FIFTH REPORT

STANDING COMMITTEE ON ENERGY (1994-95)

(TENTH LOK SABHA)

NON-CONVENTIONAL ENERGY SOURCES SCHEMES, THEIR ASSESSMENT AND IMPLEMENTATION

(Ministry of Non-Conventional Energy Sources)

Presented to Lok Sabha on 19th April, 1994
Laid in Rajya Sabha on 19th April, 1994

LOK SABHA SECRETARIAT
NEW DELHI

April, 1994 / Chaitra, 1916 (Saka)

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1. Shri G.L. Batra	—	*Additional Secretary*
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INTRODUCTION

I, the Chairman, Standing Committee on Energy having been authorised by the Committee 1994-95 to present the Report on their behalf present this Fifth Report on the subject "Non-Conventional Energy Sources Schemes, their Assessment and Implementation." The task of examining the subject "Non-Conventional Energy Sources Schemes, their Assessment and Implementation" and preparing a report on it was entrusted to a Sub-Committee of Standing Committee on Energy (1993-94).

2. The Sub-Committee held 14 sittings in all of which 11 sittings were devoted to recording of evidence of expert and official witnesses and 3 sittings for in house deliberations.

3. The Sub-Committee also undertook on the spot study visits to Madras, Madurai, Kanyakumari and Trivandrum from 10th to 12th February, 1994 to acquaint itself with the working of various non-conventional energy devices/systems.

4. The Committee wish to express their thanks to the Ministry of Non-Conventional Energy Sources, Water and Power Consultancy Services (India) Ltd., Bharat Heavy Electricals Ltd., Central Electronics Ltd. and Rajasthan Electronics and Instruments Ltd. Dr. Pachauri, Tata Energy Research Institute, Dr. S.K. Tiwari, National Aerospace Laboratories and Dr. C.S. Rao, Sardar Patel Renewable Energy Research Institute for placing before them the requisite material/Memorandum in connection with examination of the subject. The Committee also wish to thank, in particular, the representatives of the MNES, WAPCOS, BHEL, CEL and REIL, Dr. Pachauri and other representatives of TERI, Dr. C.S. Rao and Dr. S.K. Tiwari who appeared before the Sub-Committee for oral evidence and placed their considered views before them.

5. The report was considered and approved by the Sub-Committee at their sitting held on March 18, 1994 and adopted by the full Committee (1993-94) on 29th March, 1994.

6. The Committee (1994-95) at their first sitting held on 18th April authorised the Chairman to finalise the reports adopted by the previous Committee and present them to Parliament.

7. The Committee place on record their appreciation for the work done by the Sub-Committee (1993-94). The composition of the Committee (1993-94) as well as it's Sub-committee on Non-conventional Energy Sources is given in Appendices.

NEW DELHI;
18 April, 1994
28 Chaitra, 1916 (Saka)

JASWANT SINGH
Chairman,
Standing Committee on Energy.

PART A

Background Analysis

I. RENEWABLE ENERGY POTENTIAL AND ACHIEVEMENT

1.1. The development and utilisation of new and renewable sources of energy (NRSE) alongwith conventional energy sources is necessary to meet the growing demand for energy. Renewable energy sources are perennial, dependable and abundantly available. These sources besides being renewable are also non-polluting and environment friendly. The details of funds allocation for Energy Sector and Non-Conventional Energy during Seventh Plan, Annual Plan 1990-91 & 1991-92 and Eighth Plan (1992-97) are given in the statement below:

(Rupees in Crores)

Sl. No.	Sector	Outlay for Seventh Plan (1985-90)	Outlay for Annual Plan (1990-91)	Outlay for Annual Plan (1991-92)	Outlay for Eighth Plan (1992-93)
1.	Petroleum	12,627.67	3,145.20	3,589.35	24,000
2.	Coal	7,400.58	2,446.55	2,520	10,507
3.	Power	34,273.46	12,479.64	13,678.31	79,589.32
4.	Non-Conventional Energy				
a.	Central Sector	412.35	125.38	133.91	857*
b.	State Sector	107.20	N.A.	N.A.	276.52
5.	Energy Conservation	20	10	10	1,000
	Total	54,841.26	18206.77	19931.57	1,16,229.84
%	Share of Non-Conventional Energy Sector	0.95	0.69	0.67	0.98

* Excludes IREP

1.2 It may be observed from the above table that the approximate share of the Sector of non-conventional energy sources in the fund allocation for energy sector was as little as 0.95% for the 7th Plan and 0.98% for the 8th Plan. It was 0.69% for 1990-91 and 0.67% for 1991-92. In absolute term the outlay for the Eighth Five Year Plan is Rs. 857 crores in the Central Sector and Rs. 277 crores in the State Sector.

1.3 The NRSE sector includes a wide spectrum of programmes ranging from biogas and improved chulhas and solar thermal programmes, to the more sophisticated programmes for micro hydels, wind turbines, solar photovoltaics & ocean for electricity generation and hydrogen energy.

1.4 Potential of various types of New and Renewable Sources of Energy (NRSE) and technologies in India as assessed on the basis of data available are given below:—

Source/Technology	Approx. Potential Availability
Biogas Plants	12Million Nos.*
Biomass/Bioenergy	17,000MW
Improved Chulha	120Million Nos.*
Mini-Micro Hydel Power	10,000MW
Wind Power	20,000MW
Ocean Thermal Power	50,000MW
Tidal Power	9,000MW
Sea Wave Power	20,000MW
Total Solar Insolation over land area of India	5×10^{15} KWhr/year (Equivalent)

* The figures indicate the programme achievable on the basis of data available so far.

1.5 The cumulative physical achievements as on 31.12.93 in respect of various programmes of NRSE are given below:

Sl. No.	Programme	Units	Achievement upto 31.12.93*
1.	Family size Biogas Plants	Nos.	18,47,472
2.	Community/Institutional/Night Soil Biogas Plants	Nos.	1,059
3.	Improved Chulhas	Nos.	152,95,827
4.	Solar Thermal Systems	Area in m^2	2,64,380
5.	Solar Cookers	Nos.	3,10,671
6.	Solar Photovoltaics	MW	3.424
	a. Photovoltaic Power Units	KWp	477.86
	b. Photovoltaic Community lights/ TV and Community facilities.	Nos.	810
	c. Photovoltaic Domestic	Nos.	16,034
	d. Photovoltaic Street Lights	Nos.	29,313
	e. Photovoltaic Pumps	Nos.	756
	f. PV Pumps for Agriculture & Related uses	Nos.	54
7.	Wind Pumps	Nos.	3,017
8.	Wind Battery Charges	Nos.	108
9.	Wind Farms	MW	71**
10.	Mini-Micro Hydro	MW	105
11.	Urjagram Energy Surveys	Nos.	1,746
12.	Urjagram Projects	Nos.	203
13.	Biomass Based Cogeneration of Power	MW	6.0
14.	Biomass Gasifiers	MW	9.5
15.	Battery operated vehicles	Nos.	250
16.	Alcohol operated vehicles	Nos.	52

* Figures are being firmed up.

** During on the spot study of the Sub-Committee in Feb., 1994, a private manufacturer viz. NEPC-MICON informed that the supply of Wind Electric Generators by that company alone exceeded 100 MW and that the company is rolling out one WEG of 250 MW capacity every day.

Perspective Plan

1.6 In February, 1987, the then Department of Non-Conventional Energy Sources had reportedly prepared a paper titled: "Energy—2001—Perspective Plan—Non-Conventional Energy Sources" which envisaged accelerated development of Non-Conventional Energy Sources over a 15 year period for achieving a significant contribution from them to the total energy.

1.7 The MNES have stated that the Perspective Plan could not materialise on the scale envisaged because resources allocated during the 7th and 8th Plan period were too meagre compared to what was requird for achieving the targets indicated in the paper.

1.8 According to MNES the projections made in the Energy—2001 perspective plan—non-conventional energy sources were never formally adopted as targets to be achieved in a specific period. As against the projected requirement of funds, with and estimated Government share of Rs. 1424.53 crores for the 7th Five Year Plan period against the indicated physical targets, only Rs. 578.79 crores could be provided. Similarly, for the 8th Five Year Plan against the projected requirement of Government share of Rs. 4035.40 crores, only Rs. 857.00 crores have been allocated for the MNES in the Central Sector by the Planning Commission.

1.9 On the question of preparing a long term perspective plan, the Secretary MNES informed the Committee during evidence:

> "The Ministry has appointed two standing committees consisting mostly of the technical people, experts, industrialists, manufacturers, NGOs and others. We have requested this committee to interact with other R&D organisations and then advise us as to how to go about preparing a perspective plan for the Ministry as a whole and what goals should the Ministry have over next 20—25 years, including the R&D strategy."

1.10 New Strategy & Action Plan: The MNES has taken a major initiative for the development and utilisation of Non-Conventional Energy Sources during the year 1993-94 and has prepared in June 1993 a new "Strategy & Action Plan". The new plan aims at generation of nearly 2000 MW of power through Wind, Small Hydro and Bio-Energy Sources as against 600 MW envisaged earlier in VIII Plan. It also envisages programmes for village electrification in unelectrified or remote rural areas through

application of solar photovoltaic technology, with nearly one lakh number solar lanterns to the propogated during a year, and launching of a new programme for 50000 deep well Solar Pumps for irrigation, 1000 pumps are to be installed during 1993-94. Also on the cards is wider application of solar thermal energy; launching of several national programmes for bio-energy utilisation with participation of industry and municipal bodies in the field of cogeneration of power, recycling of industrial wastes, utilization of urban and municipal wastes. Universalisation of rural cooking energy programmes of biogas and improved chulhas with the installation of 10 lakh Nos. of biogas plants and 180 lakh Nos. of improved chulhas. The enhanced targets includes installation of 11 lakh square meter Solar Thermal collector area and 7 lakh Nos. of Solar Cookers in the eighth Plan. Setting up of projects in the new and emerging areas of technologies, such as, tidal power, geothermal and ocean thermal energy conversion etc., are the other highlights of the new strategy. The physical targets at a glance for different non-conventional energy projects/programmes envisaged in the new 'Strategy & Action Plan' are given below:

Strategy and Action Plan at a Glance

Sl. No.	Programme	Physical Targets/Goals for the 8th Plan	
		As originally envisaged 8th Plan	Revised Goals*
1	2	3	4
A. Power Generation			
1.	Wind Power	100 MW @	500 MW
2.	Small Hydro Power	200 MW @	600 MW
3.	Solar Photovoltaic	3 MW	25 MW
	(a) Solar Lanterns	4 lakh Nos.	
	(b) Solar Photovoltaic Power Packs	400 Nos.	
4.	Solar Thermal Power	—	30 MW
5.	Biomass/Bio-Energy	300 MW @	500 MW
	(a) Biomass Gasification		50 MW
	(b) Combustion & Cogeneration		150—300 MW
	(c) Urban and Municipal Wastes		100 MW
	(d) Recycling of Industrial Wastes		150—300 MW

1	2	3	4
	(e) Biomass Densification (Briquitting)		50 MW
		603 MW	1655 MW
B.	*Process Heat and Cooking Energy*		*(Total Power)*
6.	Solar Thermal Systems	2.75 lakh sq. m.	11.00 lakh sq. m.
7.	Biogas	7.50 lakh nos.	10, lakh nos.$
8.	Improved Chulha	100 lakh nos.	180 lakh nos.$
9.	Solar Cookers	3.0 lakh nos.	7.0 lakh nos.

@Includes private sector.
*Subject to the mobilization of additional financial resources.
$Coverage of all potential beneficiaries in foreseable future.

1.11 Estimated cost of power generation for various non-conventional energy systems *vis-a-vis* conventional methods of power generation is stated to be as given below:

Sl. No.	Source/Technology	Cost of installation (Rs. in crores/ MW)	Cost of generation [Rs/KWHr (unit)]
I.	NON-CONVENTIONAL POWER		
(i)	Wind Power	3.50	2.25—2.75
(ii)	Small Hydro Power	3.00—4.50	1.50—3.50
(iii)	Solar Photovoltaic Power (Grid connected)	30.00	10—12
(iv)	Biomass Co-Generation	1.20—1.50	1.20—1.30
(v)	Biomass Gasifiers	1.00—1.50	1.50—2.15
II.	CONVENTIONAL POWER		
(vi)	Thermal Power	2.75—2.90	1.21—1.35 1.47—1.62
(vii)	Medium/Large Hydro Power	2.50—3.50	0.75—1.50

1.12 Enquired how it is proposed to mobilize the resources required for achieving the targets in the New Strategy & Action Plan, the Ministry stated in a post-evidence reply:

> "For achieving the targets envisaged in the Strategy and Action Plan, bulk of the additional requirement of funds is expected to be mobilized through non-budgetary sources, including the participation

of financial institutions to a large extent and involvement of the private sector. The budgetary resources will be utilized, basically to provide incentives/subsidies and for purposes of demonstration projects."

1.13 The Ministry has stated that the mobilization of resources is expected to be as follows:

	(Rs. in crores)
(i) Budget	1200—1500
(ii) IREDA and other financial institutions	750
(iii) Private Sector investments	3000
	5000

1.14 The Committee observed that there were discrepancies in the figures of utilisation of funds by the Ministry during the 7th plan. This was pointed out to the officials of the Ministry during their oral evidence.

In a post evidence reply the Ministry furnished the following figures regarding the 8th Plan targets and requirements of funds.

Eighth Plan Targets and Requirements of Funds

(Rs. in crores)

Sl. No.	Item	Small Hydro	Wind Power	Co-Generation	Solar Thermal	Total
1.	(i) 8th Plan Target (MW)	600	500	300	30	*1430
	(ii) Subsidy/Domo Scheme (MW)	200	100	100	30	430
	(iii) IREDA (MW)	200	200	200	—	600
	Private investments (MW)	200	200		—	400
2.	Total funds required	2700	1750	600	350	5400
3.	Budgetary support	450	200	115	100	865
4.	B.P. for 8th Plan	100	90	—	2	192
5.	Addl. requirement for budgetary support	350	110	115	98	673
6.	Requirement under State Plan	600	150	—	35	785
7.	IREDA/Pvt. Sector/External financing	1650	1400	485	215	3750

It may be observed from the above table that the figures regarding total funds required Sl. 2 do not tally with the break-up of figures given at Sl. Nos. 3 to 7*

1.15 For catalysing the market development and for preparing the ground for attracting investment by private sector and also that the non-conventional energy sources play their due role in generation of power/energy, there is a need to accelerate the on-going programmes and launch new programmes of demonstration and utilisation of renewable energy technologies in different energy potential regions. The Ministry have stated that the 'Strategy & Action Plan' prepared by the Ministry can not be made fully operational from the year 1994-95 due to non-availability of required funds.

*At the time of factual verification of the draft report the Ministry clarified that the fund requirements shown at Sl. No. 2 of the table is the sum of serial No. 4 to 7 and that the serial No. 3 is summation of serial No. 4 and 5.

II. POWER GENERATION

(i) *Small Hydro Power*

2.1.1 Small Hydro Projects are being visualised for construction to take advantage of short gestation period and to provide electricity to remote areas where extension of transmission/distribution lines are considered uneconomical/not feasible. The projects are ideally suited on socio-economic considerations. There is also reliability of power availability to these small areas fed by such source of Power generation.

