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STANDING COMMITTEE ON ENERGY

(2011-12)

FIFTEENTH LOK SABHA

MINISTRY OF NEW AND RENEWABLE ENERGY

AVAILABILITY OF IDENTIFIED NON-CONVENTIONAL RESOURCES OF ENERGY – THEIR POTENTIAL VIS-À-VIS UTILIZATION

TWENTY-NINETH REPORT

LOK SABHA SECRETARIAT
NEW DELHI

August, 2012/Shravana, 1934 (Saka)

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Presented to Lok Sabha on 24.08.2012

Laid in Rajya Sabha on 24.08.2012

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(2011-12)

Shri Mulayam Singh Yadav - Chairman

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3	Shri N.K Pandey	Additional Director
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* Nominated as member of the Committee w.e.f. 04.05.2012 *vice* Smt. Shobhana Bhartia retired from Rajya Sabha on 15.02.2012.

@ Nominated as members of the Committee w.e.f. 15.05.2012 *vice* Shri Govindrao Adik and Shri Veer Pal Singh Yadav retired from Rajya Sabha on 02.04.2012.

INTRODUCTION

I, the Chairman, Standing Committee on Energy having been authorized by the Committee to present the Report on their behalf, present this Twenty-nineth Report on 'Availability of Identified Non-conventional Resources of Energy – Their Potential vis-à-vis Utilization.'

2. The Committee took briefing and evidence of the representatives of the Ministry of New and Renewable Energy on 1st December, 2011 and 1st March, 2012 respectively. The Committee wish to express their thanks to the representatives of the Ministry for appearing before the Committee for evidence and furnishing the information, desired by the Committee in connection with the issues relating to the subject.

3. The Report was considered and adopted by the Committee at their sitting held on 16th August, 2012.

4. The Committee place on record their appreciation for the valuable assistance rendered to them by the officials of the Lok Sabha Secretariat attached to the Committee.

5. For facility of reference and convenience, the observations and recommendations of the Committee have been printed in bold letters in Part-II of the Report.

NEW DELHI
22 August, 2012
Shravana 31, 1934 (Saka)

MULAYAM SINGH YADAV
Chairman,
Standing Committee on Energy

REPORT

PART I

NARRATION ANALYSIS

I INTRODUCTORY

Energy requirement is vital component and directly related to the economic growth of a country. Currently, installed capacity of electricity generation in the country is 1,90,516 MW and out of this 25,000 MW comes from renewable sources like wind, solar, etc. As per the Approach Paper for the 12th Five Year Plan, energy availability has been identified as a potential challenge that needs to be addressed to a substantial degree. It is estimated that for the GDP, to grow at 9%, commercial energy supplies will have to grow at a rate between 6.5-7% per year and suggests a need for 1,00,000 MW power capacity addition during the plan period. India has an energy supply shortage of 10.2%. It is expected that country's peak demand will rise to 3,35,000 MW by 2017 and there is an urgent need to build up its energy infrastructure fast enough to keep pace with the economic and social changes and to ensure sustainable GDP growth and access to electricity for all.

1.2 Conventional sources of energy, coal, oil, natural gas and nuclear energy - are non-renewable and their use is invariably associated with problems of environmental pollution, deforestation, fast depleting resources which cannot be replenished in near future. Moreover, the centralized system of power generation which we have developed with conventional sources of energy involves huge generation and distribution networks. The use of non-renewable resources in power generation involves huge expenditure, increased competition for limited resources leading to exorbitant prices, dependence on imports and energy security. It is a known fact that conventional sources of energy have their own limitations. With ever growing demand of energy, alternative means of energy will have to be explored so as to reduce our dependence on the fast depleting conventional sources.

1.3 In 1982, a separate Department of Non-Conventional Energy Sources (DNES) was created in the Ministry of Energy to look after all the aspects relating to new and renewable energy. The Department was upgraded into a separate Ministry of Non-Conventional Energy Sources (MNES) in 1992 and was rechristened as Ministry of New and Renewable Energy (MNRE) in October, 2006.

1.4 As per the information furnished by the Ministry of New and Renewable Energy (MNRE), starting with the 9th Plan, there has been consistent increase in pace of renewable energy development. Reportedly, India's renewable energy installed capacity has grown at an annual rate of 23%, rising from about 3900 MW in 2002-03 to about 24000 MW in 2011-12. Wind energy dominates India's renewable energy industry, accounting for 70% of installed capacity (17353 MW). It is followed by small hydro power 14% (3395 MW), biomass power 13%(3225 MW) and solar power 4% (941 MW) that has just started registering its presence. In terms of electricity generation with normative capacity utilization factors, the renewable power installed capacity in generating around 49 BU per year corresponding to 6% in total electricity and 11% of total capacity in 2010-11 (12.14% as on 31.01.2012). Off-grid applications of renewable energy have also made significant headway. It is pertinent to mention here that Indian Renewable Energy Programme is primarily private sector driven. It offers significant investment and business opportunities. According to the MNRE, renewable energy has started making visible impact in the Indian energy scenario viz. contributing around 12% of national electricity installed capacity and renewable energy based decentralized and distributed application thereby benefiting millions of rural folks in their cooking, lighting and other energy requirements in an environmentally benign manner, employment generation at village level and creation of opportunity and economic activities at village levels.

II. NON-CONVENTIONAL ENERGY RESOURCES - POTENTIAL VIS-À-VIS UTILIZATION

1.5 Energy generated by using wind, solar, small hydro, tides, geothermal heat and biomass is known a non-conventional energy. All these sources are renewable process of energy generation and do not cause environmental pollution. Our country has been endowed with adequate natural resources.

1.6 According to the Ministry of New and Renewable Energy, Plan-wise renewable power growth is as under:

	Beginning of 10th Plan (MW) 1.4.2002	Beginning of 11th Plan (MW) 1.4.2007	Target 11th Plan (MW)	11th Plan Achievement as on 31.03.2012 (MW)	Cumulative Achievement up to 31.03.2012 (MW)
Wind	1,628	7,092	9,000	10260	17353
Small Hydro	1,434	1,976	1,400	1419	3395
Bio Power	389	1,184	1,780	2042	3225
Solar	2	3	200	938	941
Total	**3,453**	**10,255**		**14659**	**24914**

,

1.7 State-wise installed capacity vis-à-vis estimated potential of the renewable energy sources in respect of Wind Power, Small Hydro Power, Biomas Power, Waste to Power and Solar Power furnished by the Ministry is given at ***Annexure-I.***

1.8 Estimated potential, installed capacity by the end of 11th Plan, capacity addition target for 12th Plan (2012-17) furnished by the Ministry is as follows:

Source	**Estimated potential MW**	**installed capacity by end of 11th Plan 31.3.2012**	**Capacity addition target for 12th Plan (2012-17)**	**Target installed capacity at the end of 12th Plan**	**% of Potential likely to be harnessed at the end of 12th Plan**
Wind Power	49,000	17353	15,000	32553	66%
Small Hydro Power	15,000	3395	2,100	5495	37%
Biomass Power	17,000	1150	500	1650	10%
Bagasse Co-generation	5,000	1985	1,400	3385	68%
Waste to Power	2,600 1,300	90	500	590	15%
Solar Power	>100,000	941	10,000	10,941	<11%
TOTAL	**>1,89,900**	**24914**	**29,500**	**54414**	**<29%**

1.9 According to Greenpeace Organisation, India has hardly exploited the renewable energy potential which exists in the country. Renewable energy potential is likely to be even greater considering that sources with significant generation capacity such as off-shore wind farms are yet to be mapped. In sectors such as wind and small hydropower, application of the latest developments in engineering design and equipment technology are also likely to increase potential, as are the discovery of new small hydro power sites. The potential for solar power will also increase significantly as technology improves.

1.10 Explaining about overall estimated potential, installed capacity and the growth of new and renewable energy sector, the Secretary, MNRE, during evidence stated before the Committee as follows"

> "Although it has generally been said that the new and renewable sector has not kept pace with the kind of intent that we all had in terms of developing this resources, I would like to share with you that from 3,400 MW in 2002-03 we have crossed now 21,000 MW in these nine years.

Again, in terms of the installed capacity of the country, we were only three per cent at that time; and today, we are 11.3 per cent. In terms of energy mix, in terms of generation, we were around 1.5 per cent; and today, we are at six per cent. So, in a span of almost 8 to 9 years, this achievement has taken place. This is the area of the future, there are problems on the conventional side both in terms of the distribution sector as well as in terms of the generation sector. This assumes a very important dimension. To that extent whatever we would plan and whatever we would do to take this sector forward, one of the important basic things is to find out what is the potential. To that end, we have undertaken massive programme of reassessment of all the major sources of renewable energy starting with wind, solar, bio, etc. We have already put in place a programme to have a more valid data on specifics of what the potential is."

1.11 The year-wise financial outlays (RE) vis-à-vis expenditure during the 11th Plan of the renewable energy sources under Wind Power, Small Hydro Power, Biomass/Bagasse Co-generation, Urban and Industrial Waste and Solar Power is given at ***Annexure-II.***

1.12 Regarding the constraints in harnessing of available potential of various sources of renewable energy, the Ministry of New and Renewable Energy in their written replies stated:

"The major constraints in bridging the gap between potential and achievement in grid-interactive renewable power / exploration of renewable energy sources are:

- Inherent intermittent nature of renewable energy sources leading to low capacity utilization factors ranging from about 17% to 70%, depending on resource and location; and also need for storage.
- Grid synchronization limitations on account of intermittent nature of supply;
- Relatively higher capital investment compared to conventional power projects, Requirement of preferential tariffs apart from other fiscal and/or financial concessions to make investment in renewable power a commercially attractive proposition
- General difficulties in servicing and maintenance in remote areas where the renewable energy systems are installed."

1.13 When the Committee desired to know the steps taken by the Government to overcome the constraints of technology and high costs in a time bound manner, the Ministry in a written reply stated:

- Supporting sector specific R&D activities at institutions in association with industry aimed at developing new processes/ technologies and products that are cost effective, affordable and reliable.

- Provision of fiscal and financial incentives, such as, capital/ interest subsidy, accelerated depreciation, nil/ concessional excise and customs duties.

- Encouraging private investment in renewable power projects through additional measures like Generation Based Incentives, Renewable Power Purchase Obligations and Preferential Tariffs in most potential States; etc."

1.14 When asked about the specific policy initiatives taken by the Government to promote private sector participation in the new and renewable sector, the Ministry in their written replies elaborated the steps taken by the Government:

- “Fiscal and financial incentives such as, capital/ interest subsidy/ generation based incentive, accelerated depreciation, nil/ concessional excise and customs duties;
- Generation Based Incentives Scheme introduced for Wind power and Solar Power to attract private investment by Independent Power Producers not availing Accelerated Depreciation benefit.
- Directives under Electricity Act 2003 to all States for fixing a minimum percentage for purchase of electricity from renewable energy sources;
- Preferential tariff for grid interactive renewable power in most potential States following the provisions made under the National Electricity Policy 2005 and National Tariff Policy 2006; Uniform guidelines by CERC for fixation of such preferential tariffs being issued every year.
- Jawaharlal Nehru National Solar Mission initiated in January 2010 to enable large scale capital investment in solar energy applications.
- Amendment in National Tariff Policy to enable Solar specific RPO;
- Payment Security Mechanism for Grid Connected Solar Power Projects under the Mission;
- Wide publicity on the use and utility of renewable energy through electronic and print media, etc.”

