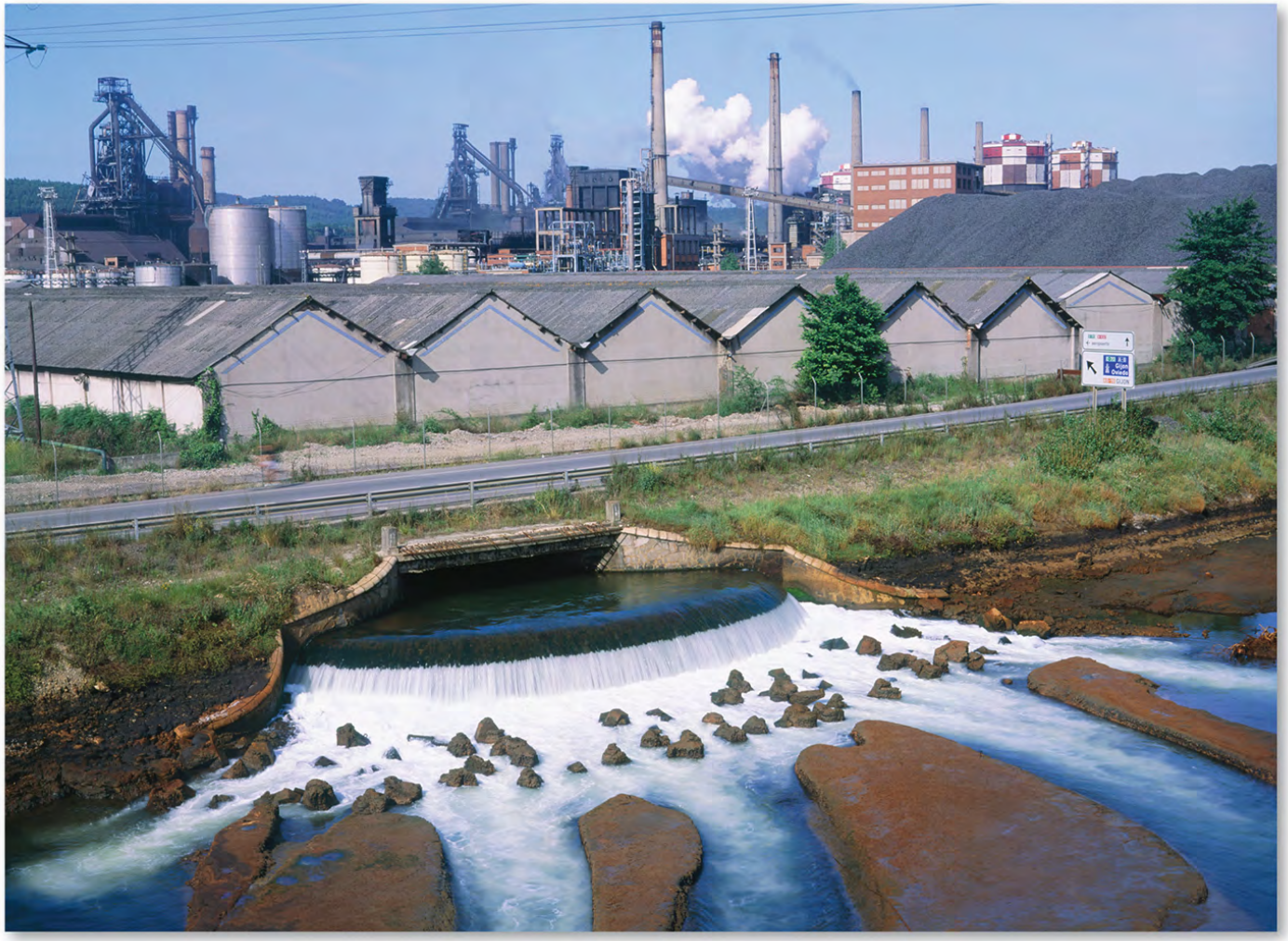


Figure 11-65: A factory in Wolfen, Germany discharges water. Water pollution from a single factory is point-source pollution.

Nonpoint Source Pollution

Figure 11-66: Pollution entering water from informal housing in Delhi, India represents a nonpoint source.