2.1.2 The Small Hydro Programme aims at speedy development of micro, mini and small hydro schemes upto 3 MW capacity for power generation from the other-wise dissipating energy in flowing waters at canal falls/irrigation dams, run-of-river and natural falls in the hilly areas having significant potential. In order to achieve better results by focussing undivided attention to this sector, the subject was transferred in Feb., 1989 from Ministry of Power to MNES.

2.1.3 Regarding potential for small hydel, the MNES stated in a note as under:

> "According to broad estimates, an overall potential of about 10,000 MW (upto 15MW) has been assessed in the country. This is being continuously revised and updated. A data base on 1400 potential sites which have been identified in various states, has been prepared, of total aggregate capacity of 1300 MW."

2.1.4 The Ministry's Annual Report (1992-93) had indicated the Small Hydro potential as 5000 MW. Enquired about the actual potential, the Secretary, MNES stated during evidence:

> "Our business rules say that we deal only with three MWs and below. This is something that we are taking up. We want this to be relaxed. We are in touch with them and we want to take it upto 15MW. IREDA is funding this 15 MW project. Our own response is for 3 MW. We feel that the potential could be more than 5,000 MW."

2.1.5 According to MNES, power generation through SHP was earlier not economically viable as the installation cost of the projects was very high. However, now through the standardisation adoption of canal or cluster approach, careful planning to achieve shorter gestation period and bulk purchases on competitive basis, SHP installations are becoming competitive with thermal, diesel or gas based power generation projects.

2.1.6 Ministry sources put the cost of installation of SHP is in the range of Rs. 3.00 to 4.50 crores per MW and the cost of generation is about Rs. 1.50 to 3.50 per KWhr.

2.1.7 Regarding the cost of installation a representative of the Ministry stated during evidence:

"It varies as per the nature of the project. For canal-based projects, it is Rs. 2.5 to Rs. 4-4.5 crores per megawatt and for the hilly area projects, it is slightly higher. It varies from Rs. 4.5-6 crores."

2.1.8 Pointing out the reasons for high cost of SHP the witness stated:

"It is mainly civil works difficulty of approach roads and transmission lines in view of inaccessibility of the region."

2.1.9 Apprising the steps taken for cost reduction, the witness stated:

"We are taking steps to encourage manufacturers for reducing the complexity, the size and the weight of these turbines and it will lead to better efficiency. The second step is standardisation. Under the World Bank project, Standardisation has been done for canal-based projects which also results indirectly in cost reduction and easy availability of spares and repair of units. We are attempting to standardise and bring about various designs in hilly hydro. We are going in for certification through testing units. We are planning to speak with the authorities in Pune as to whether they can take it up as we are planning for the wind turbines in Tamil Nadu. In addition, we are also discussing with the Ministry of Finance so that the depreciation benefit will also brings down the cost, as ultimately it is equivalent to providing a capital subsidy of 50 per cent. With these steps we are hoping that in the near future we will be able to bring down the cost of hilly hydro projects also."

2.1.10 Regarding steps required for development of small hydels an expert who appeared before the Committee stated:

"My submission is that this is an area where we should more or less go on a competitive basis and get bids. you can say that here is a site and anybody who wants to bid for developing this site is welcome. Let there be a selection of the best person."

2.1.11 On a suggestion that the possible sites should be found out quickly the expert stated that:

"If the Ministry can provide some money for investigation of sites and give all details of these sites that would be all right. This can be done in a few months time. This subject falls within the Ministry of NCES and only small flow data is required."

2.1.12 On the question of data base, a representative of MNES stated during evidence:

"In the Ministry itself we are developing a data base up to 3 MW projects and according to the information that we have received from various States about this, we have already identified 1344 sites which aggregate to about 1271 MW of 3MW projects. Almost about 40% of the sites are on canal system in Haryana, Punjab, Rajasthan, Tamil Nadu, Orissa Madhya Pradesh & Andhra Pradesh."

2.1.13 Regarding achievements in this sector the Secretary, MNES stated:

> "142 projects aggregating to 105 MW have been installed and 155 projects aggregating to 196 MW are under construction as on Ist January, 1994."

2.1.14 The target of 600 MW fixed for the 8th Plan period will have the following objectives:

(1) 200 MW capacity under MNES subsidy scheme upto 3 MW for State Govt. projects, and such private/public sector projects not eligible for IREDA/WB loan.

(2) 200 MW capacity under IREDA/WB soft loan scheme upto 15 MW for canal drop/irrigation dam toe projects in private or public sector.

(3) 200 MW capacity entirely through projects taken by with States/ private sector's own funds, utilising the promotional incentives available.

2.1.15 The problems and constraints in implementing this programme are stated to be basically institutional or operational in nature. These are given below:

(i) Problems in carrying out of detailed survey and ivestigations and preparation of DPR.

(ii) Problems of land acquisition and allotment/handing over of sites to developers.

(iii) Delay in statutory State Government clearances.

(iv) Diversion of funds by State agencies.

(v) Lack of coordination between various agencies in States such as State Nodal Agency, SEB, Irrigation Department, Power Department, Environment and Forestry Department, etc.

(vi) Lack of clear policy for private sector participation.

(vii) Low priority to SHP projects by SEBs.

(viii) Many manufacturers of small hydro equipment are on verge of closure becasue of absence of sufficient orders.

(ix) The infrastructural facilities and accessibility and approach for North-Eastern and hilly regions are poor.

(x) Time over-runs often lead to cost over-runs, compounding the shortage of funds.

(xi) Single windows for project clearance, wherever established, have not been founds to be effective.

2.1.16 When the Committee suggested implementation of single window clearance to speed up clearances, the Secretary, MNES stated:

> "We have been insisting on some sort of a Steering Committee. This has been accepted by some State Govts. and it is working very well in those states."

2.1.17 The Ministry stated in a post evidence reply in this connection as under:

> "The Ministry has suggested to various State Govts. to create a separate cell for SHP development as also to provide a "single windo" facility for all State Government clearances. In the State of Assam, Andhra Pradesh and Karnataka certain institutional arrangements have been created, the other States are yet to set up such mechanisms."

2.1.18 Pointing out that there has been a bit of neglect over the years for one reason or the other, the Secretary, MNES stated during evidence:

> "One of the reasons is that the State Governments have devoted much of their attention and their resources through their large organisations in Electricity Boards and Power Departments to large projects. When we talk about small projects, the amount of work that is to go on file is almost the same as it is for big projects."

2.1.19 Enquired whether State Govts. have announced a clear promotional policy to attract private developers and entrepreneurs, the MNES stated in a post evidence reply that the States of Tamil Nadu, Andhra Pradesh, Karnataka, Kerala and Orissa have announced certain incentives to promote private sector projects. However, to bring about a uniformity and to introduce comprehensive and more attractive packages, the MNES has prepared and circulated to all the States a set of guidelines which include the following main recommendations:

(i) Wheeling at a charge of 2%;
(ii) Banking for a period of 12 months;
(iii) Third party sale at remunerative prices to be mutually settled between the developer and the purchaser; and
(iv) A minimum buy back rate of Rs. 2.25 per kwh.

2.1.20 As regards delay in environmental and forestry clearance the MNES has suggested that non-conventional energy power projects should be exempted from the mandatory clearances. Projects below certain size, say 5MW, could be totally exempted from environment and forestry clearance while for others say upto 25 MW simpler and quicker procedures should be evolved.

2.1.21 Certain items of non-conventional energy plant and machinery are eligible for 100% depreciation under the Income-tax rules. MNES has stated that since mini/micro hydel projects upto 3 MW capacity were

originally under the Ministry of Power and were transferred to MNES only in 1989, this concession was not available to SHP equipment. The matter has been taken up with the Ministry of Finance. This incentive would significantly encourage private sector participation in small hydro projects.

2.1.22 Detailing the efforts made by the Ministry to promote SHP programme, the Secretary, MNES stated:

> "As a part of the World Bank project, we have negotiated something for the hydel projects. Some progress has been made. The response has been there. We are talking to the Rural Electrification Corporation. We have been sitting with them for the last few months. They feel that a large number of villages that are not well connected will not be connected in the near future. We are going to have a joint programme with the REC. They are going to finance partly. We are going to finance partly. The State Governments are also involved deeply in this. Unless we get the full cooperation of the State Electricity Boards, it will not be possible. I have visited the North-East. The Defence Ministry people have themselves approached us in a number of areas where they have large establishments. There are hydel sources. They have to take diesel hundreds of kms into the hills. With some kind of machinery constraints and some kind of other problems they are facing, they are also looking forward and we are trying to have a joint programme."

2.1.23 On the question of private sector participation, a representative of MNES stated:

> "As regards the new concept of joint sector private companies, in order to remove the bottlenecks, the private sector company in cooperation with the State Government, the SEB and the IREDA will set up a company and its Board will have Members representing all these organisations and also the MNES. This Board will become the single window for techno-economic clearance, funds, etc. so that all the bottlenecks are removed."

(ii) Wind Power Programme

2.2.1 The Wind Power Programme is aimed at catalysing commercialisation of wind power generation on a large scale in the country. The broad-based programme involves research and development; survey and assessment of wind resources; implementation of demonstration and private sector projects; development of capability and capacity for manufacture, installation, operation and maintenance; promotional policies; and, institutional and infrastructural development. It has been stated that as a result of the multidimensional and systematic approach, wind power has emerged as a viable and cost-effective option for grid-connected power generation, which does not endanger the environment. A conservative estimate places India's wind power potential at about 20,000 MW.

2.2.2. It is observed from the information furnished by MNES that a comprehensive wind resources assessment programme involving of wind survey and wind monitoring has been undertaken to establish the resource base and aid the wind energy utilization. The wind survey projects covering wind mapping, wind monitoring and complex terrain projects are under implementation in 22 States/Union Territories. 334 wind mapping and 94 wind monitoring stations are operational in the country. 53 sites in Tamilnadu, 25 in Andhra Pradesh, 11 in Gujarat, 7 in Karnataka and 4 in Kerala with wind potential suitable for power generation have already been identified.

2.2.3 In a Memorandum furnished to the Committee, an expert held the view that bulk of the much mentioned potential of 20,000 MW is from sites averaging well under 20 km/hr where the cost of electricity may be estimated well above Rs. 4.00/KWh.

2.2.4 According to the expert the scope to harness a decentralised source of energy presently appears to be confined to the peninsular region. There is some possibility of getting 20 km/hr or about at 50m. level (and higher) in several parts of the country including western desert district and hilly areas of South Eastern Rajasthan.

2.2.5 The expert further held the view that there is restricted access to site specific measurements of wind speed data generated by state nodal agencies and there is also delay in publishing even a part of this data. As a result, it was difficult for experts and private parties to make scientific assessment and to look for patterns which might enhance their understanding of wind resources.

2.2.6 Commenting on this point, a representative of the MNES stated during evidence,

> "That is not entirely true. It is other way round. We have about 600 stations in 23 States which are more than the total number of IMD stations in the country. We are taking assistance of the States in organising projects but the handling of the data is only through the Bangalore unit."

2.2.7 Regarding wind assessment programme the Secretary, MNES stated during evidence:

> "We have done an extensive wind mapping and wind monitoring exercise in the country and have identified specific sites where the wind velocity is such that it is possible to generate wind power. As a result, the private sector people have started setting up the wind energy system like in Tamil nadu, Gujarat and coming up in Andhra Pradesh and Kerala."

2.2.8 A representative of MNES stated in this connection:

> "We have already discovered 58 sites which exceed a speed of 18 kmph. Of these about 30 sites, where the wind speed varies between 20 and 25 kmph are found attractive by the private companies."

2.2.9 The witness also indicated:

> "We are also hopeful of discovering suitable wind speeds in mountain regions of Himachal Pradesh, UP and North East. Now we are taking up wind surveys in these areas also."

2.2.10 Pointing out that sites with a wind speed of 18 kilometres per hour are generally suited for wind power, a representative of MNES stated during evidence:

> "Generally, sites with wind speed greater than 20 KM per hour can enable economic harnessing of wind power when one is able to get a capacity utilisation of above 20 per cent. We have attained utilisation capacity upto 30 per cent. Like the site of Mupandal in Tamilnadu which is the highest capacity. In California, they have attained capacity utilisation of 30-32 per cent. At sites, where we have the speed of about 20-25 kilometres per hour, we have attained the capacity utilisation of about 25 per cent. Generally, an entrepreneur finds it attractive if the capacity utilisation is about 24-25 per cent. That means wind speed should be greater than 20 kilometres per hour."

2.2.11 It transpired during an informal discussion with the Head of Remote Sensing division of Birla Institute of Science & Technology, Jaipur that there are several gaps in the Aravali range in Rajasthan which offer ideal sports for explortation of wind potential.

2.2.12 According to an expert, isolated low hills with narrow ridge crests have been found even-windier. Pointing out the problem of land availability in exploiting the wind potential in the hills the expert stated during evidence that "there should be some policy to lease out these hills without much hassle."

2.2.13 The total land required for one MW wind power project is stated to be 8 to 10 hectares.

2.2.14 On the problem of land availability, the Chairman, IREDA stated during evidence:

> "We have three types of land. First is the public land, second is the private land and third is the Central land. As far as private land is concerned we take up the process very fast. For example, in Tamil Nadu, most of the land is in the private land. So, they are able to move fast. Wherever there is a Government intervention then there are some difficulties. These difficulties are being sorted out. In Gujarat and Andhra Pradesh, they have sorted out these difficulties."

2.2.15 On the question of land availability a representative of MNES, stated during evidence that one of the constraints that is coming in the way of the large scale exploitation is non-availability of land in time and at reasonable cost to the private sector.

2.2.16 When the Committee suggested that land owner be made a Co-sharer, the witness stated:

"We are looking into that."

2.2.17 The witness further stated:

"Another concept which we are adopting is the conjuntive use of the land for wind power as well as for grazing of crop at Lamba in Gujarat."

2.2.18 When it was suggested that instead of going for land acquisition, the Govt. may identify the sites available with them and make the same available to NRIs, the representative of MNES stated:

"That has been done in Gujarat. We will release the data as soon as it becomes available."

2.2.19 Regarding funding by IREDA for wind power projects, the Chairman, IREDA stated in evidence:

"For the first time, the World Bank has taken a keen initiative in entering this area by providing nearly 78 million US dollars..... We have signed an agreement with the World Bank in April 1993. We have been given a target of 22 MW upto 31.3.94 and we have already crossed the figure of 30 MW within the first nine months period..... We hope that we will be able to use the funds in advance say by 1995 instead of 1997. Hence, there will be no difficulty. The representatives from the World Bank are going to come and they will reassess our position and after that they will increase the funds. I recently had a discussion with the Asian Development Bank. In fact, they are keen to support the concept of joint ventures. So, I think, possibly the finance will not be a problem."

2.2.20 It has been stated that in the wind energy sector, indigenisation has been achieved to a great extent however certain components are still being inported. However, efforts are reportedly being made to achieve complete indigenisation in the area of wind energy systems and devices also.