1.15 Information and Public Awareness (I&PA) in renewable energy is an important component of the Ministry's activities. Its objective is to generate mass awareness about renewable energy programmes, policies, incentives, systems, products and devices. The programme is implemented through use of existing Government channels i.e. State Nodal Agencies (SNAs) Directorate of Advertising & Visual Publicity (DAVP), National Film Development Corporation (NFDC), Doordarshan, All India Radio (AIR), etc. Besides, a variety of media like print, electronic and outdoor publicity through exhibitions, bus panels, hoardings, kiosks etc. are used for popularization (NRSE) systems and devices. To enhance the awareness a total of 17 States were provided Central financial assistance for taking up 'information and public awareness' activities like advertisements orientation camps and outdoor publicity through hoardings bus-back panels, kiosks, wall painting and Bus-Queue Shelter's in their regional language.

1.16 In the succeeding chapters, the following important aspects of each segment of the new and renewable sources of energy viz wind power, small hydro power, solar power, biomass/bagasse cogeneration, waste to power; geothermal energy and tidal energy have been dealt:

1. Potential and installed capacities as well as 12th Plan projections,
2. Financial outlays vis-à-vis Expenditure.
3. Constraints faced by the Sector,
4. Technology mapping and benchmarking,
5. Strategy for various indigenously developed and managed new and renewable energy products and services.
6. Cost competition in new and renewable energy sources vis-à-vis conventional sources and other counties.
7. R&D activities/projects taken up by institutions and industry
8. Incentives/promotion of private participants in the sector

III. WIND POWER

1. Potential, installed capacity and the projections for 12th Plan

1.17 According to the Ministry, wind energy is the fastest growing renewable energy technology for generating grid connected power amongst various renewable energy sources. Reportedly, a total capacity of 17353 MW Wind Power has been established upto 31st March, 2012 in the country, which is about 70% of the cumulative deployment of the grid interactive Renewable Power. The Ministry have however, stated that the figures of identified potential are indicative of the identified technically feasible potential only and not of the potential that is techno-economically viable. Interim revised estimated by C-WET is ~ 1,00,000 MW at 80 m. height (unvalidated),

1.18 The Ministry have informed that against the 11th Plan target of 9,000 MW wind power, the achievement is 10,260 MW. Further, the capacity addition target for wind power for 12th Plan (2012-17) is 15,000 MW. Thus the aggregate capacity of 32553 MW is likely to be harnessed by the end of 12th Plan.

1.19 When asked about measures being taken to exploit the untapped potential, the Ministry in a written reply stated as follows:

> "To encourage exploitation of the untapped potential, the Central Government has taken various steps and measures such as provision of fiscal/financial incentives such as capital/interest subsidies, generation based incentive, accelerated depreciation, concessional excise & customs duties, fixation of RPOs and preferential tariffs by SERCs, etc. These would help to improve the projects' techno economic availability and attract private investment in setting-up the same. It is also focusing on reassessment of potential with active association of states so as to make available adequate information to private developers for identification of potential project sites."

1.20 Explaining it further, the MNRE in their written replies and presentation before the Committee on 01.03.2012 stated as follows:

(i) Resource assessment activities to be extended to unexplored areas. Under the Ministry's programme a total of 653 Stations covering 28 States and 3 UTs have been commissioned as on 30.11.2011
(ii) Since the inception of C-WET, more than 200 stations have been established. Measurements have been made/being made at 20/25/50/80/120 M height's with sophisticated instruments.
(iii) Realistic assessment at 100 M. Assessment based on actual availability of land in 7 potential States viz. Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, Madhya Pradesh has been decided.
(iv) 75 Stations have been identified of which 61 have been finalized as on 01.03.2012. NOCs has been received for 41 stations.
(v) Procurement of sensors of 100 M masts is at final stages.
(vi) A project has been initiated by C-WET in September, 2012 in association with SNAs with a total cost of Rs.20.48 cr. which would be met by Government of India.

1.21 When enquired about the non-installation of wind power projects in J&K inspite of available identified potential of 5311 MW, the Ministry in a written reply stated as under:

> "Based on Wind Atlas prepared by Centre for Wind Energy Technology (C-WET), Jammu & Kashmir has potential of 5311 MW; however, it is to be validated by actual field measurement. Wind power development is taking place in the country through private sector investments."

1.22 When the Committee desired to know the action plan of the Ministry to harness the available potential in the State, the Ministry in their written replies stated:

> "State-wise action plans for harnessing renewable energy potential are not prepared/finalized/approved at central level. The Central Government is encouraging the same through various fiscal and financial incentives. The States are backing the same with their facilitating the policies for allotment of projects sites, speedy statutory and other local clearances, fixing of preferential tariff for purchase of renewable power from the project, etc."

1.23 When asked about the strategy to be adopted by MNRE for achieving 15000 MW target for the 12th Five Year Plan, the Ministry in their written replies stated:

> "The wind power development in the country is constantly improving in last few years. The emphasis is now on bigger projects through IPPs with existing fiscal and promotional incentives such as capital/interest subsidy/generation based incentives, accelerated depreciation nil concessional excise and customs duties and policy framework at State Government level. The target of 15000 MW during 12th Plan is achievable."

2. Financial allocation vis-à-vis expenditure

1.24 The 11th Plan year-wise financial outlays vis-à-vis expenditure for Wind Power Programme furnished by the Ministry is as under:

(Rs. in crore)

2007-08		2008-09		2009-10		2010-11		2011-12	
Outlay	**Exp.**	**Outlay**	**Exp.**	**Outlay**	**Exp.**	**Outlay**	**Exp.**	**Outlay**	**Exp.**
11.50	11.17	14.00	8.41	10.90	10.90	34.90	34.90	22.05	22.05

1.25 The financial target proposed for 12th Plan has been Rs.1600 crore and for the financial year 2012-13 it has been placed at Rs. 100 crore. But approved outlay for 2012-13 is Rs.45 crore.

3. Constraints in the wind energy Sector

1.26 When asked about the major problems being faced by private sector participants in identifying and implementation of the projects in wind energy sector, the Ministry in their written replies stated that land availability, procedure for land allotment and infrastructure for power evacuation and transmission were the major constraints areas in the wind energy sector.

4. Technology mapping and benchmarking

1.27 Regarding the initiatives of the Ministry concerning technology mapping so as to increase the installed capacity of wind power potential, the Ministry in a written reply stated:

> "Globally, the wind power technology trend is towards up scaling of the size of the wind turbine. Although, world's largest wind turbine of unit size 7 MW was installed in Germany in 2008, the current trend world over is towards installations of machines in the range 1500-2500 KW unit size.
>
> The wind turbines both with gear and gearless type are continued to be installed. However, there is interesting trend in the development of commercially available direct drive (gearless) designs due to low maintenance and functioning at variable wind speeds. The major area of research are centred around enriching knowledge base, specifically large scale grid integration issues, quantification of resource availability with lower uncertainties, wind forecasting etc.
>
> In India, there has been significant technological improvement since the year 1986, when the first wind turbine of unit size 55 KW was installed in the State of Tamil Nadu. The machines with state of the art technology upto unit size of 2500 KW are now being manufactured in the country. The trend of recent installations is moving towards better aerodynamic design; use of lighter and larger blades; higher towers; gear and gearless machines; and, variable speed operation including using advanced power electronics. The machines with permanent magnet generators which are suitable for moderate wind regime are also being installed in the country.
>
> Wind turbines are being manufactured by 18 indigenous manufacturers with about 45 models ranging from unit size from 250 – 2500 KW, mainly through joint ventures or under licensed production agreements. A few foreign companies have also set up their subsidiaries in India, while some companies are now manufacturing wind turbines without any foreign collaboration. The current annual production capacity of domestic wind turbine industry is in the range of 3000 - 4000 MW. The technology is continuously upgraded, keeping in view global developments in this area."

1.28 According to Greenpeace organization, in wind sector application of latest developments in engineering design and equipment technology are also likely to increase potential as off-shore wind farms are yet to be mapped.

5. Strategy for various indigenously developed and managed renewable energy products and services.

1.29 Explaining their deployment strategy of various indigenously developed and managed new and renewable energy products and services, the Ministry in their written replies stated:

> "The wind power projects are installed on commercial basis through private sector investments based on the techno economic feasibility of the site. The Government provides various incentives for installation of wind power projects in the country including in the State of Maharashtra. These are fiscal incentive such as 80% accelerated depreciation, 10 years tax holiday on income from generation, concessional custom duty on import of specified components, excise duty exemption for manufacture of wind electric generators and parts thereof, etc. This apart, preferential tariff and Generation Based Incentive (GBI) is being provided to increase wind energy generation."

6. Cost competition and costs in new and renewable energy

1.30 When asked about cost of production of energy in wind sector in India vis-à-vis other countries, the Ministry of New and Renewable Energy in their written replies stated that there are several factors including country strategies/promotional polices due to which realistic comparison of cost of production of energy with other countries is difficult, however, indicatives are there. Wind technology is constantly being upgraded in the country. All the major State-of-the-art technologies are available. In view of low man-power cost and good vendor's availability in the country, the cost of production of energy is lower as compared to most other counties.

7. R&D activities/projects taken up by institutions and industry

1.31 Regarding R&D activities/projects undertaken by institutions or industry under wind power programme, the Committee have been informed as follows:

> " C-WET, an autonomous R&D institution under the Ministry of New and Renewable Energy has provided, support and services in the area of Wind Resource Assessment, wind turbine testing, Human resource development by providing trainings on wind turbine technology for different segments etc. have certainly contributed to identification as well as utilisation of wind energy potential in the country. The major R&D projects taken up by C-WET includes-

- Study on power quality issues in grid connected wind farms and identification of remedial measures
- Power Evacuation Studies For Grid Integrated Wind Energy Conversion System
- Development of small wind turbine
- HRD in wind energy
- The future R&D areas have been identified in the field of blade testing, sound wind forecasting system, R&D on issues of concrete tower manufacturing and problem of voltage surges and spikes which cause serious damage to machines.

8. Incentive/promotion of private participation in the sector

1.32 Giving details about incentives /Central Financial Assistance (CFA) provided for wind sector the Ministry stated as follows:

	Special Category States (NE Region, Sikkim, J&K, HP and Uttarakhand)	**Other States**
For Demo. Projects	Rs.3.00 crore X C^0.646	Rs.2.50 crore X C^0.646

C: Capacity of the project in MW; ^: raised to the power

Commercial projects	- Generation Based Incentive (GBI) @ Rs.50 per kWh subject to a max. of Rs.62.50 lakh / MW, for projects which do not avail accelerated depreciation benefit.

