4.2: Non-Renewable Resources

Learning Objectives

After completing this chapter, you will be able to:

1. Describe the global and Canadian production and use of metals, fossil fuels, and other non-renewable resources.
2. Explain the heavy reliance of industrialized economies on non-renewable resources, and predict whether these essential sources of materials and energy will continue to be readily available into the foreseeable future.
3. Outline five major sources of energy that are available for use in industrialized countries, and describe the potential roles of these in a sustainable economy.

Introduction

As we noted in Chapter 12, the reserves of non-renewable resources are inexorably diminished as they are extracted from the environment and used in the human economy. This is because non-renewable resources are finite in quantity and their stocks do not regenerate after they are mined. Note that the word reserve has a specific meaning here — it is used to denote a known amount of material that can be economically recovered from the environment (that is, while making a profit).

Of course, continuing exploration may discover previously unknown deposits of non-renewable resources. If that happens, there is an increase in the known reserves of the resource. For example, the world’s known reserves of nickel and copper have been increased during the past two decades because of the discovery of rich deposits of those metals in northern Quebec and Labrador. There are, however, limits to the number of “new” discoveries of non-renewable resources that can be made on planet Earth.
Changes in the value of non-renewable commodities also affect the sizes of their economically recoverable reserves. For example, if the value of gold increases in its marketplace, then it may become profitable to prospect for new stocks in remote places, to mine lower-grade ores, and to reprocess “waste” materials containing small quantities of this valuable metal. An improvement of technology may have the same effect, for instance, by making it profitable to process ores mine that were previously non-economic.

In addition, the life cycle in the economy of some non-renewable resources, particularly metals, can be extended by recycling. This process involves collecting and processing disused industrial and household products to recover reusable materials, such as metals and plastics. However, there are thermodynamic and economic limits to recycling, which means the process cannot be 100% efficient. Furthermore, the demand for non-renewable resources is increasing rapidly because of population growth, spreading industrialization, and improving standards of living along with the associated per-capita consumption. This has resulted in an accelerating demand for non-renewables that must be satisfied by mining additional quantities from the environment.

The most important classes of non-renewable resources are metals, fossil fuels, and certain other minerals such as gypsum and potash. The production and uses of these important natural resources are examined in the following sections.

**Metals**

Metals have a wide range of useful physical and chemical properties. They can be used as pure elemental substances, as alloys (mixtures) of various metals, and as compounds that also contain non-metals. Metals are used to manufacture tools, machines, and electricity-conducting wires; to construct buildings and other structures; and for many other purposes. The most prominent metals in industrial use are aluminum (Al), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), tin (Sn), uranium (U), and zinc (Zn). The precious metals gold (Au), platinum (Pt), and silver (Ag) have some industrial uses (such as conductors in electronics), but are valued mostly for aesthetic reasons, particularly to manufacture jewelry. Some of the more common metal alloys are brass (containing at least 50% Cu, plus Zn), bronze (mostly Cu, plus Sn and sometimes Zn and Pb), and steel (mostly Fe, but also containing carbon, Cr, Mn, and/or Ni). Metals are mined from the environment, usually as minerals that also contain sulphur or oxygen. Deposits of metal-bearing minerals that are economically extractable contribute to the known reserves of metals. An ore is an assortment of minerals that are mined and processed to manufacture pure metals. The stages in metal mining, processing, manufacturing, and recycling are summarized in Figure 13.1.

Figure 13.1. Metal Mining and Use. This diagram shows major stages of the mining, manufacturing, use, and re-use of metals, as well as the associated emissions of waste gases and particulates to the environment. Overall, the diagram represents a flow-through system, with some recycling to extend the lifetime of metals within the economy. Source: Modified from Freedman (1995).