Solid Waste: Sanitary Landfills

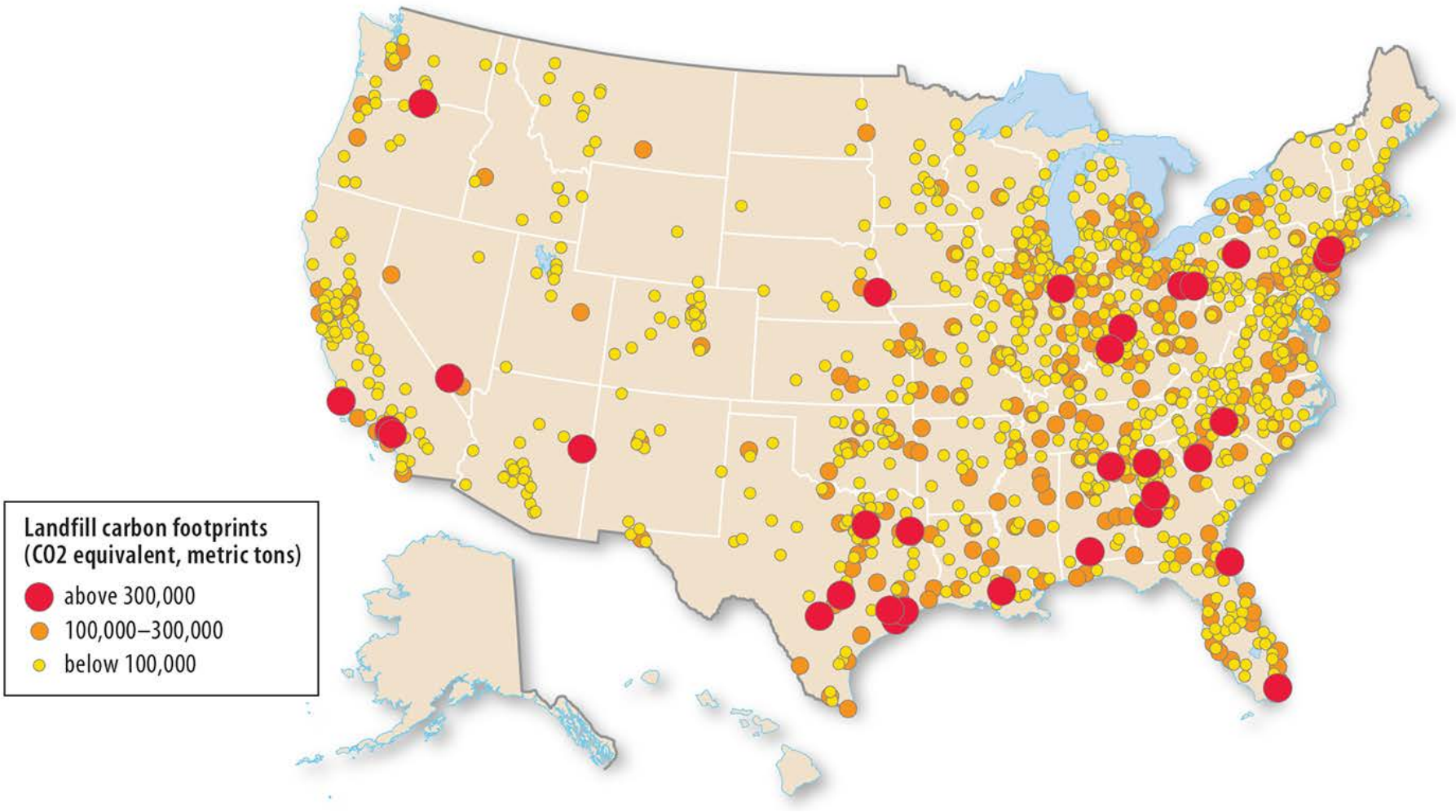


Figure 11-67: Landfills store solid waste disposed of by Americans. Recycling has decreased the per capita contribution to landfills.