1.33 The MNRE also informed that in order to provide valid knowledge of the wind energy availability in a region of interest to the stakeholders, the Ministry decided to publish wind resource data book through C-WET. Seven volumes of wind resource data books which provide extensive information of the wind characteristic where actual wind measurements carried out have been published so far. The raw data collected by C-WET is made available to any wind farm developers or stake holders. Further these data were used to prepare more than 100 micro survey reports and Indian Wind Atlas.

9. Public awareness in the sector

1.34 In the context of need for informing public and enhancing public awareness about the renewable energy sector, when the Committee desired to know what has been done in wind energy sector so far, the Ministry in their written replies stated:

> "The Ministry in association with stakeholders for wind energy is regularly organizing, seminars, workshops etc. for creating awareness. The Information Training Commercial Services (ITCS) unit of C-WET organizes National and International training programmes in wind energy technology. The unit has already organized 10 National, 7 International and 2 specialized customized training programme. This apart C-WET has also sponsored certificate and Post Graduate Diploma courses on wind energy in few colleges. In addition the ITCS unit also organizes awareness programme on wind energy for general public including educational visits to C-WET campus for college and school students."

IV. SMALL HYDRO POWER

1. Potential and installed capacity as well as 12th Plan project

1.35 Hydro power projects up to 25 MW capacity are classified as small hydro projects in the country. The reported estimated potential for power generation in the country from small /mini hydel projects is about 15,000 MW from 5718 identified sites. Out of this potential about 50% lies in the States of Himachal Pradesh, Uttarakhand, Jammu & Kashmir and Arunachal Pradesh. In the plain regions Maharashtra, Chattisgarh, Karnataka and Kerala have sizeable potential. So far 837 small hydropower projects aggregating to 3163 MW up to January, 2012 have been set up in various parts of the country and 364 projects of about 1149 MW are in various stages of implementation. State wise details are given at ***Annexure-III.***

1.36 The Ministry has set target of 2100 MW capacity addition during 12th Plan and about 3000 MW during the 13th Plan period which would take the total installed capacity from SHP Projects to about 8500 MW in the year 2021-22 (about 60% of the existing potential).

1.37 Details of the physical targets vis-à-vis achievements during the 11th Plan as furnished by the Ministry is as under:

Year	Target (MW)	Achievement (MW)
2007-08	200	204.75
2008-09	250	248.93
2009-10	300	305.27
2010-11	300	307.21
2011-12	350	352
Total	**1400**	**1418.16**

1.38 When asked about the reasons for low cumulative achievement so far vis-à-vis the potential of Small Hydro Power, the Ministry in a written reply stated as under:

> "The total installed capacity of small hydro projects, as on 31st March, 2012 is 3395 MW and projects of about 940 MW are in various stages of implementation. This is about 22% of the potential of 15,000 MW. Taking into consideration the allotment of sites made by the States, projects implementation schedules and with a reasonable growth rate in the sector, it is expected that about 2100 MW capacity would be added during 12th Plan."

1.39 On being enquired further about the action plan of the Government to harness the available potential particularly in the major potential States of Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir and Uttarakhand, the Ministry in a written reply stated as under:

> "The Ministry has stepped up its efforts to closely interact with the States and emphasized on establishing a method of regular project-wise monitoring. It is strongly felt that project wise monitoring and regular interaction with the States and SHP developers is the only way to reduce implementation time of the projects and increase pace of exploitation of the potential. Apart from regular interaction with the States with high small hydro potential (Arunachal Pradesh Himachal Pradesh, J&K, and Uttarakhand), the Ministry has also interacted with the States with moderate potential to set up SHP projects (Punjab, Maharashtra, Chattisgarh, Tamilnadu, Sikkim, Kerala, Madhya Pradesh etc.). Information regarding allotment of potential sites to the private sector, their implementation schedules and their Plan for next five years or so has been collected.
>
> The States of Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir and Uttarakhand have highest potential for development of small hydro. All the four States have policy to invite private sector to set up SHP projects. While major development of small hydro in Himachal Pradesh and Uttarakhand is coming through private sector projects, there is at present limited participation of private sector in Arunachal Pradesh and J&K and SHP projects are also being developed by the public sector. The State wise status is as follows:
>
> **Arunachal Pradesh:** The State has a potential of about 1300 MW and so far small hydro projects of about 78 MW have been set up. The State has so far allotted 40 projects aggregating to about 600 MW to the private sector. These projects are mostly in the detailed survey and DPR preparation stage. Department of Hydro Power Development is also implementing 40 small hydro projects of 42 MW. The focus of the State is to get large size hydro projects through private sector. It is expected that about 400 MW projects will be completed by the end of 12th Plan.

Himachal Pradesh: The State has a potential of about 2200 MW and so far small hydro projects of about 390 MW have been set up. The State has further allotted projects aggregating to about 1500 MW to the private sector. It is expected that about 1000 MW projects will be completed by the end of 12th Plan.

Jammu and Kashmir: The State has a potential of about 1400 MW and so far small hydro projects of about 130 MW have been set up. The State has so far allotted 12 projects aggregating to about 67 MW to the private sector. While two projects have been commissioned, 10 projects are under implementation. The State has recently revised its policy and they are in the process of allotting new sites to the private sector. About 150 MW capacity is expected to be added by the end of 12th Plan.

Uttarakhand: The State has a potential of about 1600 MW and so far small hydro projects of about 135 MW have been set up. The State has so allotted 36 projects aggregating to about 370 MW to the private sector. They had further allotted 56 projects of about 960 MW. However, the allotments have been cancelled. The issue of allotment of new sites is expected to be resolved soon but is currently sub-judicious. Further, Uttaranchal Jal Vidyut Nigam is also implementing 10 small hydro projects of 60 MW. It is expected that about 500 MW projects will be completed by the end of 12th Plan."

1.40 When asked about the progress in regard to initiatives taken by Working Group for reassessing the SHP potential in the country, MNRE stated:

"As recommended by the Standing Committee on Energy in its 16th report, the Ministry has set up a working group under the Chairmanship of Adviser (SHP), MNRE and drawing members from the Central Electricity Authority, Ministry of Power, Central Water Commission and States like Karnataka, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Meghalaya. The first meeting of the working group was held on 18th May 2011 wherein existing information about potential and strategy for undertaking the task for re-assessing the potential was discussed. The working group is of the opinion that involvement of State Government and the agency responsible for small hydro development in the State would be extremely critical and necessary in assessing the potential. The second meeting of the working group was held on 27th June,2011 along with sub-group on small hydro for preparing the 12th Plan. AHEC, IIT Roorkee has been asked to prepare a roadmap for undertaking this task. The matter has also been discussed with CEA. It is proposed to create a facility at AHEC, IIT Roorkee to undertake this task in close association with the State agencies."

1.41 When the Committee desired to know the progress of the sub-group constituted with regard to Preparation of Plan of Action for accelerating the pace of exploitation of small hydro, the Ministry in a written reply informed as under:

"The sub-group on small hydro for preparing the 12th Plan has submitted its report and the same has been discussed in the main working group on Renewable Energy. The Sub-group reviewed the progress and growth in the SHP sector during 10th and 11th Plan, status of prospective sites allotted to private sector in major States, policy provisions in various States including RPO and REC etc. The sub group has suggested actions required for faster development of the SHP sector. The main observations / recommendations are:

(i) The Ministry should review State Policies to ensure that the momentum of private sector participation in SHP is not lost. In last 3-4 years, most of the projects have come up in HP, Punjab, Karnataka, and Maharashtra. There is a need to encourage more States and bring them on board for developing more Government / Private sector projects. Focus is to be given to J&K and Uttarakhand in North, Tamil Nadu and Kerala in South, M.P and Chhattisgarh in Central and Sikkim and Mizoram in North East of India.

(ii) State wise, year wise targets should also be fixed in SHP Programme with identification of projects likely to be commissioned in following 3-4 years. This should be done in consultation with States and project developers.

(iii) Project wise monitoring should start at State as well as MNRE level.

(iv) MNRE subsidy is playing very important and catalectic role in covering risk and making SHP projects economically viable. MNRE subsidy should be continued in the 12th Plan also.

(v) The Sub-group noted that MNRE has constituted a working group to start the work of reassessing SHP potential in the country. The sub-group was of the opinion that this is an important step for systematically harnessing SHP potential in future. To accomplish this task the Sub-group recommended

- The Ministry should earmark some funds for this activity during 12th plan
- To start the work, some specific areas and States may be selected for pilot work.
- GIS techniques and modelling may be necessary for this work.
- Hydrological information may also be collected from on-going SHP projects for validation of modelling of potential.

- The Ministry may extend financial support to States for undertaking this work.

- MNRE may consider creating Regional Centres for small hydro potential assessment and identification of potential sites.

(vi) The Sub group recommended that the scope of micro hydel and water mill scheme of the Ministry should be enlarged. The water mill support should also include support for economic activities."

1.42 On being asked whether there is any proposal for a separate small hydro policy, the Ministry while denying any such proposal submitted before the Committee as follows:

> "Our country has a Hydro Policy, which was announced by the Ministry of Power in 1998 and subsequently revised in November, 2008. Small hydro projects are also governed by this policy. Further, electricity generation from renewable including small hydro are governed by Electricity Act 2003, National Electricity policy 2005 and Tariff policy 2006. MNRE is not thinking to bring out separate policy for small Hydro. As per current Hydro Policy hydro projects below 100 MW can be allotted through MOU route and only projects costing more than Rs. 2500 crore require CEA concurrence. This apart, CERC has issued guidelines for SERCs regarding tariff for power generated from renewable including small hydro."

2. Financial allocation vis-à-vis utilization

1.43 Regarding the fund allocation vis-à-vis utilization during the 11th Plan, the Ministry stated as under:

> "An allocation of Rs 700 crore was made for the SHP programme for the 11th Plan period. However, based on annual allocation, an amount of Rs.531.50 was made available for the programme. The physical target for the 11th plan is 1400 MW. During the first four years of the 11th Plan, 1066 MW capacity has been added against a target of 1050 MW. In the 5th year of 11th Plan, about 350 MW is expected to be achieved and the actual achievement for the year 2011-12 was 3534 MW (grid interactive). The target of 1400 MW for the 11th Plan is expected to be achieved in full. Similarly, the Ministry has been able to make full utilization of funds provided for the programme on year to year basis."

1.44 The Ministry have also informed that a financial requirement of Rs.1600 crore has been projected for the proposed target of 2100 MW for the 12th Plan. For small hydro power grid interactive renewable power, Rs. 340 crore funds were required to achieve target of 350 MW for the year 2012-13. However, fund allocated are only Rs.150 for achieving the target.

