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"Thermal Energy Programme in India"

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SOLAR THERMAL ENERGY PROGRAMME IN INDIA

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Solar Thermal Energy Programme is aimed at supplementing thermal energy requirement at various temperatures by harnessing perennial, non polluting and freely available Solar Energy by directly converting it into heat energy, using solar thermal devices and systems. Solar thermal systems are broadly categorised as :

a) Low temperature systems like solar water heaters, solar air heaters, solar dryers, solar timber seasoning kilns, solar desalination systems,solar greenhouses,solar passive buildings etc. having maximum operating temperature upto 100° C.

b) Medium temperature systems like solar cookers, solar refrigeration and airconditioning, solar pumping, industrial process heating etc. having temperature of operations between 100°C and 250°C.

c) High temperature systems suitable for solar thermal power generation where operating temperatures are well above 250°C. Solar thermal devices and systems including those which have been listed above are in various stages of development and commercialization. A strategy consisting of three level programme is being adapted to bring a device or system from product development to commercialization stage. The three levels are

i) Research and Development

ii) Demonstration

iii) Extension

Research And Development Programme

Grant in aid is provided to the universities, Indian Institutes of Technology, Engineering Colleges and other technical institutions for research and development for the following objectives :

(a) Development of New materials

(b) Development of New technologies

(c) Improvement in the existing technologies to suit the actual field conditions

(d) Increasing the efficiency of existing technologies

(e) Reducing the cost by inventing new cheaper materials.

Thrust Areas/Achievements

New Materials and Processes

New polym r materials, like PMMA, PVDR and EPDM suitable as glazing and sealants for solar thermal devices have been developed at IIT, Delhi and Shri Ram Institute for Industrial Research, Delhi. These materials are undergoing laboratory tests for ascertaining their suitability from the viewpoint of deterioration in optical and mechanical properties. A pilot plant facility for coating the receiver tubes of the parabolic trough collector with selective black cobalt using spray pyrolysis method, developed at IIT, Delhi is being installed at Solar Energy Centre, New Delhi. This facility would be the first of its kind in the country and would be useful for further application of coating the receiver tubes of parabolic troughs to be used for process heat and power generation applications. The coating can also be used in flat-plate collectors.

Solar Distillation

Conventional basin type solar stills being propagated through the extension programme, yield only about 3 litres of distilled water per square meter of distillation unit on a normal sunny day. Distilled water so obtained is used for meeting the requirement of batteries in automobiles and laboratory applications. Efforts are being made to increase the output of solar

distillation units by developing multi effect and high temperature distillation units at Sardar Patel Renewable Energy Research Institute (SPRERI), Vallabh Vidhyanagar and Solar Energy Centre in association with IIT, Delhi. Solar distillation units of larger capacity may prove to be quite useful for meeting drinking water requirements in remote islands.

Solar Refrigeration

This area is receiving considerable amount of attention, keeping in view, the necessity of preserving life saving drugs and vaccines and perishable items in remote and unelectrified areas. A number of combinations are being tried simultaneously with a view to develop a commercial product within reasonable cost in near future. SPRERI, Vallabh Vidhyanagar has already developed a solar refrigerator working on Zeolite-water adsorption cycle. This prototype is being vigorously tested in the laboratory and is being also uprated for a production capacity of 10 Kg of ice/day. IBP Ltd., Bombay is working on activated charcoal-methanol and calcium chloride ammonia freon based refrigeration system. A laboratory prototype is expected soon. IIT, Madras is developing pumpless refrigeration system with lithium bromide water as working pair.

Solar Pond

For meeting large amount of process heat/hot water requirements, salt gradient solar pond could emerge as cost effective technology provided salt as well as land are available cheaply. Keeping in view the problems encountered with the lining arrangement of the ponds at Bhuj and Masur, alternative lining arrangement is being tried at Bhuj pond, which would provide process heat to Bhuj dairy. A solar pond has been constructed in an Engineering college at Hubli to provide hot water to the students residing in the hostel. Central Salt and Marine chemicals Research Institute, Bhavnagar is studying the aspects of maintaining clarity in bittern based pond.

