

**TABLE 15–4 Electric Energy Resources**

Form of Electric Energy Production	% of Production (approx.)		Advantages	Disadvantages
	U.S.	World		
<p><b>Fossil-fuel steam plants:</b> burn coal, oil, or natural gas to boil water, producing high-pressure steam that turns a turbine of a generator (Figs. 15–12b, 15–21); uses heat engine.</p>	87	86	We know how to build them; for now relatively inexpensive.	Air pollution; thermal pollution; limited efficiency; land devastation from extraction of raw materials (mining); global warming; accidents such as oil spills at sea; limited fuel supply (estimates range from a couple of decades to a few centuries).
<p><b>Nuclear energy:</b></p> <p><b>Fission:</b> nuclei of uranium or plutonium atoms split (“fission”) with release of energy (Chapter 31) that heats steam; uses heat engine.</p>	8	6	Normally almost no air pollution; less contribution to global warming; relatively inexpensive.	Thermal pollution; accidents can release damaging radioactivity; difficult disposal of radioactive by-products; possible diversion of nuclear material by terrorists; limited fuel supply.
<p><b>Fusion:</b> energy released when isotopes of hydrogen (or other small nuclei) combine or “fuse” (Chapter 31).</p>	0	0	Relatively “clean”; vast fuel supply (hydrogen in water molecules in oceans); less contribution to global warming.	Not yet workable.
<p><b>Hydroelectric:</b> Falling water turns turbines at the base of a dam.</p>	4	7	No heat engine needed; no air, water, or thermal pollution; relatively inexpensive; high efficiency; dams can control flooding.	Reservoirs behind dams inundate scenic land or canyons; dams block upstream migration of salmon and other fish for reproduction; few locations remain for new dams; drought.
<p><b>Geothermal:</b> natural steam from inside the Earth comes to the surface (hot springs, geysers, steam vents); or cold water passed down into contact with hot, dry rock is heated to steam.</p>	<1	<1	No heat engine needed; little air pollution; good efficiency; relatively inexpensive and “clean.”	Few appropriate sites; small production; mineral content of spent hot water can pollute.
<p><b>Wind power:</b> 3-kW to 5-MW windmills (vaness up to 50 m wide) turn a generator.</p>	<1	<1	No heat engine; no air, water or thermal pollution; relatively inexpensive.	Large array of big windmills might affect weather and be eyesores; hazardous to migratory birds; winds not always strong.
<p><b>Solar energy:</b></p> <p><b>Active solar heating:</b> rooftop solar panels absorb the Sun’s rays, which heat water in tubes for space heating and hot water supply.</p> <p><b>Passive solar heating:</b> architectural devices—windows along southern exposure, sunshade over windows to keep Sun’s rays out in summer.</p> <p><b>Solar cells (photovoltaic cells):</b> convert sunlight directly into electricity without use of heat engine.</p>	<0.1	<1	No heat engine needed; no air or thermal pollution; unlimited fuel supply.	Space limitations; may require back-up; relatively expensive; less effective when cloudy.
			No heat engine needed; no air or thermal pollution; relatively inexpensive.	Almost none, but other methods needed too.
			No heat engine; thermal, air, and water pollution very low; good efficiency (>30% and improving).	Expensive; chemical pollution at manufacture; large land area needed as Sun’s energy not concentrated.