3. Constraints in exploiting potential in the small hydro sector

1.45 Regarding the major constraints in exploiting the available potential of small hydro power, the Ministry in a written note stated as under:

> "Small hydro projects are difficult to construct as the civil construction for the project is to be done at the site, which is normally in remote and difficult area with limited accessibility. Sometimes, even basic infrastructure such as road is to be constructed before starting the project. The working season at such location is also limited to 6-7 months due to rain, snow and extreme winter. The development of these projects also gets constrained due to forest areas and associated power evacuation facilities. Hence, SHP projects normally take 4-5 years for implementation
>
> SHP sector is a difficult sector and implementation of projects takes considerable time. They are also associated with a number of clearances which are given by different departments of the State Government. Availability of reliable information on hydrology, remoteness of sites, evacuation infrastructure are some of the constraints in exploiting available potential."

1.46 In reply to a question the Ministry stated that the Central Government has a very limited role in the development of SHP as water is a State Government subject.

4. Technology mapping and benchmarking

1.47 When enquired about the technology available for harnessing small hydro power in the country, the Ministry in a written reply stated as under:

> "Small hydro is technically matured sector with an experience of over 100 years. The present technology used in the country is State of the art and the equipment are normally over 80% efficient. Now the advancements in the sector are of the nature of technical up-gradation. The control systems in SHP projects have seen a good advancement in the last 10 – 15 years. The

electric / electronic controls are now small and more reliable with higher degree of automation. These are being achieved by the manufacturers through a mix of indigenous efforts and to some extent through technical collaborations. "

5. Strategy for various indigenously developed and managed new and renewable energy products and services.

1.48. Giving details about the strategy being applied for deploying various indigenously developed and managed new and renewable energy products and supplies for small hydro sector, the Ministry stated as follows:

> **"**The equipment used in small hydro projects is indigenously manufactured. The Ministry initiated a project to scientifically design the watermills for mechanical application and for electricity generation. The new designs of these watermills were given to some manufacturers for production. As a result of this project there are about 10 manufacturers which are routinely manufacturing improved designs of watermills for mechanical as well as electricity generation. These watermills have better efficiency, relatively long life and can be used both in mechanical as well as electricity generation mode. Now the efforts are towards development of velocity turbines and very low head turbines so that small drops in canals can also be exploited for power generation."

6. Cost competitiveness

1.49 Regarding cost of production of energy from small hydro projects, the Ministry have stated that it is one of the lowest among renewal's and that it is in the range of Rs.2.75 to Rs.3.50 per unit. The Ministry also stated that the cost of power generation from small hydro is more dependent on availability of water and plant load factor. As it is there is no comparison available on the cost with other countries.

7. Research and Development in the sector

1.50 Elaborating the support given in R&D activities for small hydro sector, the Ministry in their written replies stated as follows:

> "Main thrust is to create testing and standardisation facilities. On-site testing facilities have been created to facilitate performance testing of SHP stations. The Ministry has made this mandatory for availing subsidy. A real-time digital simulator has been set up at AHEC to provide training to SHP operators. Now, a hydraulic turbine test laboratory is being set up which would act as an independent test laboratory for various turbine models and would also help in testing new designs of hydraulic turbines."

8. Incentives/Promotion of private participants in the sector

1.51 When asked about the plans and strategies of the Ministry to achieve the target of 2100 MW set for the 12th Plan, special reference to private sector participation, incentives and monitoring mechanism, the Ministry in a written reply stated as under:

> "Private developers have identified some sites in Himachal Pradesh, Uttrakhand and Karnataka. These are for about 400 MW. This has changed the potential by about 384 MW of small hydro. The Ministry had set up a separate sub-group with members drawn from all major potential States and experts to draw the 12th Plan and the Action Plan for achieving 12th Plan targets and for faster exploitation of SHP potential in the country. Separate sub-groups have also been constituted to look into the issues of transmission / evacuation infrastructure for renewable energy based power projects and environmental aspects including land and forest clearance issues. The sub-group on environmental aspects has suggested prudent practices to be adopted for faster statutory clearances for renewable energy based power projects. This would help in reducing the gestation period and ensure increased pace of implementation of the SHP projects during the 12th Plan and help in achieving the targets. It is strongly felt that project-wise monitoring and regular interaction with the States and SHP developers is the only way to reduce implementation time of the projects and increase pace of exploitation of the potential. The Ministry would pay special attention on the this aspect and put in place institutional mechanism to monitor the projects implemented by the private sector. The sub-group on small hydro has recommended to increase subsidy for SHP project up to 10 MW capacity."

V. SOLAR ENERGY

1. Potential and installed capacity as well as 12th Plan projections

1.52 India lies in the sunny regions of the world. Most parts of India receive 4–7 kilowatt hours of solar radiation per square meter per day with 250–300 sunny days in a year. The highest annual radiation energy is received in western Rajasthan while the north-eastern region of the country receives the lowest annual solar radiation. This translates to an energy generation potential of about 30-50 MW./ sq.km. of shadow-free area covered with solar collectors for most parts of the country.

1.53 According to MNRE, the potential of solar energy is >1,00,000 MWeq i.e. 30 -50 MW/Sq. Km and the cumulative deployment of grid-interactive solar power upto 31.03.2012 is 941 MW.

1.54 The Committee have been informed that in order to strengthen the solar resource assessment and to meet the requirement of availability of Solar Radiation data, 51 solar radiation monitoring stations have been set up at sites of high potential in the country. This project is being implemented by C-WET, Chennai, an autonomous institution of the Ministry. The central server facility set up at C-WET will have all data logged from these stations for further processing and analysis. The data so collected will augment the existing solar resource maps based on satellite imagery.

1.55 In regard to solar radiation resource assessment, the Ministry submitted before the Committee as follows:

(a) C-WET : (i) 51 stations have been collecting data.

(ii) Procedure for online quality checks would begin from 2012.

(iii) Data availability will begin from April 2012.

(b) Data collection from solar power developers will begin by April 2012.

1.56 When asked about preparation of Solar Atlas, the Ministry informed the Committee that agreement on Shaving Satellite Data from ISRO will begin from April 2012 and that the first draft will come out by December 2012 and the second version by December 2013.

1.57 When asked about the initiative of the Government in harnessing the available potential of solar energy, the Ministry in a written reply stated as under:

> "The Government had approved the policy framework and announced Jawaharlal Nehru National Solar Mission in January 2010 with an objective to establish India as a global leader in solar energy by creating policy conditions for its diffusion across the country quickly and achieve a scale to drive down costs to levels required to achieve grid parity by 2022.
>
> The Mission targets include (i) deployment of 20,000 MW of grid connected solar power by 2022, (ii) 2,000 MW of off-grid solar applications including 20 million solar lights by 2022, (iii) 20 million sq. m. solar thermal collector area, (iv) to create favorable conditions for developing solar manufacturing capability in the country; and (v) support R&D and capacity building activities to achieve grid parity by 2022. The Mission is to be implemented in three phases.
>
> For the first phase of the Mission, the Government had approved a target to set up 1,100 MW grid connected solar plants including 100 MW capacity plants as rooftop and other small solar power plants till March 2013. In addition, a target of 200 MW capacity equivalent off-grid solar applications and 7 million square meter solar thermal collector area were also approved. The Cabinet had also approved setting up of large utility scale grid power plants through bundling of solar power with the unallocated thermal power available from NTPC stations and the policy to provide generation based incentive for small grid connected solar power plants.
>
> The policy measures for selection of grid connected projects in Phase -1 through global competitive bidding has led to substantial reduction in the tariff of solar power with reference to CERC tariff. This coupled with visibility in policy for solar power under JNNSM is expected to encourage investments in this sector and also to lead States to announce compatible policies. Some states like Gujarat, Rajasthan, Maharashtra have already taken the initiatives."

1.58 On being enquired about the achievement of the Phase-I target so far under the Jawaharlal Nehru National Solar Mission (JNNSM), the MNRE stated as follows:

> "The targets of the off-grid solar applications during the Phase-I of the Mission were splitted into annual targets to sanction projects, which were 32 MW during 2010-11, 68 MW in 2011-12 and the remaining 100 MW in 2012-13. Against a target of . 32MWp equivalent of Off-grid SPV systems the Ministry sanctioned projects aggregating to 40.65 MWp and projects of about 10.79 MWp were installed. This included solar lanterns, solar home lights, street lights, water pumping systems and stand-alone power projects.
>
> During 2011-12, so far 31 MWp equivalent capacity of Off-grid SPV systems have been sanctioned. It is expected that by 31.3.2012 the Ministry will be able to sanction projects aggregating to a total of 100 MWp. The Ministry has been receiving and sanctioning the project proposals to various Channel Partners including Renewable Energy Service Providing Companies, Systems Integrators, Financial Integrators, Financial Institutions besides State Renewable Energy Development Agencies, Central and State Government organizations, Public Sector Undertakings and reputed NGOs. The remaining target of 100 MWp during 2012-13 could be met provided sufficient funds are made available in the budget for 2012-13 for this activity."

1.59 Further, regarding the steps taken for achieving the targets under JNNSM, the representatives of the Ministry during the evidence submitted as under:

Application Segment	**Target for Phase-I (2010-13)**	**Status (as on Jan.2012)**
Grid solar power	1000 MW (600 SPV, 500 ST)	1054 MW allotted
Rooftop & distribution Grid connected plants	100 MW	98 MW allotted. 188 MW commissioned
Off-grid solar applications	200 MW	83.5 MW sanctioned
Solar thermal collectors	7 million sq. meters	4.88 million sq. meters

1.60 Detailed State-wise solar power capacity installed under Phase-I of JNNSM as furnished by the Ministry is given below (excluding capacity under State initiatives):

S.No.	State	Capacity (MW)
1	Andhra Pradesh	15.0
2	Chhattisgarh	4.0
3	Haryana	4.8
4	Jharkhand	2.0
5	Karnataka	1.0
6	Maharashtra	17.0
7	Orissa	4.0
8	Punjab	4.0
9	Rajasthan	123.5
10	Tamil Nadu	8.0
11	Uttarakhand	2.0
12	Uttar Pradesh	2.0
13	West Bengal	1.0
	TOTAL	188.3

1.61 Highlighting the Phase-I achievement and assuring the Committee about the future performance in solar sector, the Secretary, MNRE during the evidence deposed before the Committee as follows :

> "…On the Jawaharlal Solar Mission, the Mission is in three phases. The Phase-I ends on March 31, 2013. Around 11,000 MW is likely to be commissioned. The Phase-I is going according to the plan. The first part of the project which migrated from the older schemes has already shown results. From the year 2009 when we were only 2 MW in grid connected solar power, we are today at around 148 MW. We assure that by around 31st March, 2012, we would reach to about 400 MW."

1.62 The Committee were also informed that for the 12th Plan period, a capacity of 3000 MW has been proposed through Government support and another 6000 MW through mechanism of Renewable Purchase Obligations (RPOs) and Renewable Energy Certificates (RECs) which could make a cumulative capacity of solar power at 10,000 MW.