Solar Thermal Pump

In drought prone areas and places having low ground water table, providing dringking water is indeed a challenging task. Solar Thermal Pump could emerge as a viable technology, particularly for such areas for pumping water from a depth of 40- 60m. Under Indo-German cooperation programme, the technology for producing solar thermal pump having hydraulic capacity of 1 KW has been developed at BHEL, Rudrapur. The technology acquired from

Germany is being extensively field tested at SEC, Gwal Pahari and Rudrapur. The field proven technology may be adapted for meeting drinking water requirement in specific areas.

Energy Efficient Buildings

India is not only geographically a vast country, but climatically also; and it has been divided into six zones having different climates. For keeping living/working space comfortable, different architectural designs could be adapted with solar passive and/or active concepts. These concepts not only provide comfort conditions with lesser pollution problems but also help in conservation of commercial energy input. Even though some of the passive features were the hallmark of traditional architectural practices in the country's research in this area, it received fresh impetus with renewed interest in solar energy and related areas. A number of projects were sponsored at IIT, Delhi; Devi Ahilaya Vishwavidhyalaya, Indore and Tata Energy Research Institute, New Delhi in this area, which have resulted in developing designs of passive buildings for different climatic regions, development of thumb rules for designing passive buildings and trying new concepts in the related field. The concepts of daylighting has also been investigated. Through a survey sponsored at National Productivity Council, New Delhi, a study is being attempted to assess energy consumption pattern in domestic/industrial buildings to look into the feasibility of using renewable energy based devices for replacing/supplementing commercial energy based appliances. The designs/features developed under research projects sponsored at various institutes have resulted in adoption of the same in new buildings being constructed. A testimony of this is, 135 houses constructed by CPWD in Nehru Nagar, New Delhi. This process is being further strengthened by conducting workshops for creating awareness among the architects and users in various states and union territories.

Radiation Monitoring

Solar Radiation received at a place depend on the climatic conditions of the place besides latitude and altidue. Such a data is essential for designing solar energy based devices for a particular site in view of differences in solar radiation incident from place to place. Radiation data is presently available for a few of the selected areas which have been only recorded by IMD. This data base is required to be made broad to cover more areas. With this objective in mind, a programme has already been initiated. It is proposed to record sunshine houses,

intensity of solar radiation, cloud conditions, rainfall, ambient temperature and wind velocity/direction data at some suitable sites during VIII Plan period from the power generation view point.

Solar Thermal Power Generation

Harnessing solar energy for power generation through thermal route has been successfully demonstrated by setting up experimental projects of 20 KWe and 50 KWe capacity at Sollojipally near Hyderabad and Solar Energy Centre, Gwalpahari respectively. Point focussing dish collector based technology has been tried in case of former project and line focusing parabolic trough technology has been used for the latter. A proposal for setting up MW capacity plant near Jodhpur based on line focusing parabolic trough technology for experimental purposes is under the active consideration.

Demonstration Programme

It is done in two ways

(a) **Demonstration of Indigenous Technologies**

The technology developed under R&D programme of the Govt. is demonstrated to get the field data under actual field conditions. The data is used for further improvement in the technology.

(b) **Demonstration of Foreign Technology**

Sometimes a foreign technology is taken and installed in the field under actual conditions. After getting the data the technology is modified and improved to suit the field conditions in India.

Extension Programme

The technology proven under demonstration programme in actual field conditions is then taken under extension programme for its commercial use at large scale. Today Solar water heaters, solar cookers, solar distillation systems, solar air heaters, solar crop dryers and solar timber seasoning kilns are the devices which are being used commercially at large scale in the country.

Components of Solar Thermal Extension Programme

1. **State Nodal Agencies** The programme of the Central Govt. is implemented in the country through a nodal agency or nodal department in each State of the country. These nodal agencies are under the direct control of the respective state governments. These nodal agencies have their sub offices at district level.

2. **Incentives to the Users** The govern ment provides subsidy on the installation of these solar thermal devices to the users. Initially a subsidy of even 100 percent was provided to the users to create mass awareness regarding these technologies among the masses. After creating mass awareness, the subsidy was gradually reduced to 75%, 50%, 40%, 30% and 18%. It is a point of worth mentioning here that during the current financial year the cash subsidy has been withdrawn by the Govt, on the installation of solar water heaters, solar air heaters/crop dryers and solar timber seasoning kiln. Instead of providing cash subsidy, Govt. has decided to provide soft loan to the users at an interest rate of 10.5%. In addition to this a user of industrial solar thermal systems is also entitled to get the benefit of 100% depreciation in the very first year of the installation.