2.2.21 Asked about the difficulty in manufacturing blades of Wind Electric Generators, a representative of MNES stated during evidence:

"A few years back, one of the bottlenecks was the GRP three blade rotor system of 250 kilowatts with a diameter of 25 meters. Each blade is about 11 meters long and weighs about one tonne. The total weight of the rotor system of a modern wind turbine is about three to four tonnes. So we approached COMPROC under the Ministry of Defence who are engaged in missile development and the HAL, who are making advanced light weight helicopters. We are hopeful of getting indigenous prototype blades by August or September under R&D projects sponsored at these organisations."

2.2.22 The witness also added,

> "Another positive development as far as blades are concerned is that the largest blade manufacturer in Europe, which is a Danish company, has now come to India to set up a joint sector company in Madras. They will go into production in the later half of this year. We hope that by early next year, we should be able to roll out completely indigenous wind turbines."

2.2.23 The new strategy and at on Plan of the MNES aims at giving a market orientation to the various programmes with active private sector participation and by removing barriers and providing incentive to bring about full commercialisation as quickly as possible and to achieve a goal of 500 MW capacity wind power during the 8th Plan period comprising:—

(i) 100 MW demonstration projects through budgetary support by the Ministry and State agencies.

(ii) 200 MW private or public sector projects with soft loans by IREDA, including external financing through WB/GETF/ DANIDA, etc.

(iii) 200 MW private sector projects through incentive-driven private investment.

2.2.24 Regarding achievement on the front of wind power the MNES stated in a note as follows:

— Wind power capacity will cross the 100 MW milestone by March, 1994.

— Total* installed capacity has already reached 71 MW, which includes 31 MW private sector projects and 40 MW demonstration projects.

— 300 million units of electricity fed to the grid.

— Proposals exceeding a total capacity of 650 MW being finalised.

— Thrust on windprone States of Gujarat (350 MW); Andhra Pradesh (225 MW); Tamil Nadu (50 MW); Kerala (25 MW); and Karnataka (24 MW).

— 58 sites in eight States so far identified for large scale wind power projects.

— Wind surveys are in progress in 23 States/Union Territories to assess the total potential and identify more and more sites.

— As many as 8 manufacturers have taken up phased local production and assembly of wind turbines.

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* The Sub-Committee were informed during their visit to a private manufacture *viz.* NEPC-MICON that the supply of WEG by that company alone exceeded 100 MW in Feb. 1994.

The Indian Renewable Energy Development Agency (IREDA) has sanctioned soft loans for wind power projects of 36.5 MW capacity and proposals for 106.5 MW are in the pipeline.

The Sub-Committee on NCES undertook on the spot study of wind farms at Kayathar and Muppandal in Tamil Nadu in Feb. 1994. The Sub-Committee came to know during their visit that with a view to encourage private sector participation TNEB is permitting parties to set up wind mills in windy areas. These wind mills can be connected to the Grid. TNEB is wheeling the power to the location where power is required to the party. TNEB is deducting 2% of the energy generated by wind mills as its commission. TNEB will also purchase the surplus power produced in the private wind mill generators at the rate of Rs. 1.25 per cent for the present.

(iii) Power from Biomass Cogeneration

2.3.1. Biomass based cogeneration has been identified as an area holding considerable promise for power generation. Use of this technology in Indian industry is expected to lead to substantial savings of fossil fuels, improved productivity of industry, avoidance of environmental degradation and reduction in transmission losses.

2.3.2. Under the new strategy and Action Plan a target of 300 MW has been fixed by the Ministry for the 8th Five Year Plan.

2.3.3 The achievement in this regard as stated by the Ministry is as follows:—

"Two cogeneration pilot projects were sanctioned in the 7th Plan for two cooperative sugar mills in Tamil Nadu. The project at MRK cooperative sugar mills has since been commissioned, and about 3 MW of surplus power is being exported to grid. In the second project at Cheyyar Cooperative Sugar Mills two out of the three units of 2.5 MW each have been recently commissioned, and 1 to 1.5 MW surplus power is being fed to the grid."

2.3.4 A Task Force constituted by MNES recommended in October, 1993 that initial efforts may be concentrate on bagasse based cogeneration in the Sugar industry, which is an organised sector and has a potential of about 3500 MW surplus power generation.

"Based on the recommendations of the Task Force, the Ministry has recently launched a National Programme on cogeneration in Sugar Industry. The National Programme has four main components, *viz.* (i) Demonstration Projects (limited to one or two projects in each of the sugar producing States) under which the Central Government will give subsidy to a limited extent to the sugar mills which fulfill the required criteria laid down by this Ministry, and generate minimum 5 MW of surplus power, (ii) Operational Programme, will be operated by IREDA and under this scheme soft loans will be made available to the mills for setting up of cogeneration plants, (iii) R & D Programme to enhance potential and viability of

cogeneration schemes in sugar industry, under which areas of R & D have been identified by this Ministry and specific projects will be assigned to reputed institutions in the country, and (iv) comprising of support for preparation of Detailed Project Reports support to State Nodal Agencies for assessment studies, training, industry meets, information dissemination etc."

2.3.5 According to a press report, US was able to add an estimated additional capacity of 67000 MW through cogeneration in a short span.

2.3.6 An expert informed the Committee that in the USA it is statutory (under PURPA— Public Utility Regulatory Policies Act) for power companies to buy surplus co-generated power and at the marginal cost of production. The Committee pointed out that a suggestion made by Advisory Board on Energy in 1987 to amend the Electricity (supply) Act in this regard has not so far been implemented. Asked about the position in this regard the Secretary, MNES stated:—

"The question of having a legislation similar to some other countries' in order to make it obligatory, is under the consideration of the Ministry."

2.3.7 A representative of MNES stated in this connection:—

"The Sugar Mills are already cogenerating. We are talking of the net exportable surplus by using high pressure boilers of the order of 10-12 MWs for the sugar mills. The SEBs should agree to it. The Tamil Nadu Government has agreed to that. The Maharashtra Government is seriously considering the possibility of paying Rs. 2.25 for the surplus power. Andhra Pradesh is coming round to this rate. The UP Government is still not coming forward in an encouraging manner. This is under consideration."

Constraints

2.3.8 Ministry in a note furnished to the Committee stated that exploitation of potential of cogeneration in the Indian industry has been constrainted on account of the following factors:—

— Non-availability of capital with industry for putting up cogeneration plants.

— Lack of experience and proper technical guidance for the Industry in this area. This also includes non-availability to trained manpower in this field.

— Lack of proper policies in the States facilitating wheeling, banking and buy back of power generated by the cogenerating industries.

— Non-remunerative payments for power exported by the cogenerators.

2.3.9 Regarding inclusion of cogeneration projects under the modernisation programme of Sugar, industry, MNES stated in a post evidence note as under:—

> "In order to bring about additionality of resources for implementation of National Programme for Bagasse-based Cogeneration, launched recently by the Ministry, it has been suggested to the Ministry of Food that cogeneration projects in sugar industry should also be included under the modernisation programme for which Sugar Development Fund provides soft loans to the sugar industry. This is yet to be agreed by the Ministry of Food and is being followed up with them."

(iv) *Solar Photovoltaic (SPV) Programme*

2.4.1 Solar Photovoltaic Technology converts sunlight directly into electricity in an environmentally clean and reliable manner. The photovoltaic technology has emerged not only as a power source for small applications such as lighting, water pumping telecommunication, etc. but also as a medium size power source for centralized applications at village level.

2.4.2 The targets and physical achievements of the programme according to from the information furnished by the Ministry are as under:—

SPV systems	7th Plan Actual	1990-91		1991-92		1992-93	
		Tar	Act.	Tar	Act.	Tar	Act.
1	2	3	4	5	6	7	8
Solar Photovoltaics (PV) in KW	—	—	—	—	—	246	569
(a) PV Power units in KW	374	100	90	100	98	100	143
(b) PV community lights/TV & community facilities	791	50	100	65	86	30	70
(c) PV domestical lighting systems/ lanterns.	1,537	1,000	2,600	3,000	8,509	3,000	3,043

1	2	3	4	5	6	7	8
(d) PV street light	—	—	—	2000	3200	500	788
(e) PV Pumps	1,152	50	56	50	4	—	—

2.4.3 According to the report of C&AG (No. 2 of 1993) most of the systems installed under SPV Programme were not working mainly due to lack of proper maintenance, poor performance of the systems and apathy of local users. The average failure rate of street lighting, domestic lighting systems and water pumps, ranged from 25% to 100 per cent in some states surveyed.

2.4.4 On the question of maintenance of SPV systems, the Chairman, BHEL stated during evidence:—

> "Somebody has to maintain it in a remote village. There has to be an organisation today, that infrastructure is missing..... The municipal corporations or the village panchayats or the Block Development Officers can be associated."

2.4.5 A representative of REIL stated in this connection:—

> "Last year we had taken up 2,500 systems under the recommissioning drive through Rajasthan Energy Development Agency. Our findings were that primarily there were failures of batteries and it was only due to the lack of proper maintenance."

2.4.6 Citing the experiment at Nayagaon, Rajasthan the witness stated:—

> "In every Panchayat we are trying to train the village youth. They are managing the batteries and the system is working well. In Nayagaon there are 88 huts where lights have been provided. If the batteries are maintained properly the system will not give any major problem. In Nayagaon each household is paying Rs. 25/- per month to the Panchayat and each household knows that the system belongs to them. The complete system cost Rs. 50 lakh providing lights for 88 houses, 25 street lights, one solar water pump and two televisions. About 10 kw is the total load. The money which was taken initially, that is Rs. 250/- and Rs. 25/- per month remains with the Panchayat.
>
> It is being collected by the local school teacher. In Nayagaon they are paying and just because they are paying, they feel the system is there. They are very happy because the batteries are being maintained by the lady of the house. The only problem is, the street lights which were provided almost 20 in number those street lights are not functioning well because again this becomes the responsibility of the Panchayat. The solar water pump is working well and the television is also working well. Except

for the street lights in this village the experiment has been very successful."

2.4.7 To a query about maintenance of street lighting systems the Secretary, MNES stated:—

"It was no man's type of situation. It was a failure because of maintenance problem; nobody cared and so pilferage and theft, etc. were there. We have reduced our involvement in the street lighting system but we are continuing with it where we have got sufficient assurance from the panchayat or the local community concerned that it will be maintained."

2.4.8 The cost of installation of grid interactive SPV power project is stated to about Rs. 30 crores per MW with generation cost in the range of Rs. 10-12/KWhr. The CEL informed the Committee in a Memorandum that the production cost of SPV systems is primarily decided by the cost (per peak watt) of the solar cells/modules around which the SPV systems are configured. The cost of production of solar cells/modules is essentially dominated by the silicon wafer which is a major and expensive input material and a few other raw materials which as of today have to be imported.

2.4.9 Regarding efficiency of solar cells, MNES stated in a post evidence reply as under:—

"Commercially available photovoltaic modules manufactured with crystalline silicon technology have conversion efficiency upto 15%. Development efforts are continuing to bring about further improvements in solar cell efficiencies to 18-20% level."

2.4.10 At present the main raw-material, i.e. Silicon Wafer is produced only by one indigenous manufacturer M/s. Metkem Silicon Ltd; Madras. Their installed capacity is only one million wafers per annum. According to CEL the quality of indigenous wafers from Metkem is at least 10% better in quality than any imported wafers leading to better solar cell efficiencies and hence lower cost of the solar cells from them. Based on the projected demand for solar cells by the end of the 8th plan period i.e. and 1996-97, it is essential that we build up our capacity to at least 10-15 million silicon wafers.

2.4.11 According to CIL, is Metkem is not helped and if additional capacities are not installed in India immediately we may have to import requirement from external sources.

2.4.12 Reacting to the question of expanding the capacity for manufacturer of silicon wafer, the Secretary MNES stated:

"In terms of the present policy of the Government of India there is no particular provision for protecting any of the manufacturing activities in this sector and allied sectors. In terms of the present policy of the Government of India concessional tariffs have been

given for this industry and connected industries so that the manufacturers here in our country, the intermediaries in our country can import at the least cost the best products available and from wherever they are available."

2.4.13 The witness also added:—

"The present manufacturer is going to double meanwhile all the units engaged in SPV are importing their requirements from various parts of the world at competitive prices. It is good because in this process in the past one year costs have come down."

2.4.14 BHEL is working on the development of poly-crystalline silicon solar cells, which may prove to be more cost effective when in large scale production, though having lower efficiency of conversion but blessed with a very low cost of input materials and production. An efficiency of about 10-12% has been achieved in the laboratory. It is also being planned to produce poly-crystalline solar cells/modules on a large scale.

2.4.15 BHEL was entrusted with the responsibility by DNES in 1987 for establishing 500 KW/shift pilot plan for amorphous silicon modules. The plant had been commissioned at Solar Energy Centre, Gwal Pahari, Gurgaon. While the commercially obtained efficiencies of A-Si panels is still around 6-7% at square foot level as against 15-16% of crystalline silicon the former has also the advantage of very low input material cost leading to lower manufacturing costs. The technology, however, still suffers from the draw-back that the panel produced exhibit certain degradation. It has been possible to restrict this degradation to about 20% over the life of the module and efforts are on to reduce this further, while simultaneously increasing the designed life time.

2.4.16 Pointing out that SPV technology has come to a stage where exports are being made, a representative of MNES stated:—

"Central Electronics Limited has in recent times exported modules to Egypt and some other countries. This is a new trend because of opening up competition....Opening and liberalisation has also made it necessary for them to upgrade technology and wherever comparative advantages exist they are tieing up with the world leaders and improving and upgrading the technology. As a result of this, the efficiency has improved and the cost has come down. Last year it was Rs. 225 and it has come down to Rs. 195.

2.4.17 Enquired whether it would not be possible to manufacture SPV glasses indigenously, a representative of MNES stated:—

"As far as these glasses are concerned, the requirement of SPV industry is quite small...if the requirement is increasing, these people are ready for it. The glass manufacturers said that they can meet the requirement in three days time."

2.4.18 Making an assessment of the SPV programme, the Secretary MNES stated:—

> "Over a period of years, although there have been a large number of systems installed successfully, by and large, we ran into problem. Firstly, user was not participating in the programme; nodel agencies used to take their own time for the BOS/processing the balance of systems; they used to take the line of least resistance and distribute to guest houses, ministers bungalows, schools, etc. The manufacturers of the systems had hardly and incentive for giving services or guarantees. Therefore, CEL and BHEL were in a comfortable position because Ministry was under writing their production and they did not have any responsibility beyond distributing the panels to the nodel agencies....In our present situation, we have withdrawn subsidy as regards market oriented programme. Number of private sector companies have come into the picture and many more have set up shop here."

2.4.19 The achievements under PV programme upto 31.12.93 include 30,438 street lighting systems, 18,970 domestic lighting systems, 7624 solar lanterns, 808 community lighting TV systems and 101 power plants totalling 531 KWp.

2.4.20 Under the strategy Action plan, the target under SPV for 8th plan has been raised from 3MW to 25 MW.

2.4.21 According to MNES there are indicator that the cost of photovoltaic will come down drastically in the next 4 to 5 years with increase in production volume and improvements in efficiency. Therefore, efforts should be made to expand the use of photovoltaic to spurt the demand. The first two 100. KW partial grid interactive solar photovoltaic power projects at Kalyanpur in Aligarh district and Saraisadi in MOU district of Uttar Pradesh progressed well during the year and are expected to be fully commissioned by March, 1994. 25 KW capacity will be connected to grid under both the projects. The Ministry have invited proposals from prospective promoters in the private sector for establishing grid interactive solar photovoltaic power generating plants each of 2 MW capacity or more duing the 8th Plan on Build, Own and Operate (B.O.O.) basis/build and transfer to public and private entities at suitable locations in different parts of the country.