2. Financial allocation vis-à-vis expenditure

1.63 The financial allocation and expenditure on solar photovoltaic and solar thermal systems during the 11th Plan (upto 30.11.2011) furnished by the Ministry is as given under:

(Rs. in crore)

S. No.	Programme / system	2007-08		2008-09		2009-10		2010-11		2011-12	
		BE/RE	EXPD.	BE/RE	EXPD.	BE/RE	EXPD.	BE/RE	EXPD.	BE/RE	EXPD.
1.	Grid connected Solar Power	18/ 4.5	0.93	19.5/ 0.50	0.40	11/ 8.99	8.99	30/ 30	29.94	55/ 55	30.09
2.	SPV Plants + Street Lights	29.50/ 60.75	55.47	62.75/ 67.35	62.45	92.70/ 84.50	80.85	227.49 / 254.99	254.50	390/ 390	246
3.	Solar water heating	57.90/ 18.00	18	24.50/ 15.00	13.97	10/ 10	8.12	15/ 30	30	40/ 40	31.87
4.	Energy-efficient buildings	13.00/ 3.81	3.93	4.5/ 3	2.00	5/ 5	4.40	10/ 7	6.88	10/ 10	1.50
5.	Other Solar Thermal systems and Solar Cities										

1.64 The Ministry also stated that against an amount of Rs.1271.24 crore available at the RE stage, the actual expenditure du';ring 11th Plan under the Grid and Off-grid solar energy sector was Rs.1257.43 crore.

3. Contraints faced by the sector

1.65 In regard to major obstacles faced by the solar sector, the Ministry stated that the major constraints were non-availability of bank finance, change in rate of interest for bank loans and lack of data on the performance and operation and maintenance requirements of these projects, especially projects based on solar thermal technology.

4. Technology mapping and benchmarking

1.66 Solar energy can be used through two routes i.e. solar photovoltaics (PV) and solar thermal. Solar PV converts the light in solar energy into electricity, while solar thermal route converts solar energy into heat for various useful applications including power generation using steam.

1.67 In grid connected solar power projects that are selected under JNNSM, about 50% projects are being setup based on thin film modules.

1.68 Regarding manufacturing units for solar photovoltaic related product, the Ministry in their written replies stated:

> With a view to encourage investment in manufacturing of semiconductors including polysilicon material which is the basic material for manufacturing of solar cells, the Government through Department of Information Technology announced Special Incentive Package Scheme (SIPS) in March 2007. A total of 11 applicants, who have proposed to set up manufacturing units for solar photovoltaic related products, have reported financial closure. If these projects are set up that would result in setting up of more than 4 GW solar module manufacturing capacity in the country, apart from about 10,000 TPA poly silicon production capacity. There is a vibrant industrial base for manufacture of solar cells and modules in India. There are more than 40 manufacturers of solar modules, with an installed annual production capacity of over 1 GW. However, there is a strong dependence on imports for some of the critical raw materials and components

1.69 In regard to the solar-thermal route, the Ministry in their written replies stated:

> "Low temperature applications, such as, heating of water and space, cooking, air heating and drying of food and agricultural products, and water purification. Industrial process heat applications requiring steam, solar cooling, and Solar thermal power generation.
>
> There are large numbers of firms, which manufacture flat plate solar collectors. In addition, indigenously developed systems are available for solar cooking, solar air heating and solar drying of food products"

1.70 The MNRE also stated that solar thermal power generation is one of the key applications of solar energy through thermal route. A number of technology options are available to produce electricity using heat from solar radiations such as:

(i) Parabolic through technology - most successfully tried technology world over. A new variant of the technology know as Linear Fresnel Reflector has also been developed which has high potential for local manufacturing.

(ii) Solar tower technology - A plant of 2.5 MW has been set up near Bikaner in Rajasthan based on this technology under JNNSM.

(iii) Solar dish systems - The Government is making efforts to encourage use of this technology through steam production route.

1.71 The Ministry have further stated that in India, there are capacities to produce balance of system including turbines, heat exchangers, cooling towers, however, no production facilities exist for solar concentrator technology. Efforts are made to develop indigenous capabilities for production of linear Fresnel reflectors and solar dish concentrators

5. Strategy for various developed and managed new and renewable energy products and services

1.72 Explaining the deployment strategy adopted by the MNRE for various developed and managed new and renewable energy products and services in solar sector, the Ministry in a written replies stated :

- "Under JNNSM, policy guidelines were brought out after detailed discussion with various stakeholders including manufactures.
- The guidelines to provide support for off-grid applications stipulate that the use of imported complete PV systems is not permitted under the scheme. Use of imported components of a complete PV system is permitted, subject to adequate disclosure and compliance to specified quality norms and standards.
- For grid connected solar PV projects, it was mandated that the projects based on crystalline silicon technology shall use the modules manufactured in India. For Solar PV Projects to be selected in second batch of the phase – 1 of the JNNSM, the guidelines mandated that all the Projects to use cells and modules manufactured in India. As there is no or very small manufacturing capacity of PV modules made from thin film technologies or concentrator PV cells, these were allowed to be sourced from any country, provided the technical qualification criterion is fully met.

- This policy has so far resulted in enhancement of domestic production capacity of solar cells and modules by about 30%. However, most of the critical materials used in manufacture of solar cells and modules are still being imported.
- For solar thermal applications, the solar systems are required to be tested in India for getting support under Ministry's programmes. For low and medium temperature applications, no systems manufactured in other countries are eligible without testing and certification in the country. For grid connected solar thermal power projects, it was made mandatory for project developers to ensure 30% of local content in all plants/installations.
- In order to allow technologies to come from other countries, technology validation under Indian field conditions is supported by the Government to generate data and to enable industry to take a decision on joint venture etc."

6. Cost competition in new and renewable energy sources vis-à-vis conventional sources and other countries.

1.73 When asked the reason for fixing such a low target of 3000 MW through Government initiative, the Committee have been informed that the main reason is the high cost of solar power. The estimated financial target for the 12th Plan target of 3000 MW is Rs.7887 crore.

1.74 When the Committee desired to know the reasons for such high cost of solar power, the Ministry in a written reply stated as under:

> "The cost of solar projects is dependent upon the locations and the availability of solar resource. For various off grid applications in remote and rural areas, solar systems provide viable alternative for lighting as the cost of laying grid to many such areas becomes prohibitive. Solar thermal applications for water heating, cooking and air heating etc. also considered viable with a payback period of 3-5 years depending upon the extent of use of such systems and location of installation. Presently, grid solar power is costly as compared to wind and biomass power due to lower volumes and higher capital costs. However, recent trends suggest substantial reduction in the cost of solar systems because of large volumes generated after launch of JNNSM."

1.75 When enquired about the steps taken to make the solar power more cost effective and affordable, the Ministry have informed as under:

> "Under JNNSM, policy and regulatory framework has been provided to create large demand of solar power and off grid applications. This has resulted in reduction of cost substantially. For further reduction in cost, steps have been initiated to strengthen R&D and to encourage domestic manufacturing."

1.76 Further, the Ministry stated:

> "For selection of grid connected solar power projects, the policy guidelines adopted a strategy to have global competitive bidding with reference to CERC tariff, which resulted in substantial cost reduction in the tariff."

1.77 The Secretary, MNRE, during the oral evidence before the Committee submitted:

> "The subsidy schemes that we have of 30% subsidy for various projects, need to originate from State Nodal Agencies. So, we have been trying to make it a regular feature now that we will meet with all the SNAs every three months… Recently I have been told – we have unconfirmed reports – that Orissa has launched its first solar grid connected project and has got a lower tariff than what the Government of India has got."

1.78 The Ministry have also stated that costs of solar power in certain cases (viz. solar thermal power) is due to import of technology. With the projects which are being set up under JNNSM, indigenization of technology is likely to happen and this will have impact on reduction of cost.

1.79 According to Green Peace, who submitted before the Committee their views on green energy stated that in real market terms the price of PV modules per MW has fallen by 60% since the summer of 2008 and the reduction in costs is largely attributed to deployment led cost reductions.

1.80 When the Committee desired to know as to which of the two i.e. solar photovoltaic or solar thermal would be more cost effective, generation friendly and everlasting, the Ministry in a written note stated as under:

> "Solar photovoltaic and solar thermal routes for power generation have their own merits. Solar photovoltaic technology scores high as these plants have very low gestation period and there are no moving parts and therefore, the operation and maintenance costs are lower. However, generation from these plants is very much dependent on transient of solar radiation and storage is also a problem with these plants. Solar thermal route, though is complicated as it involves turbines and generators on the pattern of conventional thermal power plants, but has built in thermal inertia to ward off solar radiation fluctuations. These plants can be constructed in hybrid mode and with thermal storage, and thus, extending period of operation of the plant beyond sun shine hours. The areas with high amount of direct normal solar radiation are good

for solar thermal technology, whereas solar photovoltaic technology works under most of the solar radiation conditions."

1.81 In response to query regarding cost of production of solar energy in the country vis-à-vis other countries pioneering in power generation through renewable energy, the Ministry stated that the cost of power generation from solar depends on the availability of sunshine, solar intensity, sunshine house and technology used and availability of the cost of funds for the project. As such, proper comparison of cost of generation of electricity cannot be made. However, it could be +15% in India compared to other counties.

7. R&D activities/projects taken up by institutions and industry

1.82 Regarding the R&D activities under solar energy sector, the Ministry in a written reply stated as under:

"Research and Development is a critical component of the technology development. With the launch of JNNSM, R&D efforts were strengthened for accelerating ongoing R&D efforts on different aspects of Solar photovoltaic and Solar thermal technologies, including multi disciplinary research, with the objective of improving the efficiency, systems performance and reducing the cost. A comprehensive policy for research & development was put in place to achieve the objectives of cost reduction and efficiency enhancement.

A National Centre for Photovoltaic Research and Education at IIT-Bombay was approved in September, 2010. This Centre is actively engaged in research and education in PV. This Centre has started a new initiative on training of 1,000 teachers from colleges and universities on different aspects of PV technology. The Ministry has also supported a number of important research projects to academic and research institutions and industry on different aspects of PV technology. A new initiative includes joint research programme with CSIR laboratories. In the last few months three major research projects with National Physical Laboratory, New Delhi National Chemical Laboratory and Indian Institute of Chemical Technology, Hyderabad have been recommended by experts for funding by the Ministry.

For solar thermal, the major focus is put on technology development for solar thermal power. A megawatt scale National Solar Thermal Power Test and Simulation facility is being set up at Ministry's Solar Energy Centre (SEC) by IIT Bombay and a consortium of Industries. The test facility is aimed to help in designing solar thermal power projects based on technology parameters and climatic conditions of the locations. An R&D-cum-demonstration project for development of Central Receiver Technology for solar thermal power

generation is being implemented by a Group led by an Indian industry and comprising scientists from USA, Spain and Switzerland. The project aims to design and develop solar tower with an output of 1MW thermal energy.

Another major effort supported by the Ministry is on development and demonstration of 1 MW capacity solar thermal power R&D project with 16-hour thermal storage at Mount Abu, with co-funding from German Ministry and Indian industry. The project is first of its kind to provide thermal storage of 16 hours and will be based on fully indigenously developed solar dish technology. The Ministry has also sanctioned a project to set up Centre of Excellence in the area of solar thermal energy research and education at newly set up IIT Rajasthan at Jodhpur, A couple of projects on the development of solar dishes, technology validation for efficient technology of parabolic trough collectors for industrial process heat requirements and developing solar desalination technology for Bitra island have also been initiated.