3. **Incentives to the Industry**

(a) **Technical** : Govt. provides technical help to the Industry free of cost.

(b) **Financial** : Govt. of India provides soft loan to the industry for purchasing machinery, land etc. through an agency called Indian Renewable Energy Development Agency (IREDA). The agency is under direct control of the Govt. of India. In order to reduce the cost of renewable energy based devices including solar thermal devices sales tax, excise duties and octroi etc have also been exempted by the Govt. on different components of these devices.

4. **Standardization of Specification** One of the main objects of the ministry is to laydown standard specifications of different renewable energy devices including solar thermal devices. The ministry has brought out Indian Standards for solar water heating systems, solar cookers and some other devices. Solar thermal systems under extension programme are being installed as per detailed standard specifications covering even subcomponents.

Regional technical back up units have been established in different regions of the country. These centres are responsible for testing the solar thermal devices manufactured by different manufacturers for IS certification and also to provide technical help to the manufacturers and the nodal agencies. These centres are also involved in training programmes being arranged by the Govt. to train the users, manufacturers and nodal agency personals and develop technical manpower in the country in the field of renewable energy including solar thermal energy.

Targets and Achievements

The Ministry based on past experience and technical manpower with a state nodal agency gives some targets to a state on yearly basis. The funds under subsidy programme are also provided to them on the basis of the targets. The targets and the achievements during different financial years made in the country are as follows :

TABLE 1. Yearly Achievements Under Solar Thermal Extension Programme

S.No.	Year	Targets (Collector area in m^2)	Achievements (Collector area in m^2)
1.	85-86	20,000	20,000
2.	86-87	20,000	22,431
3.	87-88	30,000	30,178
4.	88-89	25,000	25,743
5.	89-90	30,000	30,165
6.	90-91	30,000	33,210
7.	91-92	45,000	48,169
8.	92-93	30,000	24,595

An area of approximately 248 thousand square meter has been installed in the country under 18659 nos. of water heating systems with different capacity varying from 100 lpd to 240,000 lpd of individual system, and other solar thermal systems. This area is capable of saving/generating 167 Million Kilo Watt hours of thermal energy annually.

Solar Cooker Programme

A cost sharing scheme for the purchase of family size solar cooker was launched in the year 1982. Under this scheme central subsidy of Rs. 150/- per cooker is being provided to the user of a solar cooker. So far nearly 2.88 Lakhs of solar cookers have been sold in the country. A state wise list of these cookers is as follows :

TABLE 2. STATEWISE SALES OF SOLAR COOKER

S.No.	State Name	Cumulative Achievement as on 31.03.93
1.	Andhra Pradesh	3015
2.	Assam	80
3.	Bihar	730
4.	Gujarat	31053
5.	Haryana	12720
6.	Himachal Pradesh	13249
7.	Karnataka	-
8.	Madhya Pradesh	97782
9.	Maharashtra	37114
10.	Orrisa	769
11.	Punjab	8684
12.	Rajasthan	29483
13.	Tamil Nadu	1304
14.	Uttar Pradesh	22523
15.	Delhi	24172
16.	Jammu & Kashmir	-
17.	Kerala	171
18.	West Bangal	2271
19.	Chandigarh	918
20.	Arunachal Pradesh	-
21.	Goa	794
22.	Andman & Nicobar	38
23.	Lakshdweep	-
24.	Pondicherry	-
25.	Manipur	200
26.	Meghalaya	732
27.	Nagaland	-
28.	Dadar & N. Havali	81
29.	Mizoram	70
30.	Tripura	-
31.	Sikkim	20
	TOTAL	287983

OTHER RENEWABLE ENERGY DEVICES

Although the studies pertaining to the solar thermal energy programme in India have been described in the previous sections, it would be of considerable interest to know about the achievements that have taken place in India in the development of Renewable Energy Devices, which is depicted in Table 3.