2.4.22 Based on the experience gained so far, certain policy changes have been introduced in the implementation of the SPV Programme for rural sector from 1993-94. The SPV Programme was given a market orientation and separate schemes i.e. Market Oriented Scheme and Socially Oriented Scheme were introduced. The Market Oriented Scheme is to be implemented through IREDA by providing soft loan assistance for certain type of SPV Systems. The Socially Oriented Scheme of the SPV Programme is being implemented by the MNES through State Nodal Agencies and Electricity Boards.

2.4.23 The socially oriented programme is mainly for difficult and economically backward areas where the market oriented programme is unlikely to pick up. For all projects approved under this scheme the MNES meets 50% of the ex-factory cost of the systems. In respect of solar lanterns, the MNES is restricted to Rs. 2000 per lantern.

2.4.24 The high intitial cost is the main barrier in SPV technology. According to an expert it should be ensured that economics of scale are realised in the manufacture of SPV systems by manufacturng in large scale to bring down the cost.

2.4.25 Regarding reductions cost of SPV, MINES has stated in a post evidence reply that with improvements in the efficiency of solar cells and increase in production volumes, costs are expected to come down to Rs. 110/wp in next 3-4 years from the level of Rs. 195/wp in 1993-94.

(v) Solar Thermal Power Generation

2.5.1 A proposal for setting up a Megawatt scale Solar Thermal Project based on line focussing collectors has been under the consideration of the Ministry.

2.5.2 Solar Thermal Power Plants are envisaged to be more suited for remote semi arid/arid areas of the country where abundant sunshine is available and no other resource of electrical energy can be made available without heavy investments. It has been estimated that around 100 hactares of land in a region like deserts of Rajasthan, can deliver 35 MW (Gross) of electrical power through this technology.

2.5.3 A two fold strategy has been proposed for promotion of this technology in the country, comprising of installation of a 30 MW R&D-cum-demonstration project near Jodhpur in Rajasthan and, promotion of 10 MW private sector projects on Built-Own-Operate basis, with partial financial assistance from the Ministry, at suitable locations in different States. The Eighth Plan target for this technology has been envisaged at 30 MW.

2.5.4 Regarding achievements under this programme, MNES stated that an initial proposal submitted by BHEL in March 1993, indicated that a 35 MW (Gross) Solar Thermal Power Project would cost around Rs. 380 crores. The economic costs of generation showed that with 65% overall Plant Load Factor, using heavy oil as back-up fuel, the cost of electricity would be around Rs. 5.04/kwh. The costs would be higher with lower Plant Load Factors. Based on the discussions with the State Govt. of

Rajasthan, it has been tentatively decided to design the plant for a 36.5% overall plant load factor. BHEL have now been asked to prepare a Detailed Project Report for the project. BHEL will be making the Report jointly with M/s Solel of Israel. The Report is expected to be completed by May, 1994. The Committee informed that the project was originally conceived 15 years ago.

2.5.5 In the meanwhile, some interest has been expressed by entrepreneurs in private sector to establish solar thermal power generation projects of 10 MW capacity at various sites on Built-Own-Operate basis.

III. RURAL ENERGY

(i) Biogas Development Programme

3.1.1 Biogas is an environment-friendly cheap fuel for our rural areas. Fuel-gas from organic materials like cattle dung, night-soil, poultry droppings, cludge, waste water, etc. without destroying their manurial value. It accrues many social benefits particularly to women and children.

3.1.2 A potential of 120 lakh family type biogas plants is estimated to exist in the country. This potential is stated to be realisable in about fifteen years if adequate financial support is extended to this programme. Against this potential, upto 31.3.93 a total of 17.63 lakh biogas plants and 1000 Community/Institutional/Night Soil based biogass plants have been set up. These plants are estimated to generate biogas equivalent to about 57 lakh tonnes of fuelwood valued approximately at Rs. 285 crores per annum besides 272 lakh tonnes of enriched organic manure per annum. During April-November 1993 84,339 family size biogas plants and 50 Community/ Institional/Night soil based biogas plants have been installed.

3.1.3 Biogas development programme is being promoted through three major schemes viz. (i) National Project on Biogas Development (NPBD), (ii) CBP/IBP/NBP and (iii) Research & Developmenton Biogas. Brief on each of these is as follows:—

National Project on Biogas Development (NPBD)

3.1.4 The National Project on Biogas Development (BPBD), which caters to installation of family size biogas plants, is in operation as a centrally sponsored scheme since 1981-82 in all the States/UTs of the country. The project, *inter-alia*, provides for technical and training support, financial incentives, such as: central subsidy, turn-key job fee (JKJE), promotional incentive, service charges for organisational infrastructures, establishment of Regional Biogas Development & Training Centres and publicity campaigns.

3.1.5 A representative of Tata Energy Research Institute (TERI) who appeared before the Committee opined:—

> "Considering the vastness of the rural areas it has not covered 1% of the total rural households in the country so far. In that sense, the impact is not very wide spread as of now."

3.1.6 Pointing out that there have been some inherent technological limitations for biogas an expert from TERI stated:—

> "In the colder regions, biogas production goes down very drastically-say by more than half-in the winter season. As a result people have found it difficult to use it on a regular basis. It is also difficult to operate in areas such as Rajasthan where people face water shortage. In parts of Rajasthan, thousands of plants have been constructed, but they have never been commissioned because of paucity of water. One of the problems is that the resources have been spread too thin even in areas where it is not likely to succeed. As a result, the failures in these parts of the country are rather glaring."

3.1.7 The expert suggested in this connection:—

> "Instead of taking it up a national programme, it would yield better results if it were to be confined to certain pockets in the country where it has maximum chances of success. Apart from using the resources most efficiently, once success rates are more, it would serve the purpose of convincing people that biogas programme could really be implemented successfully. In this way, it would be easier to create public opinion in respect of this technology and to promote it on a large scale without any difficulty. This aspect needs to be considered seriously."

3.1.8 An evaluation of the bio-gas programme by the National Council of Applied Economic Research for the period 1985-86 to 1989-90 revealed that out of the commissioned bio-gas plants only 45% and 49% of the bio-gas plants were found working in Rajasthan and Uttar Pradesh respectively as compared with the national average of 77%.

Community, Institutional and Night Soil Based Biogas Plants Programme (CBP/IBP/NBP)

3.1.9 Community, Institutional and Night Soil Based Biogas Plants Programme was initiated in the year 1982-83. It aimed at setting up of large size biogas plants at potential sites where adequate quantities of waste materials were available. Utilisation of gas for various purposes including running of engines for motive power or generating electricity to benefit community as a whole or for a large number of families belonging to an institution was attempted. During 1988-89, promotion of night soil biogas plants was also included in the programme.

3.1.10 During the Seventh Plan Period (1985-90), a total of 484 plants were installed, against the target of 450 plants, involving a total expenditure of Rs. 16.26 crores whereas during the period 1990-91 to 1992-93, 423 plants have been installed at a total expenditure of Rs. 6.39 crores.

3.1.11 Pointing out the difficulty in CBP, the Secretary MNES stated:—

"As far as Community bio-gas plants are concerned, it is very difficult to operate them because the main problem is abnout getting the gobar to do the needful. If we depute some person and pay him salary etc. then only it is possible. So, collection of gobar is a problem."

3.1.12 Regarding night soil biogas plants, the Secretary MNES stated:—

"Of late, we have also Night Soil Bio-gas plants. In fact, we have been tying up with the Sulabha Sauchalya of Shri Bindeswar Pathak. They have done an extremely good work. We are very much interested in this programme. We did feel that some market orientation has also to be given to this programme. There should be a mass movement and the people should come forward to take it up."

3.1.13 When the Committee suggested a tie-up with Sulabh International, the witness said:—

"We are already having a programme in which they are participating... We will definitey give a serious consideration to this aspect."

3.1.14 Regarding constraint in night soil plants, the expert from TERI stated:—

"Human excreta is an excellant source of bio-gas. However, considering the cultural inhibitions in serveral parts of the country, it has not succeeded in certain parts of the country. Sanitary-linked biogas plants have been functioning very well especially in Gujarat and Maharashtra."

3.1.15 As regard financial constraints, the Secretary, MNES stated:—

"Unfortunately, during the past few years the banks are not very enthusiastic about giving loans for the socially-oriented schemes. As a result of that Bank loans are not forthcoming in most of the states. There is a gap in financing all the bio-gas plants for domestic use. That is one of the problems."

3.1.16 On the question of subsidy to bio-gas plants, the witness said:—

"But, there is a lot of resistance from the nodal agencies and from the NGOs that we are going to phase out subsidy. We should continue with the subsidy."

Research and Development on Biogas

3.1.17 The MNES have stated that the main goal of R&D Programme have been to improve efficiency of methane production by a factor of two through mecrobiological manipulation, better designing of digesters biological pre-treatment of feedstocks, enhancement and sustanining defined temperature of the slurry in a marrow mesophillic or thermophillic

3.1.18 According to TERI Research and Development (R&D) has been the weakest link in NPBD so far. Though coordinated research programmes at the national level have been promoted under NPBD the results have not yet percolated to the field either in the form of low-cost plant designs or alternative feedstocks for biogas production. Therefore, it is of critical importance to give a proper thrust to R&D in biogas if the technology has to make any significant impact on the energy scenario.

3.1.19 Pointing out the constraints in wide spread implementation of the biogas programme, the expert from TERI stated:

> "The most basic constraint is that the programme is, more or less, dependent over the last 12 years on cow-dung along. Though technically all organic matter could be used to generate biogas, the emphasis so far has been merely on cow-dung. This has severly limited the scope of biogas."

3.1.20 The Expert further mentioned:

> "There are 3.4 feedstocks, like kitchen waste, municipal waste, municipal garbage, which have been experimented upon. Typha grass has also been tried. But unfortunately, the R & D efforts that have been put in the biogas programme during the last few years, have not really taken it in the sense it should have been. They have, more or less, been confined to the laboratories. So far, no prototypes have been developed which could be implemented in the fields. Agricultural waste is also another possibility."

3.1.21 According to TERI the following issues must have prominence in a revitalised R & D strategy for biogas technology:

> "A goal oriented effort needs to be mounted to developed alternative feedstock to shift the dependence on cow dung. Organic materials that have significant potential are water hyacinth market waste and kitchen waste. If these alternatives can be developed to be used in the field, the potential of biogas would be virtually unlimited and could have major impact in promoting income-generating activities and employment in rural areas and small urban centres.
>
> A coordinated project to study the microbiology aspects of biogas technology is already going on. However, special emphasis needs to be put on developing micro-organism that can produce biogas under low temperatures and with low water consumption. This could increase potential for biogas in cold and arid regions.
>
> Efforts should be made to develop cost-effective construction materials and accessories to reduce the overall cost of biogas plant installation. For instance, design of biogas burners and lamp mantles can be improved to enhance their reliability and reduce the cost. In urban areas, sewage and other municipal waste offer major opportunity to generate biogas. This would not only ameliorate the

environmental problems but provide valuable energy. A concerted programme needs to be devised to exploit this valuable waste resource.

New Strategy & Action Plan

3.1.22 Under the new strategy & Action Plan target of setting up of family type biogas plants was raised from 7.5 to 10 lakh for the VIII plan period to aim at 20-25% coverage. Physical target for the year 1993-94 was raised to 2 lakh from 1.35 lakh for the preceeding year thus reflecting an increase of 47%. Target of setting up large size biogas plants under the programme of CBP/IBP/NBP was raised from 450 to 1000 for the VIII plan period and from 50 plants during 1992-93 to 200 plants for the year 1993-94.

3.1.23 Besides, vider coverage, some of the other special features of biogas programme under the strategy and Action Plan are as follows:—

—Market orientation and support activity:

Greater involvement of voluntary organisation and private entrepreneurs has been envisaged by aiming at 75% of the work to be done on turn key fee basis and 25% of the total work to be done by voluntary organisations.

—Intensification of publicity and awareness raising campaigns.

3.1.24 Target of setting up of family type biogas plants was proposed to be raised to 10 lakh for the VIII plan period since the Ministry was in complete readyness for this raise, however, financial allocation commensurate with the proposed increase was stated to be a pre-condition. The target for the year 1993-94, however, was raised from 1.75 to 2 lakhs within the available resources by rationalisation of some of the provisions under this programme.

3.1.25 While proposing a physical target of 2.2 lakh family type and 225 large size biogas plants for the year 1994-95, plan allocation of Rs. 79.6 crores was requested for. However, an allocation of only Rs. 67 crores has been made for biogas development programme which is almost same as that for the year 1993-94.

(ii) Improved Chulha Programme

3.2.1 Improved Chulha Programme was launched as demonstration project in December, 1983. In view of the overwhelming response from the beneficiaries throughout the country, it was converted into a National Programme w.e.f. April, 1985. The programme forms a part of the 20 Point Programme and the Minimum Needs Programme of the Government. It aims at:—

(a) Fuel conservation,

(b) Smoke reduction,

(c) Check on deforestation & environmental degradation,

(d) Reduction in the drudgery of Women and children from cooking in smoky kitchens and collection of more fuel.

3.2.2 The potential for installation of improved chulhas in the country is estimated as 120 million. The achievement so far is as indicated below:—

— No. of Chulhas installed (cumulative upto March, 1993)	: 14.5 million
— Coverage of Potential	: 12.1%
— Target for 1993-94	: 24 lakhs
— Achievement during the period April-Nov. 93	: 7.90 lakhs

3.2.3 The National Programme on Improved Chulhas is implemented with a multi agency approach involving State Government Departments, Agencies, Autonomous Bodies and Voluntary Organisations. The Chulhas are constructed in the households by the trained Self Employed Workers. Various improved models to suit the user's requirements in different areas in the country have been approved under the programme. The technical and training Support Units existing in various states. The financial assistance available under the programme includes subsidy to the beneficiaries, remuneration to the Self Employed Workers, market promotion and dealership support to the Cooperative Stores, F.P.S. etc., Organisational Support to the States and Agencies, Publicity Awareness, Training and R & D Support to the implementing departments and Agencies. A four tier monitoring and evaluation system including through independent agencies also exists under the programme. The Ministry's Annual Report has indicated that the functionality of improved chulhas varies from place to place average being in the range of 70% to 75%.

3.2.4 Regarding coverage of potential household and implementing strategy, the MNES stated in a note as follows:—

(a) Wider Coverage: It is proposed to increase the coverage to 25% of the potential households by the end of 8th Five Year Plan as against 10% at the end of the 7th Five Year Plan, by enchancing the original target of 100 lakhs to 180 lakhs. Target of 1993-94 has also been stepped up by 37% more than the previous year.

(b) Functionality Improvement: Improvement in the functionality of Chulhas installed is aimed at by giving due preference to user's training and award to field functionaries on functionality.