A Research Advisory Council headed by eminent scientist, Dr Anil Kakodkar, has been set up to provide further guidance on the R&D policy of the Ministry for solar sector with an aim to achieve objectives of grid parity under Mission."

1.83 The MNRE informed the Committee about technical specialized institution namely, Solar Energy Centre (SEC) as follows:

"SEC works on the development of solar energy technologies and practices and contributes to the advancement of related science and engineering. The R&D programme of the Centre is mainly designed to address applications related issues. Based on requirement, projects are identified for in-house R&D or for interactive research with other institutions and industry. SEC also works as a referral Test Centre for solar energy devices, and provides assistance for up-gradation of test facilities Regional Test Centres for Photovoltaic devices."

1.84 When asked whether this institution has been able to achieve the goals set for them in their respective arena, the Ministry in a written reply stated:

"The Solar Energy Centre in the recent years has undertaken a number of projects related to technology validation, up-gradation and reliability. These projects have been identified for facilitating the objectives of the Jawaharlal Nehru National Solar Mission (JNNSM). These projects have mainly been taken up as collaborative projects to utilize the expertise available in other organizations. The projects can broadly be divided in the following categories:

- Solar Resource Assessment
- Solar power generation
- Solar cooling
- Solar thermal process heat

- Solar lighting
- Referral test centre for solar energy devices."

1.85 On being asked whether the Ministry is satisfied with the role played by SEC in the field of technological advancements, the Ministry in a written reply stated that the projects undertaken by SEC serve the very basic objective of the JNNSM. SEC is still working as part of the Ministry. The Ministry however, pointed out that with expanding work responsibility, it has been felt that in order to give the required autonomy of inducting specialized manpower and necessary collaboration with national and international organizations, SEC may be converted as an autonomous organization. Work towards this end has already been initiated.

1.86 In regard to the SEC contributing in identification as well as utilization of renewable energy potential in the country, the Ministry stated as follows:

> "SEC works on solar resource assessment. Knowledge of solar radiation availability both quantitative and qualitative basis identifies the potential areas with respect to a particular solar technology and application. The solar maps of the country have been developed and are available in the website of the Ministry."

1.87 When asked about the projects undertaken by SEC for improvement of battery for solar photovoltaic applications, the Ministry in a written note stated as under:

> "SEC had undertaken an R&D Project in collaboration with Central Electrochemical Research Institute (CECRI) Karaikudi in the year 2008-09.
>
> The project stands completed on 31st March 2012. It has resulted, inter-alia, in developing a hybrid battery of VRLA AGM and Gel, which was observed to be delivering better charging efficiency and lead sulfphation, a major cause of failure of lead acid batteries in SPV applications. Studies of other chemistries have also been undertaken."

8. Incentives/promotion of private participation in the sector

1.88 The Ministry in their written reply stated that they have decided to involve private sector in the implementation of both grid-connected and off-grid solar energy systems in Jawaharlal Nehru National Solar Mission. Grid connected photovoltaic and solar thermal power projects are being installed by private sector. The power generated by these projects will be purchased by NTPC Vidyut Vyapar Nigam (NVVN) and sold to the various utilities

after bundling with the equivalent amount of unallocated electricity generated by thermal power plants. The Ministry is providing Generation based incentives for electricity fed into grid having voltage less than 33 kV for projects aggregating to 100MW. Off-grid Solar Applications Scheme is being implemented through other Channel Partners such as Renewable Energy Service Providing Companies, Systems Integrators, Financial Institutions and Financial Integrators.

1.89 The Ministry also informed that NVVN have selected 37 projects during batch 1 of phase I of the mission for 620 MW capacity and another 28 projects during batch 2 of the phase 1 for 350 MW.

1.90 Besides, the policy initiatives to facilitate private sector participation in setting up the renewable energy projects, in the solar energy sector, the Ministry enumerated other incentives as follows:

(i) JNNSM initiated in January, 2010 to enable large scale capital investment in solar energy applications.

(ii) Amendment in National Tariff Policy to enable solar specific RPO.

(iii) Payment Security Mechanism for grid connected Solar Power Projects under the mission.

(iv) Generation Based Incentive Scheme introduced for solar power to attract private investment by independent power producer not availing Accelerated Depreciation benefit.

1.91 Further, Government is providing subsidy of 30% of the project cost subject to a maximum of Rs. 81 per watt peak to the beneficiaries for installation of off-grid solar photovoltaic power systems by these private developers / channel partners. For solar water heaters the Ministry provides subsidy of 30% of the project cost to beneficiaries through these Channel partners. For large grid connected solar power projects the Government charges concessional customs duty on import of items and no central excise duty is levied on components required for establishment of these power plants.

VI. BIOMASS ENERGY

1.92 The MNRE is promoting utilization of biomass like agro-waste in the form of straws, stalks, stems and fines; agro-industrial processing residues such as shells, husks, deoiled cakes and wood from dedicated energy plantations for power generation. As per bio-mass assessment study carried out by Indian Institute of Science, Bangalore, paddy straw, mustard stalk, cotton stalk, prosopis Julie-flora, groundnut shell are important resources for exploitation.

1. Potential and installed capacities as well as 12th Plan Projects

1.93 The availability of biomass in India is estimated at about 540 million tonnes per year covering residues from agriculture, agro industrial, forestry, and plantations. Principal agriculture residues include rice husk, rice straw, bagasse, sugar cane tops and leaves, trash, groundnut shells, cotton stalks, mustard stalks, etc. It has been estimated that about 70-75% of these wastes are used as fodder, as fuel for domestic cooking and for other economic purposes leaving behind 120 – 150 million tonnes of usable agro industrial and agriculture residues per year which could be made available for power generation. By using these surplus agricultural residues, more than 17,000 MWeq of grid quality power can be generated with presently available technologies. A cumulative capacity of 1200 MW (as on 31.03.2012) from biomass power has so far been commissioned mainly in the states of Tamil Nadu, Uttar Pradesh, Karnataka, Andhra Pradesh, Maharashtra, Chhattisgarh, Punjab and Rajasthan.

1.94 According to the Ministry, the potential of Biomass power including bagassee cogeneration is about 22,000 MW, out of which the cumulative achievement as on 31.3.2012 is 3135.

1.95 The biomass power/cogeneration programme was initiated by the Ministry at the end of 8th Plan and had achieved 86 MW power capacity against the target of 25 MW. The overall physical achievement during the 9th, 10th and 11th Plan as furnished by the Ministry is given under:

9th Plan		10th Plan		11th Plan	
Physical (MW)		Physical (MW)		Physical (MW)	
Target	Achievement	Target	Achievement	Target	Achievement
314	295.30	700	759.00	1700	1954 (as on 29.02.2012)

1.96 Capacity addition target for the 12th Five Year Plan for this sector is 1900 MW,

1.97 When asked the reason for the slow exploitation of biomass power, the Ministry in a written reply stated as under:

> "Biomass power is a difficult sector and implementation of projects takes considerable time. The biomass projects require a number of clearances by different departments of State Government. Competitive user on biomass resources from other industries due to non-availability and high cost of coal, adversely affecting the biomass prices against the low tariff fixed by State Electricity Regulatory Commission. Wholesale Price Index has risen by unprecedented levels. The Labor cost being a major component of the biomass price, the inflation has adversely affected the biomass industry and the biomass prices. Low resource harvesting efficiency due to lesser time available-farmers are increasingly going for multi-cropping. Un-remunerative tariff for biomass power plants-impairing investment in biomass harvesting and logistics management."

1.98 Giving a brief of biomass resource atlas, the MNRE in their written replies stated as follows:

> “A Biomass Resource Atlas for India has been prepared for surplus agro residues which have been placed on the website of the Indian Institute of Science, Bangalore, which is expected to address the issue of assessing surplus agro residue availability. The Biomass Resource Atlas has been periodically updated and now includes surplus forestry wastes for power generation. The ministry has requested the States to identify a single agency to facilitate speedy approval. Frequent interaction with Forum of Regulators and Central Electricity Regulatory Commission is being done by the Ministry to ensure tariff revision etc. for better viability of projects.”

1.99 When the Committee desired to know the reliability of Biomass Resource Atlas in assessment and Promotion of biomass power in the country, the Committee have been informed as under:

> "The Biomass Resource Atlas has provided good quality information on different crop residues through GIS maps. Based on this, the promoters may decide the location of the project in biomass resource rich state."

2. Financial outlay for 12th Plan

1.100 The proposed financial budget for the 12th Five Year Plan for bio-mass to achieve the physical target of 1900 MW is Rs. 1700 crore.

1.101 Parameters taken into account while proposing the financial account vis-à-vis physical targets as stated by the Ministry are:

> "The parameters that were taken into account while proposing the financial allocations are the higher amount of Central Financial Assistance (CFA) provided to cooperative sector sugar mills for installation of cogeneration projects, the CFA provided to Built on Operate and Transfer (BOOT) model projects in cooperative sector taken up by IPPs/Joint Venture Companies/State Government Undertakings and CFA provided to private sector sugar mills, IPP biomass power projects and committed liabilities. It also includes CFA that would be provided for fuel collection equipment and fuel preparation."

3. Constraints faced by the bio-mass sector

1.102 Regarding the major obstacles faced by the project developers in the biomass energy sector, the Ministry have stated:

- " Non-availability of firm data on surplus biomass availability for specific project area
- Interrupted supplies of biomass, especially during monsoons.
- Steep price variations in biomass supply due to competitive use of biomass in other industries
- Technical and operational problems arising out of multi fuel combustion of biomass including rice straw.
- Uncertainty associated with tariffs fixation in some potential states/inadequate tariff support from regulatory bodies.

- Lack of working capital requirements for storing huge stock of biomass materials for ensured year round operation."

1.103 When asked about the steps taken to overcome the constraints in harnessing the biomass power, the Ministry in a written note stated as under:

- "A Biomass Resource Atlas for India has been prepared for surplus agro residues which has been placed on the website of the Indian Institute of Science, Bangalore, which is expected to address the issue of assessing surplus agro residue availability.

- The Ministry has requested the States to identify a single agency to facilitate speedy approval and forward such proposal to the Ministry. Frequent interaction with FOR and CERC has been carried out by the Ministry.

- Guidelines for fixation of tariff for renewable power has been announced through CERC during 2009. 2nd Amendment in RE Tariff Regulations 2011 through CERC have been released. MNRE has also constituted a number of sub-groups to study relevant issues and make recommendations for attracting higher level of investment in this sector to achieve the various targets for the plan period.

- Technical/ operational problems is being addressed through proper project design and equipment selection through competent consultants in the sector. Issues relating to biomass supply and price are governed by market forces determining competitive uses of surplus biomass and same has to be addressed by developers only."

