table 8.4. conceivable harnessable energy flows, worldwide. terrawatts (1 tw = 30 quads per year)

Solar electric	50 (elec)	1% of the land, 20% efficiency
Biomass	20 (chem)	10% of the land, 0.8% efficiency
Ocean thermal	9 (elec)	2% of absorbed sunlight, 2% efficiency
Hydropower	2 (elec)	all practical sites
Wind power	1 (elec)	windiest 3% of the total land area; no at-sea sites
Waves, currents, tides, geothermal	<1 (elec)	

In a 1998 compendium, John Holdren estimates "conceivable harnessable renewable energy flows" for the entire world, as shown in Table 8.4.

There are non-fossil-fuel approaches to energy that are practical and economically competitive in some places—such as the use of solar energy for heating domestic water. Solar energy can heat a central boiler to provide steam for producing electrical power (the so-called "power tower" approach). Furthermore, in the form of "solar cells" made of crystalline or noncrystalline silicon layers it can serve as a source of electricity; nonsilicon systems have been demonstrated as well. After all, the great majority of our artificial earth satellites—broadcasting, weather observing, photoreconnaissance—obtain kilowatts of power from solar cells. Although this is a book on nuclear energy and nuclear weapons, it is important to note that the continued application of science and technology to the solar-cell option—solar photovoltaics—will continue to reduce the cost of this approach. But the sun's light at the earth is a dilute source of power, and one that is absent for much of the day in most places (and even for much of the year in other places), and solar energy is not yet competitive with fossil fuels or nuclear energy.

Much work has also been done on modern windmills for electrical power generation, electrical power from ocean waves, from the tides, from geothermal energy (i.e., either steam vents or hot-dry rock underground), or from ocean temperature differences. Compared with the world's actual industrial use of energy in 1996 of 11.9 terawatts (one TW is 1000 GW) and 1.8 TW of "traditional" energy (fuel wood, crop wastes, dung), these renewable energy flows might conceivably contribute 90 TW. The Department of Energy announced in June 1999 the goal for the United States of obtaining 5% of its electricity from wind energy by the year 2020, up from 0.1% in 1998.[8] In June 1999 the installed U.S. wind-electric capacity was 2.5 GWe, while a year before it had been 1.6 GWe.

One can imagine that with future sources of energy for humanity at stake, the operators of American power plants could be assessed a substantial tax per