(c) Implementing Strategy: Implementing Strategy adopted during the current year includes greater involvement of non governmental volunatary organisations and agencies, market orientation measure through increased involvement of users by way of rationalising the subsidies emphasising implementation through private entrepreneurs, assignment of remunerative economic targets for Self Employed Workers, making available different models of

Chulhas at district and block level for demonstration and sale, and decentralised approval and ISI registration at the State level.

The major constraints for achieving higher targets envisaged under the strategy and action plan stated to be non availability of adequate funds, lack of awareness amongst the beneficiaries, easy availability of models of improved chulhas at the village levels, inadequate technical back-up by Self Employed Workers, lack of full time staff for implementation of the programme at the block level, non availability of approved models to use some of the locally available cooking fuels etc.

(iii) Biomass Production, Conversion & Utilisation

3.3.1 Biomass is a traditional source of energy in rural India. Biomass has important advantages as a source of energy as it is renewable, it is relatively cheap and it is, generally, locally available.

3.3.2 The main aim of Biomass programme is to optimise the productivity of Biomass and to develop appropriate technologies for its conversion and utilisation aimed at supplementing the increasing demand particularly for thermal, electrical and mechanical energy. In order to achieve this objective, R & D on Biomass Production & Improvement, Conversion and utilisation have been initiated.

3.3.3 The potential for power generation through bio-mass is stated to be about 17,000 MW of equivalent installed capacity. MNES stated in a note in this connection as under:

> "The main contribution is from agricultural residues followed by agro-industrial residues and total wasteland availability for energy plantations. A survey carried out through National Productivity Council in 1987 revealed that about 321 million tonnes of crop residues and 50 million tonnes of agro-industrial by-products was available in the country. About 94 million tonnes of agro-residues and industrial wastes are not used at all for any purpose annually. This has a potential to replace about 25 million tonnes of furnace oil if converted into briquettes."

3.3.4 11 Biomass research centres have reportedly been established one each in different agro-climatic regions of the country. These Centres are stated to be working on 80 numbers of fast growing fuelwood species and preparing packages of practices for 35 fuelwood species.

3.3.5 It was observed from the information furnished to the Committee that the outlay for the Biomass development programme in the 8th Plan was just Rs. 15 crores as against Rs. 27.50 crores in the 7th Plan. Asked for the reasons for reduction in the outlay for this programme, the Secretary, MNES stated during evidence:

> "With regard to bio mass development programme, it is not a real reduction from the seventh Plan to Eighth Plan because in the Seventh Plan, it was all clubbed under bio mass R & D, energy plantation etc. During the Eighth-Plan, bio-mass R & D, energy

plantation were shown under different programme. So, it was not reduction in outlay."

3.3.6 Enquired why the energy plantation was dropped, the witness stated:

"As far as bio-mass development programme is concerned, the Ministry has taken this decision for two reasons. The programme was being implemented directly by the Ministry through some non-governmental organisations. That was the pattern of implementation. The programme ran into a number of difficulties. Some inquiries had to be conducted and, therefore, there was a set back to the programme.

The Second reason was that this subject was also handled by the Wasteland Development Ministry and the Ministry of Environment. The Ministry had been exchanging ideas and having meetings with these two Ministries of the Central Government in order to see what they were doing and whether this Ministry has a role.

The third reason was that it emerged during these confabulations that perhaps the Ministry should concentrate on the utilisation of bio-mass rather than the production and creating of bio-mass energy plantation and leave it to other organisations that are much better suited to do this and also have a clear mandate on this."

3.3.7 To a query whether the responsibility of energy plantation should not lie with MNES, the Secretary stated:

"This Ministry is concentrating on utilisation of bio-mass. According to my view, the responsibility must be given to the Ministry of Environment and Forests. They have the entire forest set up under them. They look after the social forestry aspect also."

3.3.8 Asked about the role of MNES in regard to biomass the Secretary stated:

"The role of the Ministry is to use the vast bio-mass that is available. We convert the agricultural waste, forest waste into energy of all types. We have launched a programme for gasification. We want to promote gasifiers of various capacity which uses different types of bio-mass as feed stock."

3.3.9 The Ministry stated in a note that an area of 17,110 ha. was covered under Energy Plantation Demonstration Programme till 1991-92 in 22 different States and UTs. The average survival rate of Energy Plantation was 62.9%. The programme is currently not in operation.

3.3.10 It is possible to briquette agro-residues and industrial wastes which can be used most efficiently particularly for meeting the thermal energy thereby replacing furnace oil and coal. Though briquetting technology has been commercialised in recent years in India, R & D support is required to achieve perfection.

3.3.11 As per the Strategy and Action Plan prepared by the Ministry, it has been proposed to launch a National Programme for Biomass Briquetting with revised target of 50 MW for the remaining period of the VIIIth Plan.

(iv) *Biomass Gasification Programme*

3.4.1 The Biomass Gasifier systems are devices which convert biomass such as wood wastes, agricultural and agro-industrial residues etc. to combustible gas through thermochemical process. The gas thus generated could be fed to dual-fuel engines or gensets to produce Mechanical and/or Electrical power. In the conventional diesel engines or gensets, it can replace diesel oil to the extent of 65-85% or even more.

3.4.2 Due to indigenous technology development currently, biomass gasifier systems of 5HP and 10 HP for water pumping application 3 KW—100 KW for power generation and 2,500—2,50,000 kcal-hr for thermal applications are commercially available.

Research & Development

3.4.3 Ministry is reportedly persuing a well planned Research & Development in the following thrust areas to make this technology more versatile both in terms of feedstock flexibility and its end use applications.

(i) Development of non-woody biomass based gasifier systems.

(ii) R&D on materials of contructions to improve reliability, life and cost.

(iii) Development of 100% producer gas based engines.

(iv) Development of application packages for variety of end-use applications.

(v) Development of new, more efficient conversion technologies eg. Rotary steam gasification, Fluidised bed gasification, Pyrolysis technologies etc.

Demonstration Programme

3.4.4 Demonstration programme on biomass gasification was launched in 1985-86 by the Ministry. Under the programme, upto March, 1993, a total of 1167 gasifier systems of assorted ratings totalling about 9.5 MW has been installed all over the country.

Strategy and Action Plan

3.4.5 Under new strategy and action plan of the Ministry for VIII Plan, a target of 50 MW has been set up for power generation from biomass gasification. During financial year 1992-93, against a physical target of 0.4 MW, Gasifier systems equivalent to 2.0 MW was installed.

3.4.6 To further accelerate implementation of the programme to achieve the target of 50 MW by the end of VIII Plan, a broad based programme by giving focus on commercial applications of the technology with support of attractive incentives has been launched in the following areas of applications.

(i) Water Pumping and other Mechanical Applications.

(ii) Electrical and Thermal Applications.

(iii) Rural Electrification.

Water Pumping and other mechanical appliances

3.4.7 Presently over 6-7 million diesel engine pumpsets are in opertion in the country, putting together they are consuming 6.0 billion litres of diesel oil per annum. In order to promote use of biomass Gasifier system in water pumping mode, Ministry is providing 60% of the cost of the Gasifier system to the user.

Electrical and Thermal Appliances

3.4.8 Number of industries such as joinery mill, saw mill, rice mill, Tea/coffee, tobacco processing industries, brick, lime, pottery kiln; gur making; bakeries, soap industries, etc. either generate and/or consume considerable amount of biomass during their course of production. In order to promote use of Gasifier Systems in such industries and other institutional/individual setup for captive power generation and thermal applications, Ministry is providing cost sharing of 60% and 30% respectively, on the cost of the Gasifier System to the user.

Rural Electrification

3.4.9 Biomass Gasifier opens a vast potential for village electrification in remote and inaccessible areas where biomass is available in abundance. This could perhaps be an ideal solution for the electrification of remote villages in hilly areas, inside deep forests which are inaccessible to grid and Islands. For rural electrification projects Ministry is providing cost towards identification of site/preparation of Detailed Project Report and 75% of the total cost of Gasifier System.

(v) *Urjagram Programme*

3.5.1 The urjagram programme was started during the Seventh Plan period with an idea to create model villages where most of the energy needs can be met using renewable energy systems. Among the specific objectives of the programme are creation of rural energy data base for

planning and implementation of the urjagram projects; to meet energy requirements of villages through the use of mix of NRSE systems and to undertake multi-level rural energy studies for developing integrated planning strategy. The programme also undertakes evaluation of field level reliability, impact assessment and socio-economic viability of the NRSE systems. The urjagram projects are implemented through state nodal agencies with the involvement of village panchayats and unemployed youth. The projects contribute not only in meeting generation of economic activity, higher incomes and creation of employment at village level.

3.5.2 Energy survey in 1746 villages have so far been completed covering 21 States of which 66 have been completed during the current year (31st Dec., 1993). Energy surveys are in progress in 286 villages. It is expected that over 100 villages by 31.3.1994, the energy surveys will be completed.

3.5.3 The urjagram projects have been well received at the State and village level. Different NRSE systems based on energy survey and requirement of the village are established in an integrated manner to meet energy requirements of individuals and villages. The projects are operated and maintained by the state nodal agencies with the help of villagers for an initial period of three years. After imparting sufficient training, the systems are handed over to the village panchayats or any other responsible body in the village for operating and maintaining the systems. A total of 203 urjagram projects have been completed so far in 15 States out of which 19 have been completed during the current year up to 31st Dec., 1993. It is expected that 25 urjagram projects will be completed by 31st March, 1994.

3.5.4 As per the new strategy and action plan prepared by the Ministry, it is proposed to cover all districts of the country by establishing at least one urjagram by the end of Eighth Five Year Plan. In order to achieve this, about 500 new urjagram projects will be taken up and 1000 village level energy surveys will be conducted. Emphasis is being given on the district level energy planning studies and it proposed that at least 10 more districts will be covered for the indepth study of energy consumption, present energy utilisation practices and potential of using NRSE systems to meet energy needs.

3.5.5 The implementation of urjagram projects and its impact at the village level and adjoining areas is sometimes seriously hampered due to lack of infrastructural and managerial facilities at the State level. The projects not only needs setting up of various renewable energy systems in an integrated manner but also require constant maintenance and monitoring for proper feedback from the field. It is observed from the completed projects that involvement of users is a major component in making the use of renewable energy system successful. The concept

"Urja Samiti" is being propagated to operate and maintain the NRSE systems installed in the villages. This concept needs further strengthening and require support from the state level organisations.

3.5.6 The lack of funds provided for the programme has been another bottleneck in enlarging the programme and taking it to all remote areas.

(vi) *Solar Thermal Energy for Rural Applications*

3.6.1 Solar Energy can be used for meeting the heat energy requirements in the rural areas.

Potential and Achievements

3.6.2 For agricultural applications, green house technology appears to be more appropriate for growing the vegetables, flowers etc. under semi-controlled conditions when the outside environmental conditions are not favourable. This technology has the potential to extend the cultivation period in cold climatic regions and also to grow off-season vegetables to increase income of the farmers. So far seven green houses have been constructed in Leh and Kargil areas of (J&K). There is an urgent need for development of low cost green houses which could be adopted by individual farmers. A task force constituted by the ministry, for preparing a document of national programme on green house, is likely to submit its report shortly. The future programme in the area would mainly depend on the recommendations of the task force.

3.6.3 Solar Thermal Energy can also be used for post harvest technology. Solar Dryers provide an excellent technology for drying of the foodgrains to the desired level of moisture contained under semi-controlled/controlled conditions. So far over 71 Solar Dryers have been installed in the country for drying variety of agricultural produce/other products. Here again the use of the driers has been for large capacity commercial applications. The emphasis now is being laid on the development of a small cabinet dryer which could be used by the individual farmers or a group of farmers.

3.6.4 Most of the diseases in the rural areas are water bound. This is because the villagers use raw and brakish water for drinking. It is possible to distill the brakish/saline water using solar stills and make it ideal for drinking purpose by adding required minerals to the distilled water. A solar still of 5000 litre capacity had calier installed at Awania in Gujarat and an another of 2000 litre capacity in Bitra in Lakshdweep Group of Island. Both these projects have established the use of solar still for drinking water applications. Similar demonstration projects are to be taken up. A small solar stills which are now commercially available are to be promoted for use by individual families to meet their drinking water requirements.

Constraints

3.6.5 The area needs R&D inputs in terms of low cost technology development. Demonstration on 100% Government funding basis and general awareness activity also needs to be strengthened.

(vii) *Wind Energy Conversion System for Rural Areas*

3.7.1 The emphasis of the programme is on indigenisation and adaptation of new technologies for wind pumping, wind battery charging and stand alone power generation and thereby supplementing the requirement of mechanical and electrical energy in small quantities in rural and remote areas.

3.7.2 Activities relating to development of technology for wind pumps have so far been concentrated mainly on development, field testing and performance evaluation of new designs and improvement in the existing design to make them more reliable, efficient and cost effective. Based on the feedstock received from the field, the design deficiencies of 12 PU 500 model have been minimized and modified design of the same has been developed. In view of the inherent performance constraints of shallow well wind pumping systems, design of gear type wind pumps have been developed for pumping water from deepwells. The designs are based on either adaptation of imported machines or indigenous development. The prototypes of modified 12 PU 500 and gear type deepwell wind pumps have been field tested and have found field worthy and suitable for water pumping from shallow depths and deepwells respectively.

3.7.3 Alongwith field testing and evaluation of the performance of imported small wind battery charges and stand alone wind generators, efforts for development of indigenous wind battery chargers has taken place simultaneously. Technology for manufacture and installation of wind battery chargers upto 5 KW capacity is available indigenously.

Demonstration Programme

3.7.4 Over 2800 shallow well water pumping wind mills have been installed under demonstration programme in 23 States/UTs. An operation Research Programme, comprising of 220 indigenously developed deepwell wind mills, has been taken up in 9 States for comparative evaluation of performance under actual field conditions. So far 217 systems have been installed out of which 19 have been installed during 1993-94 upto 30.12.1993. The remaining wind pumps are expected to be installed during 1993-94.

3.7.5 108 small wind battery chargers in the capacity range of 50 MW to 4 W imported for evaluation and performance testing under varying agro-climatic conditions have been installed in the country. Simultaneously efforts have been made to develop wind battery chargers indigenously upto 5 KW capacity.

3.7.6 There has been substantial shortfall in achievement of target in regard to wind pumps during the 7th plan and in the succeeding years as indicated below:—

	7th Plan	1990-91	1991-92	1992-93
Target	5,100	600	500	500
Achievement	2,540	171	112	93

Small mechanical wind pumps raising ground water has been known for over a hundred years in Australia, USA and other countries.

3.7.7. Indicating that the maintenance requirement is rather high, an expert wind energy opined:—

> "One of the unfortunate aspect of 6th and 7th Plan Programme were that while 3000 machines of a certain type called 12 PU 500 were distributed in different States, the results were not very encouraging. In most places, the machines are not found working. The maintenance support was not adequate. This was a low-cost design developed by Dutch Volunteers. This design has to be more closely looked after by farmers themselves or by maintenance people. It is not suited for high-wind areas. This programme has virtually fully financed by the Government. All this has not developed a positive feedback".

3.7.8 The expert suggested in this connection as below:

> "In 1985 CSIR and Swiss Development Corporation has brought out a report in which it was mentioned that in certain parts of country wind pumps is the relatively most cost-effective option. Our policy should be to go for an intensive use of wind pumps in those areas where it makes an economic sense".

