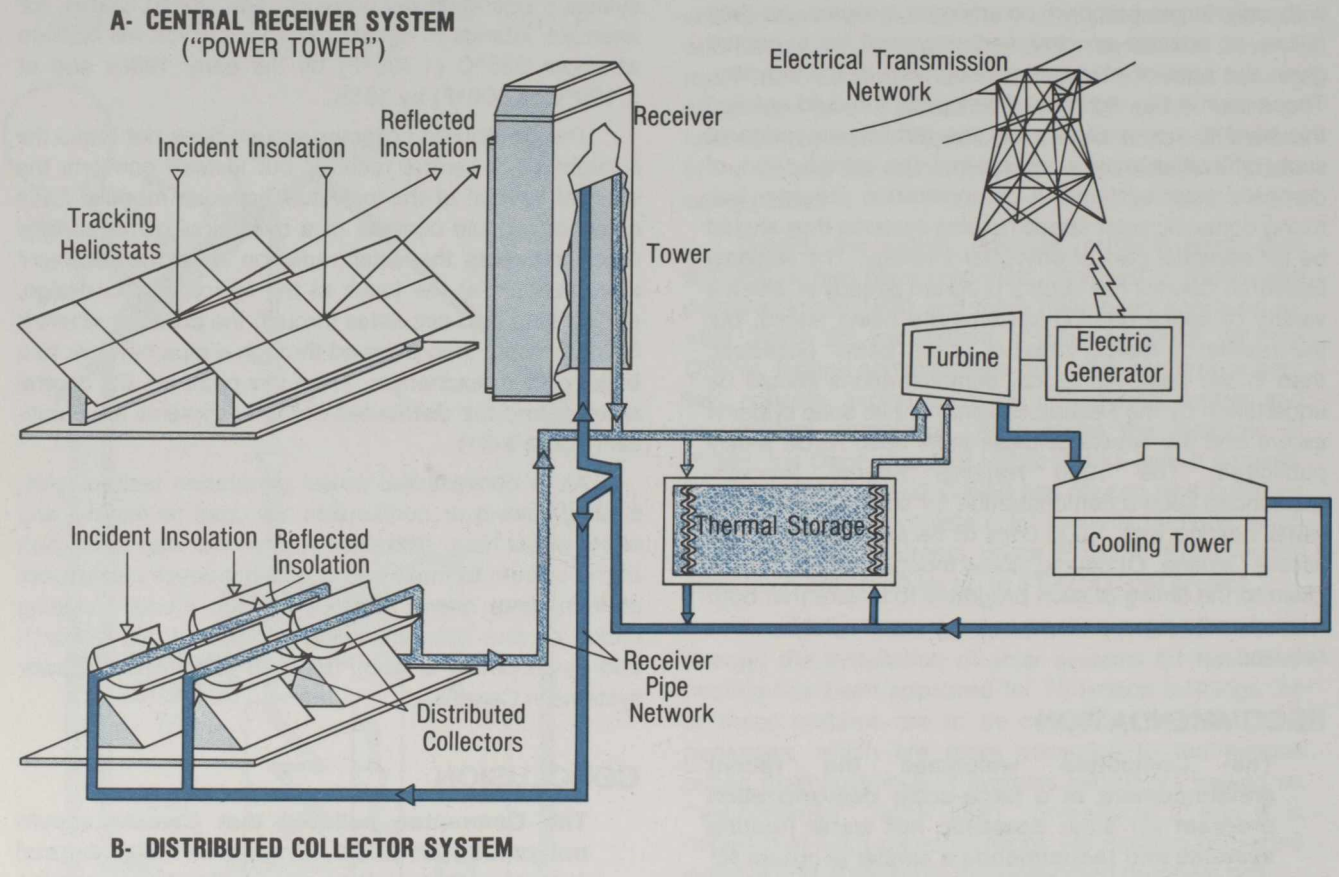
program provided the impetus for development of solar cell technology, it also inadvertently created a major barrier to the widespread use of such cells. In the space program the only feature required of this technology was efficiency. Research thus concentrated on delivering the most watts per cell, regardless of the expense involved. High costs have since been a major impediment to this technology penetrating other markets.

but they are also much less costly. It may well prove cheaper to use more of these less expensive solar cells to produce a given amount of electricity than fewer expensive but highly efficient ones. Work is also underway on extending this thin-film concept to less expensive materials such as cadmium, cuprous sulphate, and indium and tin oxide. Other research is being directed at developing more expensive solar cells (such as gallium

Figure 6-31: SOLAR-THERMAL POWER SYSTEM CONFIGURATIONS



Source: After United States, Department of Energy, 1978, p. 5.

The expense evolves from the need to use extremely pure and perfectly formed silicon crystals. The conventional way to make photovoltaic cells is to pull a single, pure crystal of silicon from a melt, slice it into thin wafers with a diamond saw and "dope" it with impurities in a high-temperature furnace. This process is very energy intensive and expensive; thus much research is concentrating on reducing the cost of photovoltaic cells.

Canada is investigating the use of thin films of inexpensive grades of silicon (such as amorphous silicon) formed at low temperatures. These cells are only about one-half as efficient as pure silicon crystal cells arsenide) which have the ability to operate at very high temperatures. Such a cell could be placed at the focal point of a group of concentrating mirrors, like that atop a solar power tower (silicon cells would fuse in this high-temperature environment).

Photovoltaic cells still remain too expensive to compete with conventionally-generated electricity in areas with an electrical grid. In places far from central generating facilities, however, photovoltaic systems can compete with other energy sources. Important areas for early application of photovoltaic systems include marine