Solid Waste: Hazardous Waste

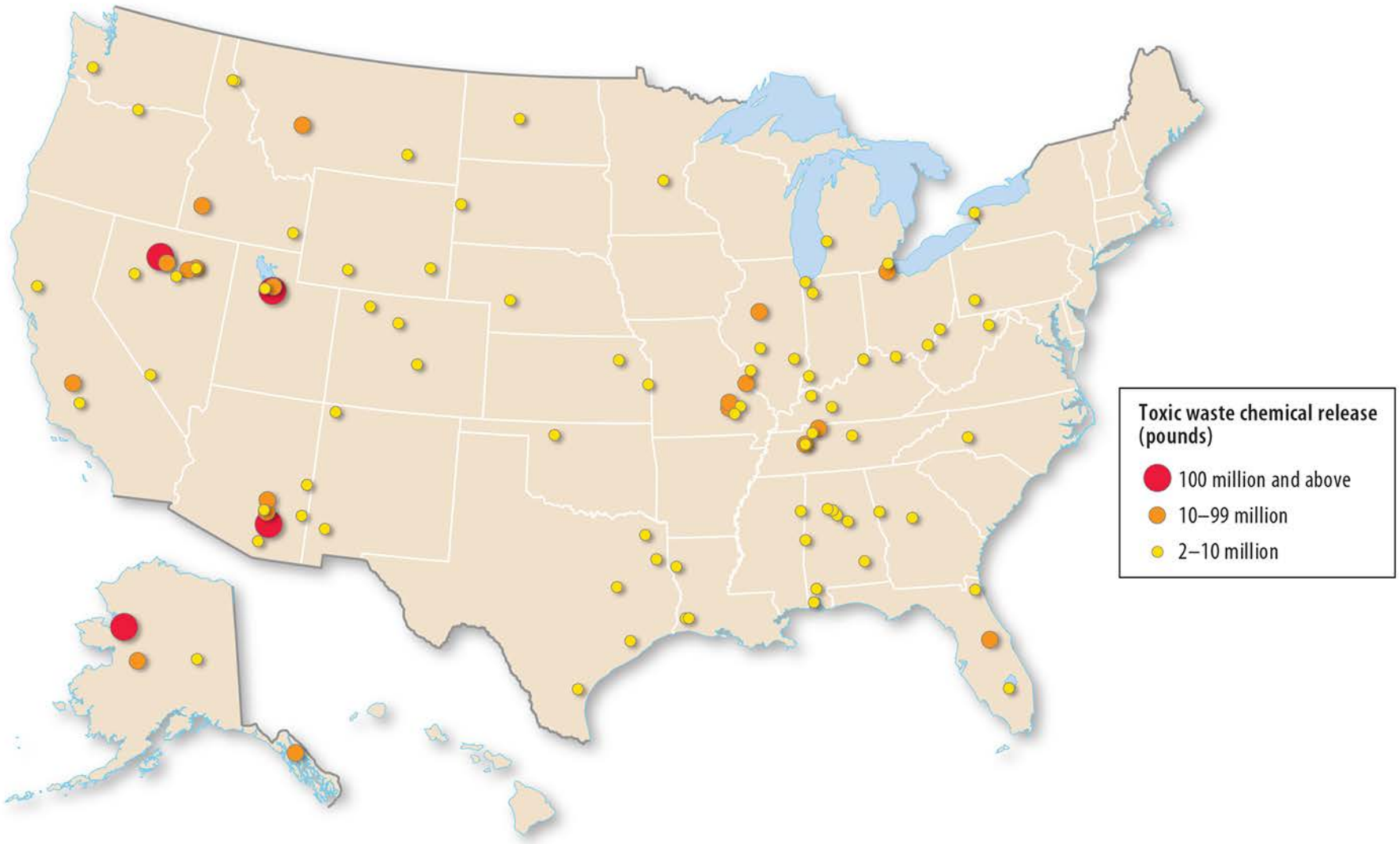


Figure 11-69: Industrial sites release toxic chemicals as hazardous waste. The largest emitters are mines in the West.

Key Issue 4: Why Are Industries Changing Locations?

4.1 Emerging Industrial Regions

4.2 Industrial Change in Developed Countries

4.3 Skilled or Unskilled Labor?

4.4 Recycling and Remanufacturing

Emerging Industrial Regions

- New international division of labor: low-paid, low-skill jobs moved to developing countries
- Mexico: North American Free Trade Agreement (NAFTA) created industrial growth
- Brazil, Russia, India, China (BRIC): projected industrial growth