3.7.9 In regard to wind battery chargers, the expert stated in a Memorandum furnished to the Committee that the earlier demonstration using imported units have not given a satisfactory feedstock which probably accounts for a slum in recent times although this activity started nearly 10 years back. There is need to develop a great deal of site and need specific schemes for the use of such battery chargers. The arrangements to replace parts periodically, regular operation which requires dedicated trained manpower, and meeting these costs through sale of electricity or from development budget for many years to come should up be also fully worked out. The optimum mix of the year size of windmill, battery storage, diesel or other back up must also be worked but as models for multiplication. This is an area in which a great deal needs to be done to create a market or justify inclusion in development schemes.

3.7.10 Wind pumps have been installed during VI and VII Plans with full cost of the hardware being funded by MNES. For popularising wind pumping system in rural areas, a cost sharing scheme is being launched

in 1993-94. Under this scheme 300 wind pumps for drinking as well as micro irrigation purposes are proposed to be installed with MNES contribution limited to about 50% of the cost of the wind pump.

3.7.11 A programme on field evaluation of indigenously developed wind battery chargers upto a capacity of 5 KW in rural and remote areas for supplying small quantity of electricity for telecommunication, powering electronic devices, lighting etc. are also being launched with full cost sharing for the hardware cost by MNES. A target of 20 KW has been set for the cumulative capacity of the machines to be installed under this programme for 1993-94.

(viii) *Human and Animal Energy Programme*

3.8.1 About 84 million draught animals in our country are capable of generating about 40 million horse power of energy or 30,000 MW of equivalent power. Therefore, draught animals play an important role in the economy of both rural and semi-urban areas by way of providing short distance haulage as well as for mechanising small holding agriculture. There are about 15 million animal drawn vehicles in use in the country. However, it is estimated that hardly 2 million of them are of improved designs. Thus, there is a great scope for developing and marketing improved animal drawn vehicles suitable for different areas of the country. There is also great need to step up support for breeding programmes for draught animals, a subject being dealt with by the Ministry of Agriculture.

3.8.2 An expert Committee set up by MNES has submitted a report on "Programmes and Policies on Draught Animal Power" The Committee has recommended taking up a modernisation programme consisting of survey and field testing studies—R&D, popularisation and management. Based on the recommendations of the Committee, the Ministry is developing a national programme with a view to increase agricultural production from small holdings and also transport capability for short distance haulage using the DAP system. The programme would be implemented in close coordination with various Central Govt. Ministries/Departments/ Organisations and the State Govts.

3.8.3 Regarding achievements of under this programme, the MNES in a note stated as below:—

> "The Ministry have been supporting R&D and demonstration projects with very inadequate financial support. During the years several new designs of carts have been developed. Improved designs of carts developed by CARTMAN Bangalore, and Glass fibre Technology Centre of CEAT Ltd. Hyderabad have been taken up for demonstration in the States of Andhra Pradesh, Karnataka, Kerala, M.P. Maharashtra and Tamil Nadu. Detailed standards have been worked out of field tested carts for making them available to manufacturers and fabricators for large scale production".

3.8.4 Institute of Engineering and Rural Technology, Allahabad has started fabricating and marketing an improved version of cycle trailor. Design improvement in the existing designs of hand carts, cycle rickshaws and wheel barrows in Karnataka, Kerala and Tamil Nadu are being carried out for development of their improved versions.

3.8.5 It was observed from the information furnished by MNES that outlay for Human and Animals Energy Programme has come down from Rs. 2.54 crores in the 7th Plan to Rs. 1 crore in the 8th Plan. Asked for the reason for decline in the outlay under this programme Secretary, MNES stated:—

> "Rs. One crore provided for human and animal energy programme is more or less in line with what has been spent by us in the Seventh Plan. Internally, within the Ministry, we thought we could set aside Rs. 2.5 crores."

3.8.6 A representative of the Ministry stated in this connection:—

> "In the Seventh Plan, there was no separate mention for Human and Animal Energy. There was no Budget shown separately for that, as far as Planning Commission was concerned."

3.8.7 The programme has been allocated a budget of Rs. 25.00 lakhs only for 1993-94. For 1994-95, a budget allocation of Rs. 50 lakhs has been made.

3.8.8 As regard to constraints, the Ministry in a note stated as under:—

> "Selection of specific modern technologies and systems appropriate for different purposes, areas and socio-economic group of people is required to be carried out at the grass root level involving non-governmental organisations and training institutions. Simultaneously, emphasis needs to be laid on conservation and improvements in the breeds of draught animals and also to ensure food and fodder security. Linkages are required to be developed with the Ministry of Agriculture and Rural Development at the Central level. Similarly coordination among various departments and agencies involved is needed at the state and district level."

IV. URBAN AND INDUSTRIAL

(i) *Domestic Energy & Process Heating Application*

4.1.1 The principal objective of the programme is market development and commercialisation of solar thermal systems for making heat energy requirement for different applications in domestic, commercialisation and industrial sectors. Solar thermal systems could save commercial fuels as well as electricity which otherwise are being utilized for this purpose.

Solar Water Heating Systems

4.1.2 Heating of water by utilising solar energy is a well known established technology in many parts of the world including India. In India, several types of solar water heating systems have been developed by various reserach institutions as well as private industries. These systems have become popular not only for domestic use but also for large establishments like hotels, hostels, hospitals, Government buildings, industries such as textiles papers, food processing dairies etc.

4.1.3 MNES has been installing such system for the last many years through state nodal agencies in large number all over the country. The programme was initally launched during 1983-84 with an average subsidy of 75% to 90% which was reduced during subsequent years and brought down to 15% to 18% in 1992-93. Approximately, 12500 domestic and 6150 industrial solar hot water systems have been installed till 31st March, 1993 covering a collector area of around 2.48 lakhs metre square. This in all have been saving the energy to around 130 million kwh per year as against 5×10^{15} kwh/yr of estimated potential of solar energy available in the country.

4.1.4 It is observed from the information furnished by the Ministry that the targets and achievements for installation of collector area were as under:—

	7th Plan	1990-91		1991-92		1992-93		1993-94	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Solar Thermal Systems in Thousand sq.m.	1,42	30	33	43	48	60	25	55	17
			(Till 31.12.93)						

4.1.5 Asked for the reasons for shortfall in achievement during 1992-93, a representative of the Ministry stated during evidence:—

> "There was a problem with regard to the quality of water-heating system supplied by various manufacturers. In order to ensure better quality product, the Ministry insisted upon ISI specifications being adopted by the manufacturers. Those who have got the BIS registration only were eligible to supply the solar water systems to the users. As a result of this, the achievement programme got a little setback. I will not, of course, say it a setback. The industry and the users took a little time to comprehend the various aspects involved in it. Hence, there was a little bit of a shortfall in achievement."

4.1.6 The witness also indicated that the reduction in subsidy also resulted in fall of demand by 15.2% in 1992-93.

4.1.7 Under the new action plan, it is proposed to install solar thermal systems covering around 11 lakh metre square of collector area at the cost of Rs. 240 crores during VIII Plan by mobilising institutional finance and private entrepreneurship to achieve this target, commercialisation approach has been given to the programme and financial assistance to users and manufacturers have been provided through IREDA in terms of soft land and tax benefits instead of direct subsidies since 1.7.1993.

4.1.8 Pointing out that sale of collectors have gone down due to sudden withdrawal of subsidy from July, 93 the Chairman, Bharat Heavy Electricals stated during evidence:—

> "We are not against reducing the subsidy but our point is that it should be reduced over a period of about three years."

4.1.9 An expert on solar thermal energy, who appeared before the Committee stated in this connection:—

> "I think in my view, the programme is not moving fast. As I see it, in Gujarat the sale of solar cookers and solar hot water systems have almost come to a standstill because of withdrawal of the subsidies on these devices."

4.1.10 On the question of withdrawal of subsidy, the Secretary, MNES stated during evidence:—

> "This subsidy available in the budget was a self-limiting factor. Secondly, there is no incentive for cost reduction, there is no incentive for better products and there is no competition because the manufacturing capacity is tied up directly with the availability of subsidy. The third thing that we have analysed and found out was that as a result of the subsidies having to be paid through a number of nodal agencies and through the lower bureaucracy, naturally there was certain amount of malpractices, as in the case of many other programmes where these cash subsidies are doled out through various

avenues. The whole systems promoted a nexus between a few manufecturers and the agencies doing out the subsidies rather than promoting competition for better products and for lowering the costs.

If I may put it in a nutshell, we have now tried to introduce a system where we will give support to them, and we have a devised new mechanisms in which we are going to give soft loans to them. In addition to this, we are advertising, giving publicity and are trying to create an awareness. Of course, there are usual incentives for profit making companies. They can get 100 per cent. depreciation. We have made out a case to the Finance Ministry that for domestic systems also that they should give small tax incentives. They had rejected it; then, I took it up at the level of the Minister. At that level, they had raised an issue saying that they are not in a position to do that. We have, again taken it up recently and sent a note to the Prime Minister.....The domestic users are not having the benefit of 100 per cent. depreciation and that is only meant for companies. So, we said that atleast 50 per cent. of the cost should be exempted and it should be allowed to be deducted from their taxable income. We also said that the revenue losses on account of this to the Government will be minimum and it is possible to administer such a system."

4.1.11 Pleading for tax exemption for individual solar water heating systems, the Ministry stated in a note as under:

"One of the incentives available to industrial units is 100% depreciation concession. However, no such incentive is available to the users of domestic solar water heating systems resulting to the hinderance in the market growth of such systems. With the tax incentives available to the users of these systems, it is expected that the minimum installation in the next 3 years will be around 4000, 6000 and 8000 respectively which could save electricity to the tune of 324 lakh units in total amounting to Rs. 648 lakhs @ Rs. 2/- per unit of electricity. The total revenue loss in terms of income tax rebate @ 30% of the cost of system will result to around Rs. 630 lakh only the net loss is therefore, 'NIL' and rather there will be a gain of environmental and employment benefits apart from electricity saving to the country. In view of the above, tax benefits to the users of domestic solar water heating systems is extremely essential which may be required only for a period of three years by which time, the market would have picked up sufficiently and the tax benefit could be withdrawn thereafter."

4.1.12 Regarding decline in the sale of these systems, a representative of MNES stated:

"It is purely a temporary phenomenon. Because of the programme changes that we have made, the industry is getting used to market development activity rather than going to State nodal agencies."

4.1.13 The M.D., IREDA stated in the connection as under:

"Very recently as per the direction of the Ministry, IREDA has taken up a market oriented programme for solar thermal systems and devices which includes all categories of solar systems for heating applications, not for power generation. It is basically for two categories of end-users-domestic and non-domestic-end-users. We have a programme for domestic of end-users which will have a rate of interest 5% per annum to be repaid over a period of eight years with a moratorium period of one year. They are in a position to repay it in five or six years time keeping in view the present cost of electricity which they have to pay. For a family of five, the installation cost comes to around Rs. 12000 for a 100 litres per day capacity system. In another programme we have for non-domestic-end-users we have kept the rate of interest as 10.3%. It is also six plus two year loan; two years being the moratorium period. These end-users can approach IREDA directly if the value of the loan component is more than 2.5 lakh. If it is less than Rs. 2.5 lakh they can go to manufacturers themselves or they can go to financial intermediaries or they can go to corporate buyers."

4.1.14 Suggesting that the use of solar hot water system should be made compulsory, a representative of BHEL stated:

"All the multi-storey building in Israel have to compulsorily use solar panels. Now our buildings use diesel enegines as a stand by. If we make it compulsory to use solar panels, etc. In hospitals and multi-storeyed building it will help production to a great extent."

4.1.15 In this context one expert from TERI stated:

"I think there is no reason why the city of New Delhi and several parts of India could not have had large scale solar heaters. I might mention that in countries like Israel, almost hundred per cent. of the homes are heated with solar energy. In Cyprus, something like 80% of the homes get solar heat. In many other countries of Southern Europe, you have a similar situation. India is blessed with more solar energy than several other countries and there is no reason why we could not follow a similar approach. So, I think, in the solar thermal field, our performance has not been up to the mark."

4.1.16 In a note furnished to the Committee, MNES stated in this connection:

"To make use of solar hot water systems mandatory in Government buildings a proposal was initiated with Ministry of Urban Development the report of the task force constituted by this Ministry for this purpose has been accepted by the Ministry of Urban Development who in turn has taken a policy decision to make these systems obligatory in hotels, hospitals, and hostels. A letter has been

addressed to State Government by MNES to issue suitable directives to concerned establishements in their States for implementing this decision."

4.1.17 Regarding enactment of legislation in this regard, the Secretary, MNES stated:

"At this stage our development, merely introducing some legislation enforcing things in our country may not be constructive.

We have taken the example of Israel. We are having a dialogue with the Ministry of Urban Development. They have taken a policy decision first to introduce mandatory hot-water system for functional buildings of the Central Government.

We are having a dialogue with them that they should slowly introduce it for functional buildings and also for non-functional buildings by amending the bye laws and recommend it to the State Governments. We have already written to the State Governments for buildings of a functional nature."

4.1.18 As regard to achievement in 1993-94 in respect of collector, the MNES stated in a note as follow:

"A physical target of 55,000 sq. metres collector area had originally been proposed for 1993-94 when the Ministry was implementing an extension programme with subsidy. However, during the year the programme has been changed to market driven programme with financing arrangements through IREDA since 1.7.93. As a consequence of this measure the physical target achievement with available budget will be 15,000 sq. metres collector area through IREDA. It is envisaged that the overall achievement under the old subsidy programme and the new market driven programme will be of the order of 35,000 sq. metres collector area during the current year. The achievement till 31.12.1993 is 16993 sq. metres which includes 2500 sq. metres through IREDA."

Solar Cookers

4.1.19 Solar cooker is a device which cooks food with the help of solar energy, and can save substantial amount of LPG, kerosene and electricity in semi-urban and urban areas. It also acts as an oven cum cooker. Apart from daily meals being prepared by the housewife, it can be used for baking and rosting etc. such as preparation of ghee from butter, kheer, cakes, rosting of ground-nut, basin and sujee etc. Out of the various types of solar cookers developed in past, box type has been quite popular among the people (especially in urban and semi-urban area) and is being sold all over the country under subsidy programme of Central Government. It can cook four items at a time within 2-3 hours depending upon the availability of sunshine and the type of recipe being prepared. On an average it is capable of saving around 3 cylinders of LPG in a year if used regularly.

4.1.20 The Ministry launched this programme during 1982-83 for selling large number of solar cooker all over the country by allocating yearly target to the State nodal agencies. An amount of Rs. 150/- per cooker is provided as Central Government Subsidy other users in addition to that provided from State Governments varying from Rs. 150 to Rs. 250.

4.1.21 The targets and achievements in regard to sale of solar cookers during the last three years are given below:—

	1990-91		1991-92		1992-93	
	Target	Actual	Target	Actual	Target	Actual
Solar Cookers Nos. in thousand	33	27	45	55	40	54

4.1.22 During the year 1993-94 a target for sale of 50000 solar cookers had originally been fixed which was reportedly increased to 68000 based on the requests received from State Governments. The physical achievement till 31.12.1993 was 22643. MNES envisage that the target will be achieved in full during the current financial year.