TABLE 3

THE ACHIEVMENTS OF RENEWABLE ENERGY DEVICES IN INDIA (UPTO DEC 1992)

S.No.	Programme	Units	Cumulative Achievement Upto Dec.92
1.	Family Size Biogas Plants	Nos.	16,62,783
2.	Community/Institutional/Night Soil Biogas Plants	Nos.	865
3.	Improved Chulhas	Nos.	133,50,861
4.	Solar Thermal Systems	Area in m^2	2,29,731
5.	Solar Cookers	Nos.	2,38,906
6.	Photovoltaic Power Units	Kwp	331.02
7.	Photovoltaic Community Lights/ TV and Community Facilities	Nos.	719
8.	Photovoltaic Domestic Lighting Systems/Lanterns	Nos.	11,600
9.	Photovoltaic Street Lights	Nos.	29,289
10.	Wind Pumps	Nos.	2,983
11.	Wind Battery Chargers	Nos.	107
12.	Wind Energy Farms	M.W.	43.025
13.	Mini-Micro Hydro	M.W.	87.665
14.	Urjagram Projects	Nos.	170
15.	Biomass Based Cogeneration of Power	MW	3.0
16.	Biomass Gasifiers/Stirling Engines	MW	7.9
17.	Battery Operated Vehicles	Nos.	154
18.	Alcohol Operated Vehicles	Nos.	25

Some Experiences

1. **Functionality** : According to a survey, 74% utilisation of Solar Water Heaters (SWH) systems was found. The reasons for less utilisation of the capacity were found to be as follows:

a. No proper attention for operation & maintenance by the users

b. No adequate attention was paid towards matching the capacity of SWH systems with the users requirement

c. Lack of spare parts in market being used in SWH system

d. User nodal agency manufacturer's interaction

e. Users need training for operation & maintenance.

2. **Factors Affecting the Progress of the Programme**

The following are the factors which affect the implementation and the achievements of the programme.

(a) **Mass-Awareness**

Mass awareness is the main factor which affects the progress of the programme. In spite of several other constraints the programme has picked up nicely in the regions where the mass awareness has been created by the concerned state governments through publicity through media and demonstration.

(b) **Nodal Agency Infrastructure**

Infrastructure of the state nodal/implementing agency responsible for the implementation of the programme in the concerned state and the technical man power with the nodal/implementing agency plays an important role in the better implementation of the programme. It has been seen that a state performs better results if its nodal agecny has technically source permanent staff than a state with transferable staff and also not trained in the area of renewable energy devices.

(c) **Incentives to the Users**

In addition to the Central Govt. some state govts. also provide some additional incentives to the users/manufacturers of renewable energy devices from their own budget. It has been observed that the achievements are better in the states where additional incentives are also provided.

(d) **Solar Industry**

Solar industry in the country is concentrated in some particular regions of the country. In some of the regions no solar manufacturers is there. Such regions face lot of problems in implementing these programme due to nonavailability of devices in time and also the very-very high cost as compared to the other regions where there are so many solar energy manufacturers.

(e) **Policies of Different State Govts.**

The policies of State Govts. regarding renewable energy devices is also a factor affecting the progress of solar thermal energy programme. The states where the consumption of conventional energy is not favoured or economically viable, the installation of solar hot water systems is a normal practice in industries. For example, in the State of Karnataka the rates of electricity in industrial sector are fixed in such a way that the consumption of electricity beyond a limit fixed by State Govt. is very expensive and installation of SWH systems becomes economically viable. This is the reason the industry goes for the installation of SWH systems for fulfilling its requirement of hot water at even the lowest incentives provided.

3. **Maintenance**

It was noticed that the system which were installed in Govt. buildings under high percentage of cost sharing are not maintained properly. Contrary to this the systems which have been installed in private sector with less percentage of subsidy are maintained quite well.

4. **User-Contractor Relationship-Open Marketting Approach**

As per the practice followed in the initial years of the programme, nodal agency used to finalise every thing regarding the installation of a system. The reason was that the user was not well aequainted with these renewable energy devices. The inspection, release of funds to the contractor, and award of the work to the contractor was done by the nodal agency. In such a process the contractor was not answerable to the users and generally the user faced so many problems. Now the policy has been changed and user decides every thing regarding the purchase of a device. This practice will definitely improve the working, quality and other factors of the process.