4. Technology mapping and benchmarking

1.104 Explaining about the technology being used for this sector, the MNRE in a written reply stated as follows:

"Biomass gasification technologies of sub-megawatt capacity (5 kW to 1 MW) have been successfully developed indigenously for electrical and thermal application using different types of biomass. Biomass gasifier systems is being manufactured by about 8-9 indigenous manufacturers. Initially, biomass gasifier systems have been retrofitted with duel fuel diesel engines. Subsequently, 100% producer gas engines up to 250 kW have been developed and manufactured indigenously. Presently, higher capacity producer gas engines are modified engines or imported engines."

1.105 Regarding technological upgradation introduced in these areas and the resultant benefits accruing thereon, the MNRE in a written reply stated as follows:

> "State-of-art technology is available in the country for setting up of biomass projects. Some of the projects in the country have adopted very efficient technology i.e. upto 110 ata pressure boiler. Biomass power producers, however address specific issues with respect to management, storage, utilization of biomass power projects and competitive uses of biomass which are governed by market forces. When the Ministry initiated its programme on biomass power/bagasse cogeneration 45 bar/440°C. steam pressures were just being introduced. These were than increased to 65 bar/485°C based on a demonstration programme initiated by the Ministry. By the year 2004, the steam parameters were upgraded to 87 ata 510°C which gave almost 5% to 6% higher output in gross power generation than the 67 ata system. In the year 2008, the projects adopted 110 ata 540°C steam pressure which gave additional power generation of about 6% with the same quantum of fuel.
>
> The paddy straw in Punjab was burnt in the field without value addition, the Technology for power generation using 100% paddy straw developed and made operational in Punjab.
>
> As far as biomass gasification technology is concerned, efforts are under way to manufacture 100 % producer gas engines in the country. In addition, efforts are being made to improve efficiency of gasification technology through introduction of efficient gas cleaning systems, operation and maintenance, biomass preparation, developed guidelines for standards and specifications and testing etc."

1.106 The MNRE is promoting small biomass power projects (up to 2 MW capacities) based on biomass gasification technology connected at the tail end of the grid and providing higher Central Financial Assistance. Such megawatt capacity biomass gasifier based projects would be set up in rural areas where biomass feed stock could be supplied on sustainable basis and in cost effective manner, reducing T&D losses and ensuring access of electricity in rural areas contributing over all rural development. The Ministry has been requesting State Governments to allow power evacuation at 11 KV grid line and keep such projects outside of zoning which would help in promoting programme in a big way.

5. Strategy for various indigenously developed and managed new and renewable energy products and services

1.107 Regarding strategy of MNRE for various indigenously developed and managed new and renewable products and services in Biomass sector, the Ministry stated as follows:

> "In order to promote biomass gasifier based distributed / off grid, tail end grid connected and captive power projects, Central Financial Assistance (CFA) is being provided. Apart from CF, fiscal incentive such as 80% accelerated depreciation, 10 years tax holiday on income from generation, concessional custom duty on import of specified components, excise duty exemption are being provided for projects having long term Power Purchase Agreements. This apart, preferential tariff is being provided for sale of power from such projects in potential states."

1.108 In a presentation, the MNRE summed up bio-technologies which have been successfully developed indigenously as follows:

- "Biomass Combustion
  - Biomass used in boilers to generate heat/steam to drive turbine for generating electricity
- Biomass Cogeneration
  - Simultaneous production of heat/stem and electricity
  - These technologies are fairly well established in the country. Efficiencies of boilers/turbines comparable to best in the world.
- Biomass Gasification
  - Conversion of woody and non-woody biomass such as Rice husk, arhar stalks, cotton stalks, wood chips etc. to produce gas.
  - Technology successfully developed indigenously".

6. Cost competitiveness

1.109 When the Committee desired to know whether any evaluation has been made regarding the cost of production of energy from biomass, vis-à-vis cost in other countries, MNRE stated as follows:

> "In most of the developed countries, large capacity biomass power projects are installed as compared to our country wherein smaller capacity project ranging from 1 MW to 10 MW is mostly preferred. This is due to number of

factors which include high cost of biomass, transportation, pre-possessing, storage and seasonal availability. The cost of production of energy ranges from Rs.3.75 to Rs.4.00/unit depending on plant load factor, interest rates on loan etc."

1.110 The Ministry further stated that the biomass power projects in the country are based on state-of-the-art technology developed indigenously. However, due to low cost of material as well as labour, the cost of production of energy is slightly lower as compared to other countries.

1.111 When enquired about the initiative of the Government to make biomass power more cost effective and also to popularize it in the area where raw material is available in abundance, the Ministry in a written note stated as under:

"The Ministry is providing central financial assistance for creating awareness to various States nodal agencies, Cogeneration Association of India, Confederation Indian Industries, Regional Chamber of Commerce, etc., for conducting business meets, seminar symposia, training programmes. Apart from this biomass energy news letters are published on quarterly basis for creating more awareness in this field."

1.112 Further, the Committee have been informed that the Ministry is promoting projects for recovery of useful energy/ power from different biomass feedstock materials/ ingredients that are either waste or surplus.

7. R&D activities in the sector

1.113 In their presentation before the Committee, the Ministry enumerated the R&D projects in Biomass sector as follows:

- "Advanced Biomass Research Centre (ABRC) at CGPL, IISc, Bangalore (2008)
- Gasifier based power projects linked with dedicated plantation on degraded/marginal land (2MW taken up in Tamil Nadu)
- Rice husk and other biomass (including pine needles) based small gasifier systems for distributed/off-grid power generation in rural areas/industry.
- 100% rice straw based small capacity boiler for power generation (by NIRE in association with Thermax, at Ludhiana)"

8. Incentives/promotion of private participants

1.114 In response to a query regarding availability of reliable data to the private sector operators in the field of biomass in view of seasonal variations and shifting of biomass to other industries, the Ministry stated as under:

> "The Ministry has sponsored a project to Indian Institute of Science, Bangalore to update the data available of biomass resources atlas being dynamic in nature, taking into account the competitive uses of biomass by various industries."

VII. URBAN AND INDUSTRIAL WASTE TO ENERGY

1.115 The MNRE has been implementing a programme for Energy Recovery from Urban and Industrial Wastes. Urban population constitutes 27.8% of the total population of the country as per 2001 census. The problem of urban waste management is notable not only because of large quantities involved, but also its spatial spread across the Urban Local Bodies and the enormity and variety of problems faced in setting up of systems for collection, transportation and disposal of waste and mainly non-availability of land for landfills. A large quantity of wastes, both solid and liquid, are generated in industrial sectors such as sugar, pulp and paper, fruit and food processing, sago / starch, distilleries, dairies, tanneries, slaughterhouses, poultries, etc. Despite requirements for pollution control measures, these wastes are generally dumped on land or discharged into water bodies, without adequate treatment, and thus become a large source of environmental pollution and health hazards. This problem can be mitigated through the adoption of effective waste management systems and waste-to-energy conversion technologies.

1. Potential and installed capacity

1.116 The MNRE has submitted that about 50 million tonnes of solid waste (1.40 lakh tonnes per day) and 6000 million cubic metres of liquid waste are generated every year by 423 Class I cities. This translates into a potential for generation of nearly 2600 MW of power from urban wastes in the country. The estimated potential for recovery of energy/generation of power from solid and liquid wastes being generated in various industrial sectors is about 1300 MW and is expected to increase to about 2000 MW by 2017. As on 31st March, 2012 a capacity of 90 MW has been installed.

1.117 When asked the meagre cumulative achievement under waste to energy, the Ministry informed that about 80 projects for energy recovery from variety of industrial waste with an aggregate capacity of 145 MWeq. have been installed in the country. After a few demonstration projects (pilot projects) the waste to energy projects based on industrial wastes and effluents are being promoted under a regular programme on Energy Recovery from Industrial wastes. Further, an evaluation study about their success is being carried out.

1.118 Regarding the year-wise targets and achievements during the 10th and 11th Plan periods, the Ministry furnished as follows:

Year	Targets (MW)	Achievement (MW)
2002-03	10	3.78
2003-04	10	22.1
2004-05	10	4.15
2005-06	7.5	1.75
2006-07	10	16.67
2007-08	10	18.73
2008-09	15	10.02
2009-10	25	20.65
2010-11	30	31.20
2011-12	40	45.20
Total	**167.5**	**174.25**

1.119 The MNRE stated that three projects for energy recovery from Municipal Solid Wastes with an aggregate capacity of 17.6 MW have been set up at Hyderabad, Vijayawada and Lucknow. Other urban waste projects include a 1 MW project based on cattle dung at Haebowal, Ludhiana; a 3.5 MW projects for generation of power from biogas at four sewage treatment plants in Surat; 150 kW plant for vegetable market and slaughterhouse wastes at Vijayawada; and 300 kW project based on vegetable market wastes at Chennai. The project at Lucknow is presently non-functional due to certain operational problems.

1.120 The Ministry also stated that they continue the implementation of the programme on Energy Recovery from Urban Wastes besides a separate programme for setting up of five pilot projects on energy recovery from Municipal Solid Wastes (MSW) in accordance with the directions of the Hon'ble Supreme Court.

1.121 When asked about the progress of the five pilot projects under implementation on energy recovery from Municipal Solid Wastes (MSW), the Ministry stated as follows:

i. 16 MW project at Okhla, Delhi: The project for generation of 16 MW electricity from about 1300 tons per day municipal solid wastes have been completed at a total cost of Rs.240.00 crore. The project is under commissioning since January, 2012.
ii. 8 MW project at Bangalore: The project for generation of 8 MW power from about 700 tons per day municipal solid wastes is under implementation at Bangalore. The execution work is delayed due to financial difficulties being faced by the Developers i.e. M/s. Srinivassa Gaythiri Resource Recovery Ltd.
iii. 11 MW project at Hyderabad: The project for generation of 11 MW electricity from about 1000 tons per day municipal solid wastes is under implementation at a total cost of Rs 105.00 crore by M/s. RDF Power Ltd., Hyderabad. The project is expected to be completed by May, 2012.
iv. 7.5 MW project at Pune: The project based on a new technology namely pyrolysis followed by internal combustion engines is being implemented by M/s. Rochem Ltd., Mumbai, at Pune, at a total cost of about Rs.90.00 crore. The project is expected to be commissioned by December, 2012.
v. 12 MW project at Gazipur, Delhi: The project is being set up by M/s. IL&FS and GMR for generation of 12 MW power from 1300 tons per day municipal solid wastes. The project, based on production of Refuse Derived Fuel to be used for power generation through boiler based on reciprocating stoker grates followed by a steam turbine, is being set up at a total cost of about Rs.140.00 crore. The project is expected to be completed by January, 2013."

2. Financial outlay for the 12th plan and for the financial year 2012-13

1.122 The Ministry informed that the proposed financial outlay for the 12th Plan under Urban and Industrial Waste to Energy sector is Rs. 1,245 crore and for the financial year 2012-13 is Rs. 45 crore. However, out of the proposed outlay of Rs.45 crore for the year 2012-13, the approved outlay has been only Rs.20 crore.