Manufacturing as Percentage of GNI

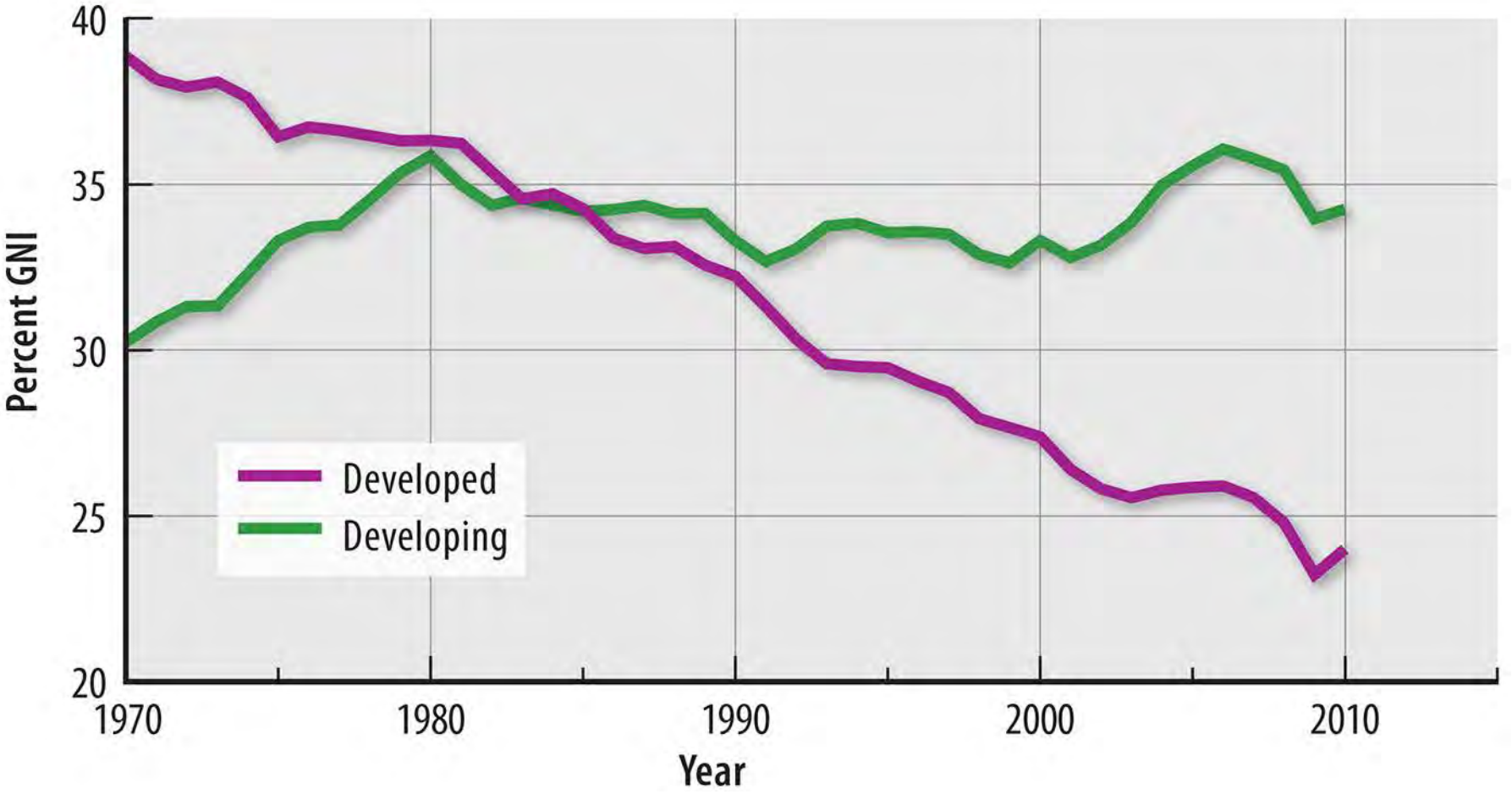


Figure 11-70: Manufacturing represents a declining share of GNI in developed countries; it has been fairly constant in developing countries since 1980.

