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

**United Kingdom**
Dominated world production of steel and textiles during the nineteenth century. These industries have declined, but the country has attracted international investment through new high-tech industries.

**Mid-Rhine**
Europe’s most centrally located industrial area. The area specializes in high-value goods like luxury cars made with skilled labor.

**Rhine-Ruhr Valley**
A center of iron and steel manufacturing, originally because of proximity to large coalfields. Rotterdam, Europe’s largest port, lies at the mouth of several branches of the Rhine River as it flows into the North Sea.

**St. Petersburg**
Russia’s second-largest city, specializing in shipbuilding and other industries serving Russia’s navy.

**Kuznetsk**
Russia’s most important manufacturing district east of the Ural Mountains, with the country’s largest reserves of coal and an abundant supply of iron ore.

**Urals**
Location of the world’s most varied collection of minerals. Proximity to these minerals has attracted iron and steel, chemicals, machinery, and metal fabricating plants.

**Volga**
Russia’s largest petroleum and natural gas fields.

**Northeastern Spain**
Europe’s fastest-growing manufacturing area during the late twentieth century. The area near Barcelona is the center of Spain’s textile industry and the country’s largest motor-vehicle plant.

**Po Basin**
A textile center, taking advantage of somewhat lower wage rates and hydroelectric power from the nearby Alps.

**Donetsk**
One of the world’s largest coal reserves.

**Moscow**
Russia’s oldest industrial region, centered around the country’s capital and largest city.
North America’s Industrial Regions

Figure 11-6

SOUTHEASTERN ONTARIO
Canada's most important industrial area, central to the Canadian and U.S. markets and near the Great Lakes and Niagara Falls.

MOHAWK VALLEY
Takes advantage of inexpensive electricity generated at nearby Niagara Falls.

NEW ENGLAND
A cotton textile center in the early nineteenth century. Cotton was imported from southern states, and finished cotton products were shipped to Europe.

WESTERN GREAT LAKES
Centered on Chicago, the hub of the nation's transportation network and now the center of steel production.

MIDDLE ATLANTIC
The largest U.S. market, so attracts industries that need proximity to a large number of consumers and depend on foreign trade through one of this region's large ports.

PITTSBURGH-LAKE ERIE
The leading steel-producing area in the nineteenth century because of its proximity to Appalachian coal and iron ore.

SOUTHERN CALIFORNIA
Now the country's largest area of clothing and textile production, the second-largest furniture producer, and a major food-processing center.
East Asia’s Industrial Regions

China

- Tianjin, Beijing & Shenyang
- Beijing
- Shenyang
- Bo Hai
- Nanjing
- Wuhan
- Yangtze River Valley
- Guangdong Province & Hong Kong

China

- The world's leading manufacturer of many products, thanks to having the world's largest supply of low-cost labor and the world's largest market for consumer products. Manufacturers cluster in three areas along the east coast.

South Korea

- Seoul
- Busan

Japan

- Tokyo-Yokohama
- Nagoya
- Osaka
- Kobe
- Kyoto

JAPAN

- An industrial power since the 1950s and 1960s, initially by producing goods that could be sold in large quantities at cut-rate prices to consumers in other countries, now by manufacturing high-quality electronic products.

South Korea

- Has followed Japan's lead in focusing on export-oriented manufacturers, such as cars, electronics, and steel. The country is a leading producer of oceangoing ships.

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
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.
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
Figure 11-12: Beer production is a bulk-gaining industry, so bottling takes place near large population clusters.
Figures 11-13 & 11-14: Vehicles are mostly produced (right) in areas where they are sold (top left), representing a bulk-gaining industry.
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.
• 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.
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.
Figure 11-17: Steel minimills are located closer to markets, which also serve as a source of scrap metal.
Figure 11-18: In 1980, world steel production was concentrated in developed countries.
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
Figure 11-20: Truck freight movements are concentrated in the eastern U.S.
Figure 11-21: Most rail freight movements are between the East and West.
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
Figure 11-23: Average hourly manufacturing wages in 14 of the 15 largest industrial countries.
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
Figure 11-27: Close to one-half of all cotton yarn is spun in China and India.
Figure 11-28: Ninety percent of all cotton is woven in China and India.
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.
Figure 11-31: The United States and China lead in coal 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.
Figure 11-34: Fossil fuels make up about 90 percent of energy use in the United States.
Figure 11-35: Developing countries consume less fossil fuels than their population would predict, but demand is growing.
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.
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
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 of petroleum are largest in Venezuela, Saudi Arabia, Iran, and Iraq.
Figure 11-41: Growth in petroleum production is forecast from potential reserves.
Natural gas production has increased through the development of fracking technology.
Figure 11-44: The largest flows of petroleum internationally are out of Southwest Asia and into other parts of Asia and into Europe.
Figure 11-45: The United States has become more reliant on imported petroleum (b) than in the 1970s (a).
Figure 11-46: Oil prices reflect demand and international events; declining demand due to conservation has reduced the price of oil.
Concerns over nuclear power including

• Potential accidents
• Safe disposal of nuclear waste
• Bomb material
• Limited reserves
• High cost
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
The production of hydroelectric power depends in part on the availability of acceptable sites.
Figure 11-52: Wind power potential is high in the Rocky Mountains and Great Plains.
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
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
Figure 11-57: Human-caused increases of carbon dioxide have increased global temperatures.
Figure 11-59: Acid deposition was increasing in the United States until the 1990s.
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
Figure 11-62: water withdrawal by use

- 32.5% irrigation
- 11.9% public supply
- 45.4% thermoelectric
- 2.7% aquaculture
- 0.6% livestock
- 1.5% mining (industrial self-supplied)
- 1.5% domestic self-supplied
Per Capita Water Use by World Region

Figure 11-63: per capita water withdrawal for world regions
Figure 11-65: A factory in Wolfen, Germany discharges water. Water pollution from a single factory is point-source pollution.
Figure 11-66: Pollution entering water from informal housing in Delhi, India represents a nonpoint source.
Figure 11-67: Landfills store solid waste disposed of by Americans. Recycling has decreased the per capita contribution to landfills.
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
Figure 11-70: Manufacturing represents a declining share of GNI in developed countries; it has been fairly constant in developing countries since 1980.
Figure 11-72: The North American Free Trade Agreement began in 1994.
Figure 11-73: Mexican industries have increased vehicle exports to the United States since NAFTA.
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.
Figure 11-75: Industry in the United States has shifted to the South, in part because of right-to-work laws in southern states.
Figure 11-76: Motor vehicle production has shifted to Mexico and the U.S. South.
Figure 11-77: Motor vehicle production has shifted to Eastern Europe.
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
THE ASIAN TECH RACE
Outsourcing

U.S. JOB FLOW TO EAST BOOSTS INDIAN ECONOMY BUT CAUSES ANGER IN AMERICA