Moreover, hygroscopic materials can be used indefinitely without deterioration. When solar radiation is inadequate to meet heating requirements, thermal energy can be released from the chemical storage system. When sunlight is freely available, the chemical storage system can be dehydrated or "recharged".

Systems using hygroscopic compounds for heat storage are under development in Sweden and Canada, and a Swedish experimental system has been in operation since November 1979 meeting all the heating needs of a five-room house with no backup systems whatsoever. The hygroscopic salt used is sodium sulphide (NaS_2). Eight separate storage tanks of the material are situated in the basement and solar heat is derived from 40 square metres of solar panels on the roof. The sodium salt has a very high energy density compared with conventional heat storage media such as water or rocks. Eight tons of the dry salt can store and deliver 8,000 kWh of heat — enough to meet the space and water heating needs of a small, well-insulated house even allowing for the storage of up to half the year's collected energy for winter use. An attractive and novel feature of the Swedish "Tepidus" system is its combination with a ground-source heat pump to minimize the requirement for conventional energy in domestic heating.

Canadian research in chemical storage has centred on the hygroscopic mineral zeolite, a naturally occurring mineral available as a mined product. Artificial zeolites are also on the market and are presently used as gas adsorbents, drying agents and water softeners. Researchers have suggested that a typical solar house would need only 1 to 4.6 cubic metres of zeolite to meet all of its heat storage requirements and that airtight, moisture-proof bins of this material might cost as little as $0.37 per kilogram by 1982. Unlike the Swedish system which uses flat-plate collectors, a zeolite storage system requires a higher operating temperature and must be coupled with evacuated-tube or concentrating solar collectors. Zeolite storage systems were investigated at Carleton University and researchers there envisage both industrial and domestic applications for the system. They see the greater potential in domestic settings, however, by using heat pumps in combination with zeolite-based storage, or by charging the system with heat derived from off-peak electric power or from industrial sources.

CONCLUSION

The Committee believes that chemical and large-scale thermal heat storage systems should have a high priority in solar research and development in this country. Such systems seem to offer a means of overcoming one of the major impediments to the widespread application of active solar heating, namely the mismatch between the availability of and requirement for solar energy.

RECOMMENDATION

Research should be aimed at reducing the cost and establishing the reliability and durability of thermal storage components in active solar systems.

RECOMMENDATION

The funding level for RD&D in chemical and large-scale thermal heat storage must be increased substantially and steps must be taken to assist in the commercialization of the systems developed.

There is also considerable opportunity for exporting such technology once it is established. Canadian solar equipment manufacturers have noted that overseas customers regard the Canadian climate with its wide range of temperatures as a good test of the ruggedness of solar systems. Thus if our manufacturers can develop a system which is capable of meeting the space heating requirements of a Canadian home, they should be in a good position to develop export markets as well. Furthermore, these storage systems should not be limited to solar applications. Many other renewable energy sources are also intermittent in nature and effective storage of the energy which they do provide will increase their potential for contributing to our energy supply. If a zeolite storage system also permits economical storage of off-peak electricity and aids in waste heat recovery, then the payoffs from developing such a system will be great indeed.

Unlike space heating systems using chemical heat storage, solar domestic hot water systems utilize the hot water tank (or an auxiliary, pre-heat water tank) for storage. Domestic hot water heating is a solar technology (along with swimming pool heaters) which is already competitive in certain parts of Canada, particularly in the Maritime Provinces where electricity costs are the highest in the country. Figure 6-30 shows a solar domestic water heating system.

Economics represents a major barrier to the widespread use of active space-heating systems. The relatively low cost of conventional fuels and the high front-end costs of active solar systems are holding back the development of a solar market in Canada. Furthermore, the need for building standards to promote passive solar design is paralleled by the need for durability and relia-