Vehicle Production in Mexico

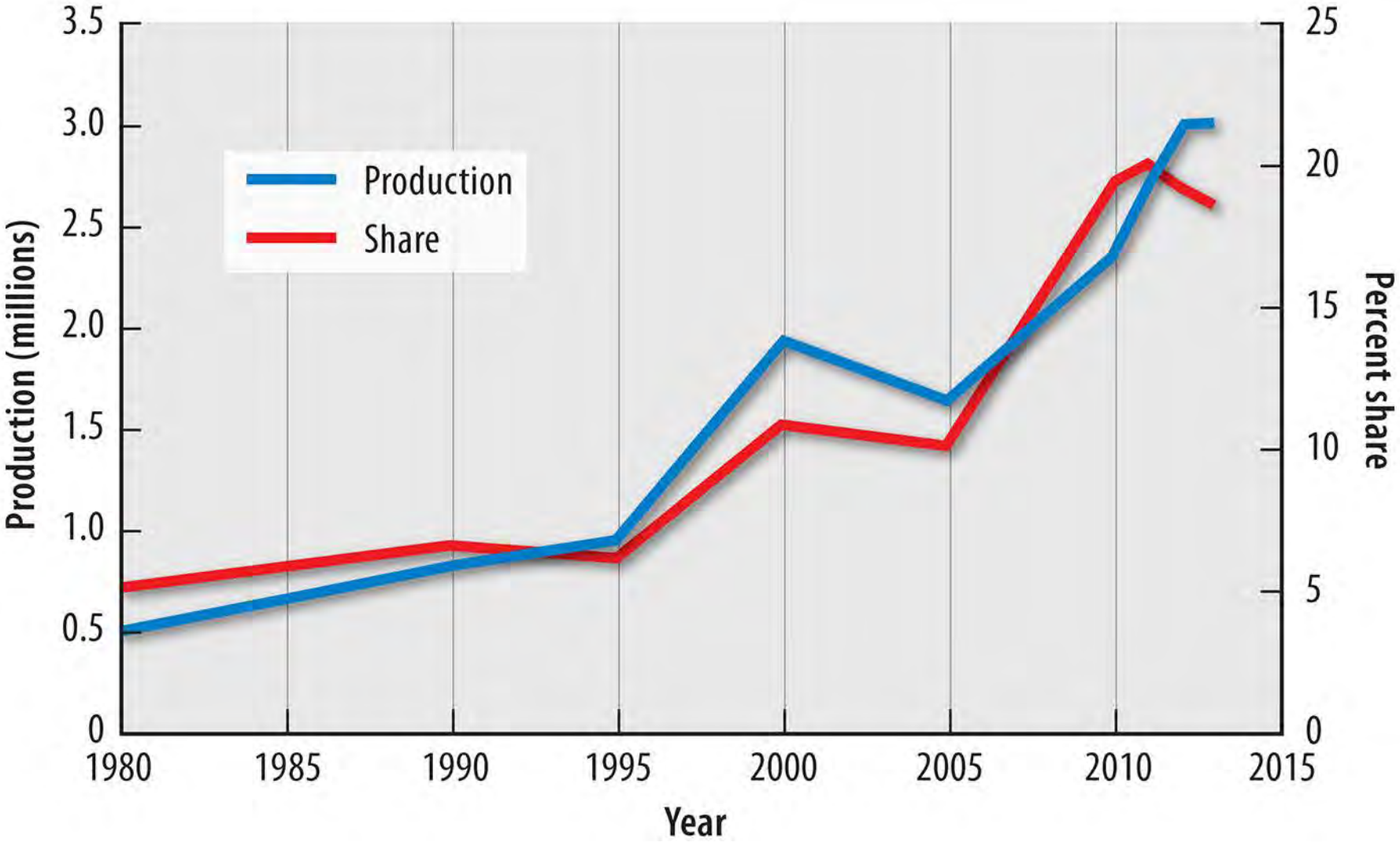


Figure 11-72: The North American Free Trade Agreement began in 1994.

U.S.–Mexico Vehicle Trade

Figure 11-73: Mexican industries have increased vehicle exports to the United States since NAFTA.

