edge of the atmosphere ultimately reaches the surface of the Earth, either as direct or diffused radiation. In the Earth's temperate regions, mid-day solar radiation, on a clear day perpendicular to the sun's rays, typically reaches 260 Btu/foot^2/hour (823 watts/metre^2/second). By comparison, a barrel of crude oil contains approximately six million Btu, or the equivalent of 23,000 hours of sunshine on that one square foot.

Expressed in this way, available solar energy does not appear very impressive, yet the total amount of energy involved is immense. To illustrate this point, the amount of sunlight received in one year by 4,300 square miles of land, which is only 0.15% of the surface area of the contiguous United States, is roughly equal to that country's entire 1970 energy consumption.

Solar radiation is diffuse and intermittent both seasonally and diurnally. Substantial areas of collectors are therefore needed to make large-scale use of this resource and costly backup systems and/or storage facilities are required for some applications. Yet in spite of these disadvantages, solar energy has numerous characteristics which make it attractive as a future energy source. As already noted, the total amount of energy available is immense. Solar energy is also inexhaustible, ubiquitous, free and relatively non-polluting in its end use.

A wide variety of technologies have been and are being developed as man attempts to exploit the solar resource to meet his energy needs. For ease of discussion these applications can be divided into three categories: space and water heating, solar-thermal power generation, and direct conversion to electricity (photovoltaics).

2. SOLAR SPACE AND WATER HEATING SYSTEMS

A. PASSIVE SYSTEMS

The benefits of passive solar design are only now being appreciated in this country, but such design offers a great potential for reducing conventional energy consumption in Canadian homes and buildings.

A passive solar space heating system is one in which the structural and architectural elements (walls, floors, windows) of a building are used to collect, store and distribute part of the thermal energy needed to meet the structure's heating requirements. In a purely passive system there are no fans, pumps or other mechanical devices needed to distribute the thermal energy as it moves by natural means (conduction, convection and radiation). Passive solar heating systems can be divided into three main types: direct gain, indirect gain and isolated gain (Figure 6-28).

In addition to the passive solar design features aimed at maximizing solar collection (increased south-facing windows) and storage (additions of thermal mass) noted in Figure 6-28, there is a third integral part to passive solar design which involves energy conservation or the reduction of heat loss. To maximize the contribution of passive solar gain to a building's heat requirements the building must be energy-efficient. Passive solar and energy-efficient design are thus inseparable. A detailed account of potentials and problems associated with these two concepts is presented in the section on Conservation as an Energy Source.

Information and education are essential elements in bringing about increased demand for passive solar and energy-conserving houses and buildings. Many people are not aware that passive solar and energy-conserving designs are already cost-effective in some applications at today's energy prices. The economics of this combined approach to energy saving can only improve as the price of oil continues to rise. The program of public information on energy conservation which the Department of Energy, Mines and Resources has in place has been highly successful and has served as a model for similar programs in other countries. This effort should be expanded making sure that new publications keep up-to-date with developments in the field.

CONCLUSION

Passive solar space heating coupled with energy-efficient design and construction has a great deal of potential to reduce energy demand for space heating in Canada. Information on passive solar design is a natural companion to the conservation message which the Government has been carrying to the public.

RECOMMENDATION

The Federal Government should extend its public education program on conservation to include information on passive solar energy and energy-efficient building practices.

B. ACTIVE SYSTEMS

Active solar systems differ from passive systems in that heat is transferred through the system in a regulated way by pumps or fans. In addition, a heat storage device other than the building mass is used. An active solar heating system is therefore composed of the following components: a solar collector whose function is to gather the sun's energy; a circulating loop with pumps and pipes to carry the heat from the collector to the house; a heat storage reservoir of some kind to assure that the heat can be distributed evenly during the day; and a thermostatic control system to distribute the heat when and where required. Depending on the