4.1.23 During the VIIIth Plan period the Ministry has kept a sale target of 7 lakhs solar cookers. For this thrust is being given on commercialisaion/market orientation to the programme. It has been decided that Central subsidy on solar cookers will be withdrawn w.e.f. 1.4.1994 and the programme will be left free to the manufacturers and market intermediaries for promoting it among the public. To maintain quality and durability of solar cookers, standard specifications laid down by MNES have been approved by BIS. 73 solar cooker manufacturers also exists all over the country, among whom 25 have already applied to BIS for ISI recognition. The facilities of Regional Test Centres developed in the country will be made available to the manufacturers for getting their product tested for ISI certification.

4.1.24 The financial incentives to buyers and manufacturers is planned to be provided in terms of soft loan and tax benefits apart from the sale tax and excise exemptions on the product to manufactures. According MNES, the approach of market orientation will help in bringing better model of solar cookers in the market with reduced price. This in turn will help in increasing the sale of solar cookers throughout the country solving the great shortage of fossil fuel for cooking energy need.

(ii) Energy from Urban, Municipal & Industrial Wastes and its Utilisation

4.2.1 India generates large quantities of wastes from Urban, Municipal and Industrial sectors and most of these wastes find their way into the

environment with little or no treatment which results in their natural biodegradation with consequent release of methane into the atmosphere. These resources, if effectively utilised, can offer viable option for energy generation with attendant benefits of reducing emission of green house gases, avoiding deforestation, and minimising environmental pollution. The results of research and development efforts and experience gained from some of the pilot experimental projects on utilisation of urban/municipal and industrial wastes have made possible to scale up and demonstrate technologies to utilise these wastes and residues for recovery of energy.

4.2.2. Under the new strategy and action plan adopted by MNES, it has been proposed to extend the coverage to include high rate biomethanation of various substrates and efficient utilisation of biogas generated from them as a means of providing effective technologies using the renewable biomass resources and wastes.

Objectives

4.2.3 In the first phase of this activity a National Programme has been initiated which is being partly supported by UNDP under its GEF technical grant. The activities under this programme cover:

— Development of institutional framework at the national level to generate the necessary awareness and capabilities to provide the impetus to the bioenergy development programme utilising high rate biomethanation processes, etc.

— To develop requisite expertise and capabilities in the national and State level institutions, R&D organisations and Universities to assimilate and adapt technology, improve applied R&D skills in the field and to provide technical knowhow and assistance in setting up plants using the biomethanation processes.

— Promote the use of biomethanation technology and biogas utilisation as cost effective means of energy generation.

— To develop the national master plan and shelf of investment proposals to utilise this important renewable resource.

4.2.4 The following demonstration plants are to set up under the programme:—

(a) Community sewage treatment plants	3 nos.
(b) Leather effluent/solid waste treatment plants	4 nos.
(c) Abattoir waste treatment plants	1 nos.
(d) Pulp & Paper effluent treatment plants	2 nos.
(e) Vegetable market waste/MSW treatment plants	3 nos.
(f) Biogas utilisation projects	3 nos.

4.2.5 The duration of the programme to achieve the above objectives will be five years starting from January, 1994. The total estimated outlay of the programme is Rs. 30.70 crores, Rs. 14.20 crores being MNES share and balance being assistance from UNDP/GEF. In addition there would be a financial participation by user agencies/industries of the order of about
Rs. 10.00 crores in the cost of above demonstration projects.

4.2.6 In order to achieve the objective and targets in a time bound manner, a National Bioenergy Board (NBB) is being constituted in the Ministry of Non-Conventional Energy Sources. The Secretary, MNES will be the Chairman of NBB. The NBB will have the representation of members from other related Govt. Ministries/Departments. In addition to above, industrial associations, national institutions and other agencies as well as national and international experts (UNDP & other consultants) having relevance to the programme would also be invited to participate in the NBB and implementation of the programme.

4.2.7 The functions of NBB will be two fold; to develop a national strategy for bioenergy development for longer range planning purpose and to provide guidance and directions to various sub projects demonstration as proposed under the programme.

V. NEW TECHNOLOGY AREAS

5.1 In the field of renewable energy, some of the promising new technology areas are alternate fuels and battery vehicles for surface transportation and ocean energy. Other new technology areas include hydrogen energy, fuel cells and geo thermal energy.

5.2 Technology for battery operated vehicles for 18 seater and 32 seater capacity and five models for industrial uses have been developed indigenously by BHEL, Bhopal and two other private firms which are now manufacturing these vehicles on commercial scale.

— Over 250 Battery Operated Vehicles are in use for passenger and industrial uses.

— Technologies for alternate fuels *viz.* ethanol, methanol and Compressed Natural Gas have been developed and demonstrated.

— About 50 diesel buses of DTC and MSTC have been run on dual fuel (diesel-alcohol) and logged about 40 lakh Kms. The visible smoke in emission of these buses could be reduced by about 35% as compared to diesel alone. 10 percent blending of alcohol with petrol and its use in 25 vehicles of Delhi Administration is currently being demonstrated at Mall Road, Delhi.

5.3 A proposal for commissioning of 1 MW power plant based on wave energy in A&N Islands by M/s Sea Power AB, Sweden and another proposal for commissioning of 100 MW OTEC off the Tamil Nadu Coast by M/s Sea Solar Power, USA have been proposed under the category of build-own-operate. A Memorandum of Understanding has since been signed between the State Govt. of Tamil Nadu and M/s Sea Solar Power for setting up a 100 MW OTEC plant near Kulasekarapatinam by SSP with an investment of 250 million dollars.

5.4 The subject of tidal power has recently been shifted from Ministry of Power to Ministry of Non-Conventional Energy Sources. A techno-economic feasibility study report for 900 MW tidal power in the Gulf of Kachchh has been prepared by Central Electricity Authority. The total cost of this project is estimated to be Rs. 6000 crores as per the norms for power plant under Central sector.

5.5 The task for execution of the project has been entrusted to NHPC by Ministry of Power. NHPC has indicated a requirement of Rs. 5.0 crores for getting appraisal of the feasibility report by export foreign firms/ consultants, conducting pre-investment feasibility studies and survey and investigation for tidal power areas in Gulf of Cambay and Sunderban areas.

5.6 In regard to constraints, MNES stated in a note as under:

> "The New Technology Programme has suffered major set back due to provision of adequate Budget in the Annual Plans. To plan and implement large scale and impact making projects in alternate fuels and ocean energy, there should be provision of adequate budget in Central sector, as the State Transport Corporations and State Governments are not able to put funds in these new areas. In case of exploitation of ocean energy, the indigenous technologies are at recent level. These technologies have not been fully commercialised even globally."

5.7 Asked how soon is it expected to harness different forms of ocean energy, the MNES stated in a post evidence reply as under:

> "There are mainly three forms of ocean energy *viz.* wave energy, tidal energy and ocean thermal energy conversion. Tidal energy has been exploited commercially in France, Canada, China and Russia. A tidal energy power plant of 240 MW capacity is commercially in operation since 1966 in France. The other ocean energy technologies are at proof of concept level and multi-mega-watt plants could not be taken up due to high capital costs in comparison to conventional power plants. In view of large potential for power generation and environmental benefits from ocean energy, there is great need to give more emphasis to exploit these technologies for power generation at commercial level. With the greater emphasis being laid on environment protection, these technologies are expected to mature in next 10-15 years on commercial basis. The first OTEC project is likely to come up in India. An MoU has been signed recently between Tamil Nadu Electricity Board and M/s Sea Solar Power INc. USA for setting up a 100 MW Ocean Thermal Power project. The first unit of 100 MW of power at a cost of US$ 250 million is likely to be commissioned in 3-4 years."

During their on the spot-study visit to IIT, Madras the Sub-Committee on NCES was apprised of the research programme started in 1982 by the Wave Energy Project Group. Based on the design data developed in the laboratories a demonstration plant of 150 KW capacity for conversion of wave energy into electrical energy has been built at Vizhigam near Trivandrum. It was commissioned in Oct., 1991. The Sub-Committee were informed during their visit to this plant that the structure built originally for the plant was washed away by a cyclone and that it took 6-7 years to design and build a stable structure. The Sub-Committee was further informed that they have now been successful in finalising the civil engineering design of the structure.

Research and Development

5.8 According to an assessment of Planning Commission, linkages between R&D and their commercialisation remained tenuous and weak both at the Centre and State levels. Manufacturing units still do not have adequate production capacity for NRSE technologies and adoption of adequate quality control measures by them have not been very satisfactory.

5.9 MNES stated in this connection that efforts are underway to associate industry in all major R&D projects right from the start in order to ensure stronger linkages between R&D and industry and facilitate their commercialisation. The market orientation and competitive environment is also likely to result in increased production.

5.10 It was suggested to the Committee by an expert that the Ministry should develop R&D strategy, specifying goals for achievement in a given time frame and should set up a Committee of experts including representatives of industry and manufacturers to monitor the progress of R&D. Reaching to this suggestion MNES stated in a post evidence reply:

> "Expert Committees for major programmes have been employed from time to time. Recently, following the re-organisation of the activities of the Ministry, an apex Advisory Committee for the Ministry comprising representatives for industry, both public and private, representatives of non-governmental organisations, educational institutions and user agencies has been set up. The R&D programmes of the Ministry is being reviewed by a Committee to develop a comprehensive R&D strategy with clear cut priorities and goals and appropriate linkages with industry. The Apex Committee will consider the new directions of R&D and long term strategies to be followed along the lines of what has been followed by other countries including JAPAN."

PART B

Conclusions and Recommendations of the Committee

1. Renewable energy sources are perennial, dependable and abundantly available besides being non-polluting and environment friendly. One viable option to the problem of increasing energy shortages lies in harnessing new and renewable sources of energy (NRSE). The Committee's examination of non-conventional energy sources schemes reveals that the record of harnessing renewable energy until recently was rather poor. With the exception of biogas plants and improved chulhas, implementation of most of the other programmes were not at desired level. The Committee however find that in the area of power generation some renewable energy technologies such as of wind power, small hydels, bio-mass gasification and co-generation have reached the stage of commercialisation. The Committee feel that for catalysing the market development and to ensure that the NRSE play their due role in generation of power/energy, there is a need to step up the pace of implementation of the on-going programmes and launch new programmes of demonstration and utilisation of renewable energy technologies.

2. The Committee observe that in terms of resources, the trend in allocation of funds to NRSE has been hopelessly poor which largely constrained the implementation of various programmes. The fund allocations for NRSE over the 7th and 8th plan periods have been only a small fraction of the total energy sector allocations. Out of the total outlay of Rs. 1,16,230 crores for the energy sector in the 8th plan, the share of NRSE is less than even one percent. The Committee are of the firm view that so long as allocations remain at the current level, non-conventional energy will continued to be viewed in terms of playing a marginal role. The Ministry has indicated additional requirement of Rs. 673 crores for budgetary support and Rs. 785 crores under the state plan to achieve the targeted goal in the new Strategy and Action Plan. The Committee feel that there is a strong case for correcting the imbalance in resource allocation for NRSE and accordingly recommend that a beginning in this direction should be made by allocating additional funds needed by the Ministry for implementing the new Strategy & Action Plan in the 8th plan period.

3. The Committee find that there is a vast potential of 20,000 MW for wind power and 17,000 for biomass and 10,000 MW for Mini-Micro Hydel power. Ocean Thermal Sea Wave and Tidal power constitute a potential of 79,000 MW. Besides these, there is vast availability of solar energy. On the

basis of data available so far an ambitious programme for installation of 12 million biogas plants and 120 million improved chulhas, can be considered as achievable which if fully implemented would save wood equivalent to over 120 MMT/year. As Against this enormous potential, the number of biogas plants installed is 1.8 million and improved chulhas 15.3 million. According to MNES the power generation capacity installed so far is just 71 MW* of wind power 105 MW Small Hydel Power and 15 MW biomass based systems. As these systems are cost effective and can be commercialised, the Committee urge that a perspective plan and a crash programme for exploiting the vast potential of New and Renewable sources should be drawn up at the earliest and commensurate programmes formulated to be included in the successive Five Year Plans.

4. The Committee note that the Ministry has prepared a "New Strategy & Action Plan" which aims at generation of nearly 2000 MW of power through Wind, Small Hydro and Bio-energy sources as against 600 MW envisaged earlier in VIII Plan. It also envisages propagation of one lakh number solar lanterns during a year; launching of new programme for 50,000 deep well Solar Pumps for irrigation wider application of Solar Thermal energy; launching of several national programmes for bio-energy utilization and setting up of projects in the new and emerging areas of technologies such as tidal power, geo-thermal and ocean thermal energy conversion, etc. The Committee would urge that the MNES should periodically monitor the progress and ensure that the targets aimed in the Action Plan are achieved without shortfall.

5. The Committee find that wind energy, small hydro and biomass based co-generation have been identified as areas holding considerable promise for grid interactive power generation. There are, however some institutional or operational impediments which come in the way of quick exploitation of the potential. The measures called for in this connection are indicated below:

(i) There is need for development of suitable infrastructure and allotment of land to windfarms and small hydro developers by State Governments. In the case of private lands, the concept of making land owner a co-sharer in the project and the possibility of putting the land to conjuctive use be examined and promoted.

(ii) The Committee note that private sector has shown considerable interest in establishing Wind Farm, Small Hydro and

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* When the Sub-Committee undertook on the spot study, a private manufacturer *viz.* NEPC—Micon, Madras informed that wind Electric Generators supplied by the company alone exceeds 100 MW capacity.

Cogeneration projects. However, most of the States are yet to announce a clear promotional policy to attract private developers and entrepreneurs. The Ministry has suggested guidelines to States including wheeling, banking, third party sale, minimum buy-back rate of Rs. 2.25 per unit, etc. The Committee have been informed that some of these incentives are already available in Gujarat, Tamil Nadu and Andhra Pradesh. The Committee suggest that the other State Governments should also announce the policy in this regard expeditiously.

(iii) The Committee have been informed that there is delay in planning and execution of the projects on account of multiplicity of agencies at the State level, who are concerned with these projects. The Committee feel that a suitable institutional framework should be set up for dealing with these projects. The Committee would suggest that as already done in a few States, a State Level Committee should be set up to coordinate and provide "Single Window" clearance and a separate "Cell" should be set up in the State Electricity Boards to provide assistance to entrepreneurs.

(iv) There is considerable delay in environment and forestry clearance for wind power and small hydro projects. The Ministry of Environment and Forests should take an early decision on the question of exemption of environmental clearances for small hydro projects upto 5 MW and simple and quick procedure evolved for relatively larger projects, say upto 15 MW. This will enable speedy exploitation of small hydro potential which is abundant in regions like North Bihar and other river basin.

(v) In order to bring about additionality of resources, the Committee recommend that co-generation projects in sugar factories should be included under the modernisation programme for which sugar development fund provides soft loans to the sugar factories.

(vi) With regard to the question of 100% depreciation under the Income Tax Rules for equipments used in the micro-hydel projects, the Committee wonder why the Govt. has not decided this issue so far considering the fact that this concession is already available for major power projects and certain items of non-conventional energy plant and machinery. In order to encourage private sector participation, the Committee urge that this concession should be extended to small hydro projects without any further delay.

(vii) The Committee recommend that small hydro projects upto 15 MW should be transferred to the Ministry of Non-Conventional Energy Sources.