BRIC Countries, U.S., and Mexico

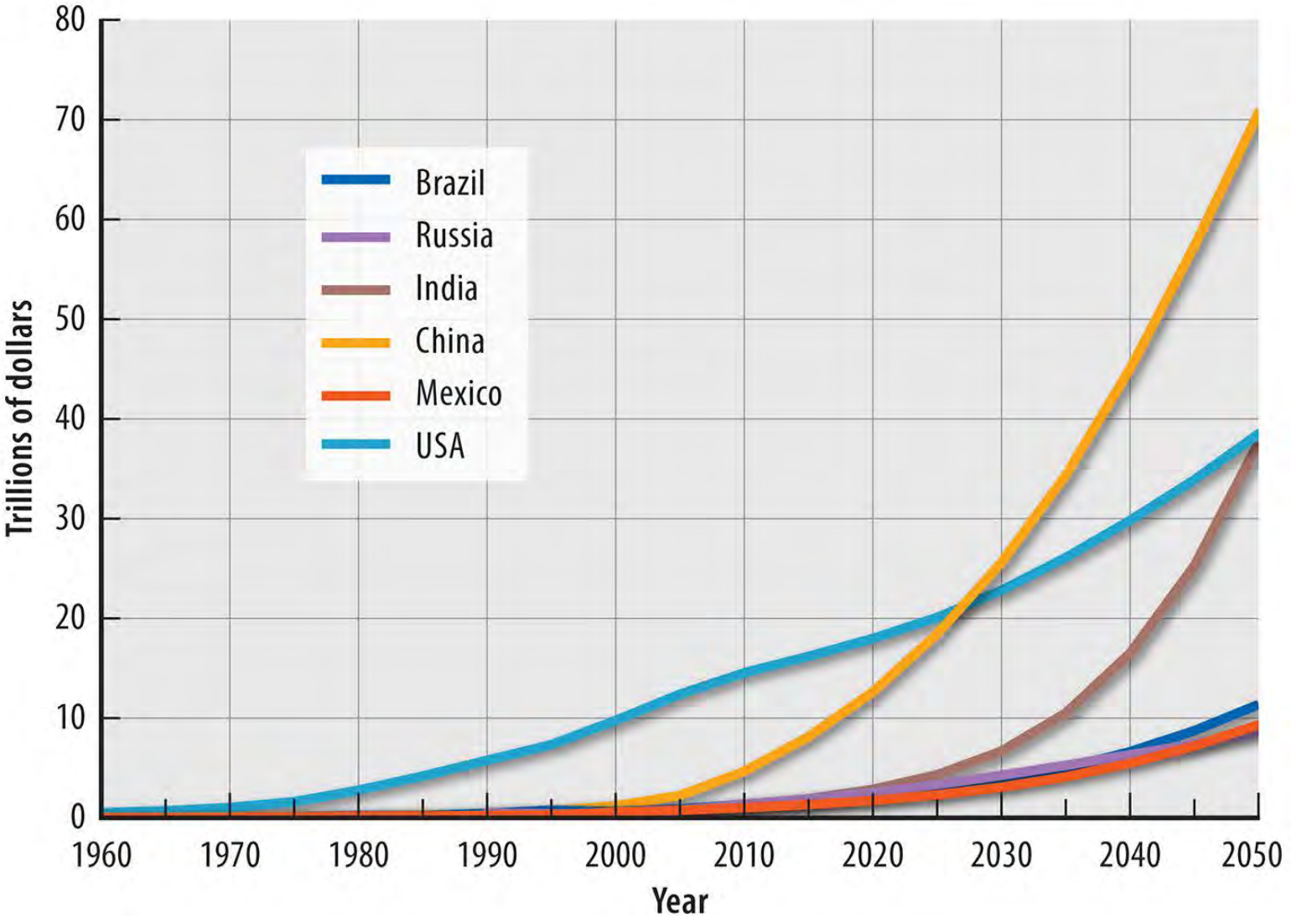


Figure 11-74: India is expected to match the GDP of the United States by the 2050s; China is expected to exceed it in the 2020s.

