of 10 m this leads to 3.6×10^{10} m^2. It is to be concluded that all the electricity needed in the US can be met by covering the paved roads with PV modules. Of course, no one is seriously proposing this action. We use the road analogy to show that if society wanted, it could establish land use priorities favorable to photovoltaics just as it has done to accommodate the ubiquitous automobile. We are certain that each state could find areas of unused land around airports, parking spaces, rooftops, highway dividing strips, or desert land that could be used for photovoltaics.

These simplistic "back-of-the-envelope" calculations show that having enough area for PV modules is not a limit for a homeowner or a large city. Certainly, there are sunny places in every country that could be used for generating significant amounts of PV power. As will be evident in other chapters, it is the initial cost of the photovoltaics, not the amount of land that is the primary barrier to be overcome.

2. *Photovoltaics can meet all of the world's needs today if we would just pass laws requiring photovoltaics and halting all fossil and nuclear plants*:

   Besides the difficulty of convincing the people's representatives to pass such a law, the first technical problem faced would be the intermittent nature of the solar radiation, available only during the day and strongly reduced in overcast skies. Energy storage would solve this problem but no cheap storage method appears on the horizon. Nevertheless, well-developed electric grids may accept large amounts of PV electricity by turning off some conventional power plants when PV plants are delivering power. Adequate grid management would allow up to 20 to 30% of the electric production to be intermittent [4].

   But now for a dose of reality. The cumulative production of PV modules up to the year 2002 is about 2000 MW. Thus, if you took all of the PV panels that were ever made up to and including the year 2002, and put them all in the same sunny place at the same time, they would generate enough electricity to displace about one of last century's 500 MW smoke- or radioactive-waste–producing power plants. (This assumes that the solar plant would operate at full output for an equivalent of six hours per day owing to the daily variation in sunlight). Clearly, if we want photovoltaics to make any meaningful contribution to the world's energy supply, very massive increases in manufacturing capacity are needed. Additionally, PV electricity is very expensive, presently between 5 to 10 times more expensive than conventional alternatives. Mass use of PV electricity today could produce significant negative distortion of the economic system.

   Thus, requesting the immediate and exclusive use of photovoltaics is not feasible technically or, probably, economically. It would also be socially unacceptable.

3. *Photovoltaics cannot meet any significant fraction of world needs. It will remain a small-scale "cottage" industry that will only meet the needs of specialty markets like remote homes in developing countries or space satellites*:

   Figure 1.3 shows the evolution of markets associated with different applications [5]. Some used to be considered as *specialty* markets, for example, the category of "world off-grid power" which is trying to supply power to the ∼1/3 of the world's citizens who lack it. The grid-connected market, whose growth has been meteoric in the past decade, is by no means a small market. Ironically it is the large-scale (recently awakened) centralized power plant market which is the smallest "specialty" application in today's world. Thus, evidence from the recent past tends to refute