6. The Committee note that on the basis of wind assessment programme undertaken so far specific sites have been identified mostly in the peninsular region. The Committee learn that there are several gaps in the Arvali range in Rajasthan which offer ideal spots for exploiting the wind potential. The

Ministry is also hopeful of discovering suitable wind speeds in mountain regions of Himachal Pradesh, UP and North East. The Committee desire that the wind assessment programme should be completed in a given time frame and the sites with wind potential suitable for power generation in all parts of the country should be identified and published to accelerate exploitation of this potential.

7. At present, data for three years is collected to assess the wind speed at a particular site. According to an expert one year data in this regard will be sufficient to make an assessment. The Committee therefore recommend that the desirability of curtailing the period of assessment to one year may be examined keeping in view the need to accelerate harnessing wind power potential.

8. Under the SPV programme, 30438 street lighting systems, 18,970 domestic lighting systems, 7624 solar lanterns, 808 community lighting-TV systems and 101 power plants totalling 531 KW have been installed. An appraisal of this programme by the CAG has brought out that most of the systems installed under SPV programme were not working mainly due to lack of proper maintenance, poor performance of the systems and apathy of local users. The average failure rate of street lighting, domestic lighting systems and water pumps ranged from 25% to 100% in some states surveyed. The Committee feel that this problem could be solved only if sufficient training is imparted to the users and the systems entrusted to the village panchayats or any other responsible body in the village for operating and maintaining the systems. In the subsidy based programme, the manufacturers of the systems hardly had any incentive for giving services or guarantees. The Committee note that the programme has been restructured recently and given a market orientation and two separate schemes i.e. Market Oriented and Socially Oriented Schemes introduced. The Committee hope that the Ministry will exercise care to see that past failures do not recur and appropriate measures taken to successfully implement socially oriented scheme where the chances of such failures are more.

9. The high initial cost is the main barrier in SPV technology. The production cost of solar cell/modules is essentially dominated by the silicon wafer which is a major and expensive input material. The Committee have been informed that efforts are on to improve the conversion efficiency of solar cells from 15% to the level of 18—20%. With improvements in the efficiency of solar cells and increase in production volumes costs are expected to come down to Rs. 100/MW in next 3-4 years from the level of Rs. 195/MP. The Committee urge that efforts should be made to expand the use of photovoltaics to spurt the demand which would break the low production high cost cycle and bring about cost reduction. The Committee also note that BHEL is working on the development of polycrystalline silicon solar cells and also entrusted with the responsibility for establishing 500 KW/shift pilot plant at Gurgaon for amorphous silicon modules. The Committee desire that this new technology should be given a

laboratory trial in a given time frame and a successful commercial utilisation ensured by creating suitable production capacities in the new plants.

10. The Committee note that for promotion of solar thermal power generation a R&D-cum-demonstration project of 30 MW size has been proposed to be installed in Rajasthan by BHEL in association with M/s Solel of Israel. The Committee note this project which had originally been conceived 15 years back is still at the stage of preparation of project report. Time and cost overrun ultimately make such efforts prohibitive and difficult to be undertaken on the plea of paucity of funds. The Committee desire that the project should be taken up for execution early and completed on schedule so that the project may induce private sector participation in setting up of such projects elsewhere.

11. The Committee observe that the programme relating to solar water heating systems has suffered considerably due to reduction/withdrawal of subsidy during the last two years. The installation of collector area in 1992-93 was just 25,000 sq.m. as against the target of 60,000 sq.m. and in 1993-94 the installation up to the end of Dec. 1993 was only 17,000 sq.m. as against the target of 55,000 sq.m. In the Committee's view, withdrawal of subsidy in this case is a step in the right direction as it had constrained the market development, product development and after sales service. In order to reverse the present trend and promote the market, the MNES has pleaded for 100% income tax benefit to the user of domestic solar water heating system. The Committee see merit in Ministry's plea as the commercial user already has this incentive. An economic cost-benefit analysis of income tax rebate also shows a net gain to the economy. The Committee therefore, recommend that the question of income tax rebate should be looked into by the Ministry of Finance on a right perspective and the relief sought for be announced at the earliest.

12. The Committee note that the matter regarding obligatory use of solar water heating systems in hotels, hospitals and hostels has been taken up with the state governments following a policy decision taken by the Ministry of Urban Development in this regard. The Committee suggest in this connection that the desirability of wider provision for mandatory use of solar water heating system in all govt. buildings and public sector undertakings and also the need for amendment of Building Byelaws by State Govts. to incorporate mandatory use of these systems should be examined and if found appropriate, steps should be taken early to implement the same.

13. The Committee are not impressed by the number of solar cookers sold during the last 12 years of the subsidy scheme which is just about 3.10 lakh. Considering the advantages of this device particularly in solving the fossil fuel shortage, the Committee felt that it should have been possible to propagate the use of solar cookers on a large scale. The MNES has

proposed to withdraw the subsidy on solar cookers from April, 1994. Now that the programme will be market driven, the Committee hope that it will yield a better product at a competitive price and eventually ensure wider use of solar cookers.

14. One of the barriers to market expansion of domestic renewable energy systems and devices like bio-gas, improved chulhas, domestic solar hot water systems, solar cookers, etc. is stated to be low availability of institutional financing for these devices. The Committee desire that efforts should be made for ensuring greater participation of financial institutions including commercial banks in financing the non-conventional energy devices.

15. The Sub-Committee observed that there were discrepancies in the figures of utilisation of funds by the Ministry during the 7th Plan. This was pointed out to the officials of the Ministry during their oral evidence on 27.1.94 and the sitting of the Sub-Committee was adjourned for want of satisfactory clarification from the officials. The Committee observe that the figures furnished after evidence regarding total funds required during the 8th plan by the Ministry in respect of small hydro, wind power, co-generation and solar thermal programmes do not tally with the break-up of figures. The Committee note with serious concern that the Ministry has not exercised proper care in furnishing information despite the fact that the Secretary, Ministry of NCES asked for another opportunity to furnish the correct figures. It is regretted that the same has not been done even in their later correspondence. This is a serious lapse on the part of the Ministry and they should set things right by furnishing the correct data at the earliest. In the meantime the Committee expects that a proper explanation about the discrepancy would be provided at the earliest.*

16. Though there has been considerable progress in installation of bio-gas plants and improved chulhas, their functionality rate leaves much to be desired. While the failure rate was over 50% in the case of bio-gas plants in some states, it was in the range of 25-30% in the case of improved chulhas. The Committee desire that special emphasis needs to be given on development of micro-organisms that can produce bio-gas under low temperatures and with low water consumption and also development of alternative feed stocks and low-cost designs in respect of bio-gas plants. For the success of community bio-gas, there is a need to involve and ensure the commitment of the local people.

17. The proposed establishement of a National Bio-energy Board to develop a national strategy for bio-energy development is a step long overdue. This is expected to provide impetus to the bio-energy development programme utilising high rate biomethanation processes. The Committee

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* At the time of factual verification of the draft report, the Ministry clarified that the fund requirements shown at Sl. No. 2 of the table is the sum of serial No. 4 to 7 and that the serial no. 3 is summation of serial No. 4 and 5.

note that demonstration plants on utilisation of Urban/Municipal and ~~vegetable market waste. The Committee desire that the task of setting~~ Industrial wastes are planned to be set up over a period of five years with an outlay of nearly Rs. 31 crores. These projects will include community sewage, leather effluent/soil waste, abattoir waste, pulp and paper effluent and vegetable market waste. The Committee desire that the task of setting up of these demonstration plants should be acomplished expeditiously without bracketing into a five year long time frame.

18. The Committee note that a bio-mass gasification and densification programme for power generation, water pumping and thermal applications has been launched with a target of 100MW under the new Strategy & Action Plan. About 94 million tonnes of agro-residues and industrial wastes are reportedly not used at all for any purpose annually. Bio-mass gasifiers opens a vast potential for village electrification in remote and inaccessible areas where bio-mass is available in abundance. The Committee feel that this could perhaps be an ideal solution for the electrification of remote villages in hilly areas, inside deep forests and islands.

19. The Committee are not happy with the performance of wind pump demonstration programme which suffered sever set back in terms of achieving targets and functionality. Over 2800 shallow well water pumping wind mills have been installed so far which were installed with the full cost of the hardware being funded by MNES. A cost sharing scheme has reportedly been launched during the current year with MNES contribution limited to about 50%. The performance of wind battery chargers programme was no better. The Committee desire that the programmes relating to wind, pumps and wind battery chargers should be thoroughly reviewed with a view to identifying deficiencies and taking appropriate corrective measures.

20. There is a great scope for developing and marketing improved animal drawn vehicles suitable for different areas of the country. According to MNES, improved designs of carts developed by CARTMAN and by a private organisation have been taken up for demonstration and a national programme to increase the transport capability for short distance haulage using the Draught Animal Power System is being developed. The Committee desire that the programme should be finalised and launched soon and the Committee be apprised of the details of the programme.

21. Animal drawn plough and other equipments still remain the mainstay in the field of agriculture and for centuries together no change in their design has been made to improve their effectiveness with the result that draught power of animals is wasted. Since the present wastage is enormous the Committee recommend that institutional support should be provided to organisations like CARTMAN to improve the designs of animal drawn plough and other equipments with a view to reducing the burden on the animals and also to improve the efficiency of equipments.

22. With commercial scale manufacture of battery operated vehicles for 18 seater/32 seater capacity and different models for industrial uses, the

programme for battery operated vehicles needs to be enlarged. This should get proper publicity so that industrial units, paramilitary forces, defence establishments etc. where vehicles are utilised for transportation of employees at short distances are attracted to use these vehicles. The Committee hardly need to emphasise the need for concerted efforts to develop bigger vehicles with higher pay load capacity and longer ranges.

23. The Committee fail to understand why our country had to lag behind in exploiting the large potential of tidal energy considering the fact that this has been exploited commercially by several countries in the past nearly three decades. A tidal energy power plant of 240 MW capacity is stated to be in operation in France since 1966. It is only now a pre-investment feasibility study has been proposed to be conducted for establishing a 900 MW tidal power project in the Gulf of Kach. The Committee would like to be apprised of the anticipated power generation cost and the likely completion schedule of this project. If found commercially viable, the Committee stress that efforts should be made to set up such projects in other feasible sites early. Another notable step in the field of ocean energy is signing of an MoU between Tamil Nadu Electricity Board and M/s. Sea Solar Power for setting up a 100 MW Ocean Thermal Energy Conversion project by SSP on build-on-operate basis. In view of large potential for power generation and environmental benefits from ocean energy, the Committee feel that there is great need to give more emphasis to exploit these technologies for power generation at commercial level. The Committee desire that in order to give impetus to the new technology programme adequate funds should be provided on priority basis.

24. In view of the vast potential of ocean thermal energy indicated by the MNES, the Committee suggest that a separate cell may be set up to conduct extensive survey and identify the possible sites to enable exploitation of ocean thermal energy.

25. The Committee note that a demonstration plant of 150 KW capacity was commissioned at Vizhiagam near Trivandrum in Oct., 1991 for conversion of wave energy into electrical energy. During the on the spot study visit, the Sub-Committee were informed that the structure originally built for plant had been washed away by a cyclone and that it took 6-7 years to design and build a stable structure. They have now been successful in finalising the civil engineering design of the structure. The Committee in this connection would like to emphasise that the time lag between successful completion of a research project at laboratory stage and its Commercial exploitation should be reduced to the minimum.

26. The Committee have been informed that the R&D programmes of the Ministry is being reviewed by a Committee to develop a comprehensive R&D strategy with clear cut priorities and goals and appropriate linkages with industry. The Committee will await the outcome of the review and the action taken on its findings. The Committee suggest in this connection that

major public undertakings like BHEL should be directed to provide more funds for R&D particularly to new and renewable energy technologies. Private sector should also be asked to include a definite percentage of funds for R&D in their project report for new Industry. The feasibility of including this as a condition before sanction of funds by financial institutions should be examined.

27. The Committee feel that there is a need for adoption of an integrated approach to propagate renewable energy systems alongwith rural development programme and energy conservation programme.

28. In order to bring about mass awareness of the renewable sources of energy and their importance the Committee also feel that renewable energy should be introduced as a subject in the school curriculum at various stages.

NEW DELHI;
18 April, 1994

28 Chaitra, 1916 (Saka)

JASWANT SINGH,
Chairman,
Committee on Energy.

APPENDIX-I

COMPOSITION OF THE STANDING COMMITTEE ON ENERGY (1993-94)

CHAIRMAN

Shri Jaswant Singh

Lok Sabha

2. Shri Bhawani Lal Verma
3. Shri Murli Deora
4. Shri Motilal Singh
5. Shri Khelsai Singh
6. Shri Khelan Ram Jangde
7. Shri Parasram Bhardwaj
8. Shri S. Thota Subha Rao
9. Shri Shiv Charan Mathur
10. Shri K.P. Reddaiah Yadav
11. Dr. Krupasindhu Bhoi
12. Shri Dalbir Singh
13. Shri Vilas Muttemwar
14. Shri P.C. Chacko
15. Shri Virender Singh
16. Shri Laxminarain Tripathi
17. Prof. Rita Verma
18. Shri Ram Tahal Chaudhary
19. Shri Shankersinh Vaghela
20. Shri Keshari Lal
21. Shri Rajesh Kumar
22. Shri Arjun Singh Yadav
23. Shri Ajit Singh
24. Shri Haradhan Roy
25. Shri Anil Basu
26. Shri Vijay Kumar Yadav
27. Dr. Venkataswara D. Rao
28. Shri Chitta Basu
29. Shri Mohan Singh (Ferozpur)
30. Shrimati Dil Kumari Bhandari

Rajya Sabha

31. Shri Parmeshwar Kumar Aggarwalla
*32. Shri Sunil Basu Ray

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* Ceased to be a Member of the Committee consequent on his retirement from Rajya Sabha on 9th July, 1993.

33. Shri M.M. Hashim
***34. Shri Manmohan Mathur
35. Smt. Ila Panda
36. Shri J.S. Raju
***37. Shri Dayanand Sahay
38. Shri Rajni Ranjan Sahu
39. Shri Viren J. Sahu
40. Shri Matang Singh
***41. Smt. Kamla Sinha
**42. Shri Yashwant Sinha
43. Dr. Naunihal Singh

** Ceased to be a Member of the Committee consequent on his resignation from Rajya Sabha w.e.f. 14th November, 1993.

*** Ceased to be Member of the Committee consequent on his retirement from Rajya Sabha on 2nd April, 1994.

APPENDIX-II

COMPOSITION OF SUB-COMMITTEE ON NON-CONVENTIONAL ENERGY SOURCES (1993-94)

Shri Shiv Charan Mathur — *Convenor*

MEMBERS

2. Shri Shankersinh Vaghela — *Alternate Convenor*
3. Shri S. Thota Subbarao
4. Shri K. P. Reddaiah Yadav
5. Shri Vilas Muttemwar
6. Shri P.C. Chacko
7. Shri Rajesh Kumar
8. Shri Arjun Singh Yadav
9. Shri Ajit Singh
10. Shri Manmohan Mathur
11. Smt. Ila Panda
12. Shri Matang Sing
13. Dr. Naunihal Singh