Industrial Change: United States

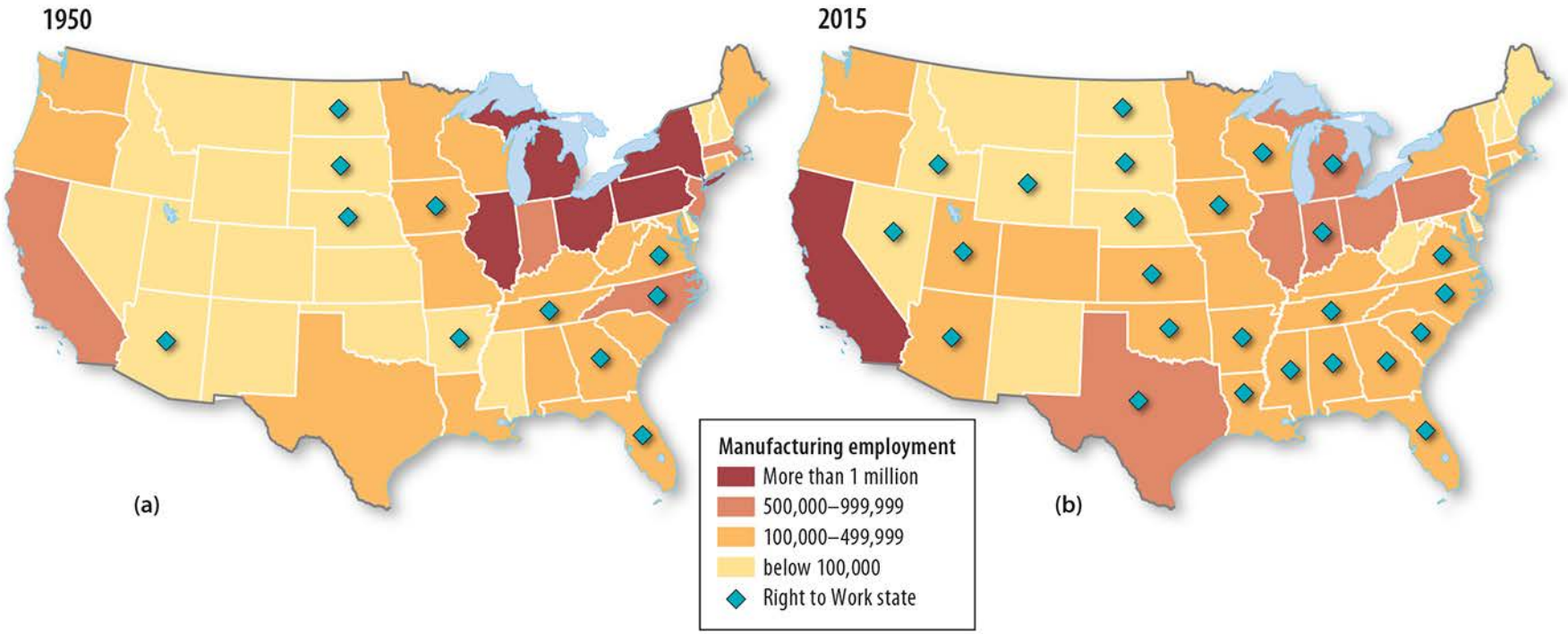


Figure 11-75: Industry in the United States has shifted to the South, in part because of right-to-work laws in southern states.

