15.14: Geothermal Energy

The final form of renewable energy to be considered here is **geothermal energy** in the form of steam, hot water, or hot rock that produce steam used in steam turbines. First harnessed for the generation of electricity at Larderello, Italy, in 1904, geothermal power has since been developed in Japan, Russia, New Zealand, the Phillipines, at the Geysers in northern California and especially in Iceland, an island nation that essentially rests upon a bed of steaming hot rock.

The best source of geothermal energy is subterranean dry steam which, unfortunately, is rather rare. Steam mixed with superheated water is much more common, with the byproduct water varying from very high purity to water laden with corrosive, scale-forming salts. Badly contaminated water is normally injected back into the hot rock formation from which it came to prevent contamination of surface water.

Hot, dry rocks can be used to produce steam from water injected into fractured rock formations. This source of geothermal energy is potentially ten times that of steam and hot water sources, but has been hindered largely over concerns raised by miniscule earthquakes that have resulted from fracturing the rocks. Development of this source continues on an experimental basis.

An interesting possibility that has yet to be demonstrated is the use of supercritical carbon dioxide as a working fluid for the extraction of energy from hot rocks (Figure 15.16).

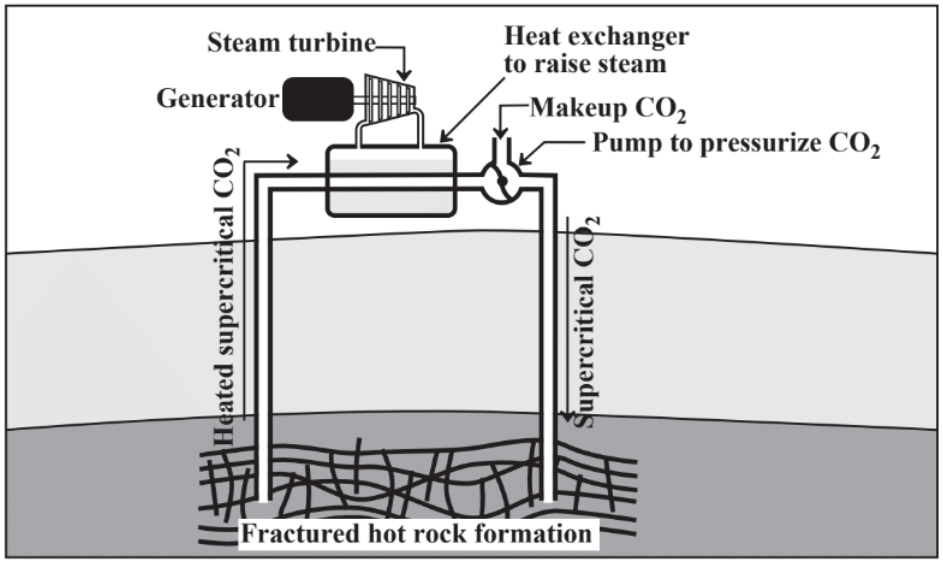

Figure 15.16. A system for extracting heat from hot dry rock formations using supercritical or dense phase carbon dioxide. The carbon dioxide is pumped into a fractured hot rock formation through an injection well and is removed through a production well. The hot carbon dioxide is run through a heat exchanger to raise steam to run a turbine that is coupled to an electrical generator and through which water and steam are recycled. Makeup carbon dioxide is added to the carbon dioxide line downstream from the heat exchanger and the carbon dioxide is repressurized and recycled through the hot rock formation.