Industrial Change: North America

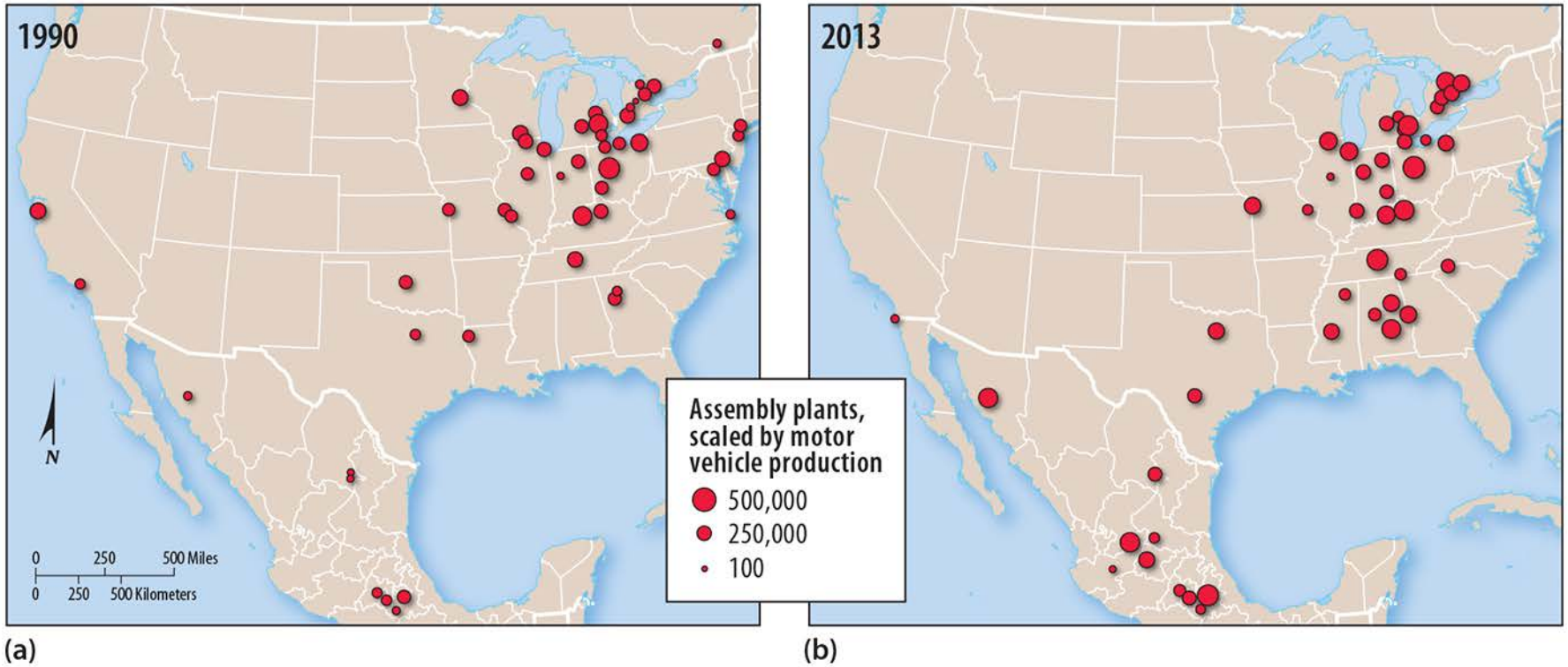


Figure 11-76: Motor vehicle production has shifted to Mexico and the U.S. South.

Industrial Change: Europe

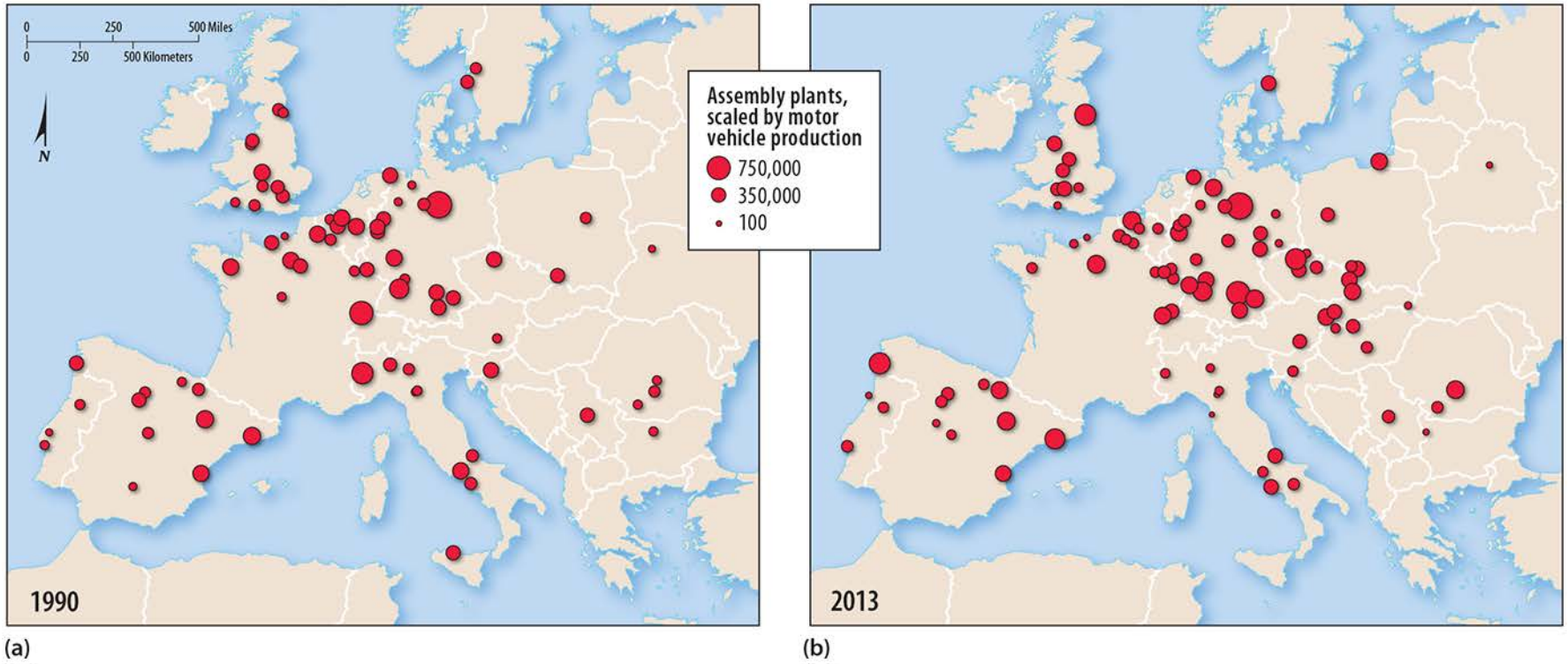


Figure 11-77: Motor vehicle production has shifted to Eastern Europe.

Skilled or Unskilled Labor?

Skilled labor has some advantages over cheaper, less skilled labor.

- Lean production
  - teams with flexible tasks
  - problem solving
  - leveling: less hierarchy
  - productivity from skilled operators

Outsourcing

Outsourcing