3. Technology mapping and benchmarking

1.123 The increasing industrialization, urbanization and changes in the pattern of life, which accompany the process of economic growth, give rise to generation of increasing quantities of wastes leading to increased threats to the environment. According to the Ministry, in

recent years, technologies have been developed that not only help in generating substantial quantity of decentralized energy but also in reducing the quantity of waste for its safe disposal.

1.124 The composition of urban wastes is rapidly changing with increasing use of packaging material, which includes paper as well as plastic bags. Municipal Solid Wastes in the country typically comprise organic and inorganic wastes, including, recyclables in the following proportion:

- Organic matter (Biodegradable and non-biodegradable) - 37-60%
- Inert matter - 35-55%
- Recyclable matter - 5-10%

1.125 Regarding the requirement of technologies for recovery of energy from Municipal Solid Waste for both thermal and biological processes, the Ministry in a written reply stated:

> "The organic component of waste can be converted into useful products and recyclables could be recycled, leaving inerts to go to the landfills. Therefore, the technologies for recovery of energy from MSW should include both thermal and biological processes. Biological method involves biomethanation of biodegradable fraction of waste for producing methane-rich biogas, which can be used as fuel for generating electricity. Thermal method involves combustion of organic waste as fuel with evolution of heat energy for generation of power. Advances in thermal conversion involve destructive heating of organic materials with a limited supply of oxygen (gasification) or without any oxygen (pyrolysis) to produce a combustible gaseous product consisting of simple hydrocarbons and hydrogen".

1.126 When asked about the technological up-gradation in the waste to energy sector, the Ministry in a written reply stated:

> "The equipment for segregation of wastes for removal of moisture and inerts have been identified and are now being deployed. Similarly, the reciprocating stoker grate type boilers are getting installed in place of travelling grate boilers that were tried earlier."

1.127 The Ministry have further stated that technologies and systems for setting up projects for Energy Recovery from Municipal Solid Wastes have been identified and first few projects based on new technologies are now getting installed.

4. Incentives and Financial Assistance for promotion of waste to energy sector

1.128 The quantum of financial assistance being provided by the MNRE for setting up Projects on energy recovery from a variety of urban waste furnished by the Ministry is as under:

- **Setting up five pilot projects on energy recovery from Municipal Solid Wastes:** Financial assistance at the rate of Rs. 2 crore per MW, subject to ceiling of 20% of project cost and Rs. 10.00 crore per project, whichever is less is to be provided for five pilot projects.
- **Power generation from biogas generated at Sewage Treatment Plants:** Financial assistance @ 40% of the project cost subject to a maximum of Rs 2.0 crore/MW shall be provided for projects for generation of power from biogas being produced at Sewage Treatment Plants.
- **Power generation from other Urban Wastes:** Financial assistance @ 50% of project cost subject to upper limit of Rs. 3 crore per MW shall be provided for setting up projects based on biomethanation technology for power generation from cattle dung, vegetable market waste, slaughterhouse wastes, night soil and any other urban waste generated in the urban areas. In case of the projects for generation of only biogas for thermal application, the financial assistance will be limited to Rs. 1.0 crore / MWeq (i.e. biogas production of 12000 cu.m / day).
- **Power generation from mix of Urban and Agricultural Wastes:** Financial assistance @ 30% of project cost subject to upper limit of Rs. 3.0 crore / MW shall be provided for setting up projects based on biomethanation technology for power generation from a mix of cattle dung, vegetable market and slaughterhouse wastes along with agricultural residues and wastes.

1.129 The Ministry have stated that the Schemes are applicable to both, Private as well as Public Sector entrepreneurs and organizations as well as Non-Governmental Organizations (NGOs), for setting up of waste-to-energy projects on the basis of Build, Own & Operate (BOO), Build, Own, Operate & Transfer (BOOT), etc.

1.130 In regard to the programme on energy recovery from industrial and commercial wastes, the Ministry stated:

"The type of projects covered under the Programme on Recovery of Energy/ Power Generation from Industrial and Commercial Wastes and Effluents include biomethanation of industrial solid and liquid wastes /effluents; power generation from biogas through boiler + steam turbine configuration, or biogas engine / turbine configuration; and, power generation from industrial solid wastes through boiler + steam turbine configuration."

1.131 The financial assistance for projects of different categories in the form of capital subsidy being provided by the Ministry is as follows:

Wastes / Technologies	**Capital Subsidy**
Industrial Waste to Biogas • Biomethanation of low energy density and difficult industrial wastes (i.e. dairy, tannery, slaughter house, sugar (liquid), bagasse wash, textile (liquid), paper (liquid) and pharmaceutical industry).	Rs. 1.0 crore / MWeq. (12000 Cu.m. biogas per day)
• Biomethanation of other industrial wastes.	Rs. 0.50 crore/ MWeq. (12000 Cu.m. biogas/ day)
Power Generation from Biogas • Boiler + Steam Turbine Configuration • Biogas Engine / Turbine Configuration **Power Generation from Solid Industrial Waste** • Boiler + Steam Turbine Configuration	 Rs. 0.20 crore / MW Rs. 1.00 crore / MW Rs. 0.20 crore/MW

1.132 On being asked the funding ratio for different projects of waste to energy, the Ministry in a written reply stated:

"Financial support is being provided for setting up of projects on Energy Recovery from Industrial Wastes in fixed quantities subject to an upper limit of 20% of the cost of the projects."

1.133 The Ministry have further stated that to promote harnessing of the available potential of urban and industrial wastes into energy, they proposed to continue present level of fiscal and financial support for waste-to-energy projects for the time being.

VIII. GEO THERMAL ENERGY

1.134 Geothermal energy is heat stored in deep interior of the earth. This heat energy can be used for producing electricity and also for direct heat applications. It has been reported that in the last few decades, there has been an increase in the use of geothermal energy all over the world. In India, Geological Survey of India has identified about 340 geothermal hot springs in the country. These springs are perennial and their surface temperatures range from 37° - 90°C which is suitable for direct heat applications and reservoir temperature 102^0 C – 260^0 C. It has also been stated that to exploit the geothermal energy sources, mapping of the deep surface structure and demarcation of the area of geothermal heat trapped inside the surface is needed so that decisions regarding deep drilling, estimation of its potential, number of years for which the resource can be profitably tapped etc. can be taken. So far the Ministry have been able to undertake only shallow bore hole drilling at some of the geothermal fields.

1. Potential and installed capacities

1.135 The Ministry in a presentation submitted before the Committee that 340 springs have been identified by Geological Survey of India and rough estimates based on GSI studies indicate that energy generation potential is 10,000 MW.

1.136 The Committee have been informed that the hot springs present in the country are grouped into seven geothermal provinces: (i) Himalayan – Puga, Chhumthang Province (ii) Sohana Valley (iii) Cambay Basin (iv) Son-Narmada-Tapti (SONATA) lineament belt (v) West Coast (vi) Godavari basin and (vii) Mahanadi Basin. These geothermal resources are distributed in the States of Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Maharashtra, Orissa, Uttarakhand and West Bengal.

1.137 The MNRE in a written reply gave the thermal characteristics of some of the above mentioned potential States as follows:

Provinces	Surface T° C	Reservoir T° C	Heat flow (mW/m^2)	Thermal Gradient (°C/km)
Himalaya	>90	260	468	100
Cambay	40-90	150-175	80-93	70
West Coast	46-72	102-137	75-129	47-59
SONATA	60-95	105-217	120-290	60-90
Godavari	50-60	175-215	93-104	60

These geothermal resources are distributed in the States of Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Maharashtra, Orissa, Uttarakhand and West Bengal.

- A geothermal exploratory study by a private consultancy firm has projected tentative geothermal potential of 1500 MW within the East Godavari Geothermal region in AP.
- Magneto-telluric (MT) studies assigned to National Geophysical Research Institute (NGRI), Hyderabad in 1999 to assess the deep reservoir temperature at potential sites have indicated Geothermal Potential at :
  - Puga geothermal field located in the N-W Himalayan range in Ladakh district of J&k
  - Tatapani geothermal field in the Sarguja district of Chhattisgarh.
  - Satluj-Spiti, Beas and Parbati valley in Himachal Pradesh.
  - Surajkund in Jharkhand. GSI studies have indicated Rajgir also as a potential region.
  - Badrinath - Tapovan area in Uttarakhand,
- GSI surveys in Maharashtra have shown hot spring clusters concentrated in west-coast and north-east margins. There are 60 hot springs in the States in 18 clusters. The best sites are Unhawre (khed) and Tural both in Ratnagir district.
- The Mahanadi belt in Orissa is a geothermal region. The potential of this region needs to be further studied and investigated.

1.138 Regarding the utilization of geothermal energy, the Committee have been informed as under:

- A cold storage plant was constructed in the 80s by IIT, Delhi in Manikaran, Himachal Pradesh to utilize geothermal energy at 90 ºC for preserving vegetables and fruits.
- An experimental geothermal power plant of 5 kW capacity was set up by NAL in 1992 at Manikaran in Himachal Pradesh. The power plant was operational for some time but was subsequently damaged by a landslide.

- Studies and experiments on utilization for geothermal energy for non-electrical applications such as space heating, green house, borax & sulphur extraction plant have been carried out in Puga region. An R&D project was undertaken in 1997 by RRL, Jammu for utilizing geothermal energy for mushroom cultivation and poultry farming."

1.139 When the Committee desired to know about the assessment of the potential of geothermal energy in the country, the Ministry in a written note stated as under:

> "Magneto-telluric (MT) studies were assigned to National Geophysical Research Institute (NGRI), Hyderabad to assess the deep reservoir temperature of potential sites at Puga geothermal field located in the north-west Himalayan range in Ladakh district of Jammu and Kashmir and Tatapani geothermal fields in the Sarguja district of Chhattisgarh. Further, a project on MT investigations for assessing the geothermal potential in Satluj-Spiti, Beas and Parbati valley in Himachal Pradesh, Badrinath-Tapovan in Uttarakhand and Surajkund in Jharkhand was assigned to NGRI has shown promising geothermal potential."

1.140 Further, the Ministry have stated:

> "There is a good potential of geo-thermal energy in the Ladakh region of Jammu and Kashmir. It is based on the assessment of geo-thermal exploration studies carried out by Geological Survey of India (GSI), National Geo-physical Research Institute (NGRI), Central Electricity Authority (CEA) and National Hydro Power Corporation (NHPC).

.2. Financial outlays for the 12th plan and for the financial year 2012-13

1.141 For the new technology under geothermal energy sector, the Ministry has proposed a financial outlay of Rs. 100 crore for the 12th Five Year Plan and Rs. 7 crore for the financial year 2012-13. However, the approved outlay for 2012-13 is only Rs.1 crore.

3. Constraints in harnessing geothermal energy potential

1.142 Regarding the constraints faced by the MNRE in harnessing the potential in geothermal energy sector, the Ministry stated as follows:

> "Due to high altitude, difficult terrain, harsh weather conditions, very short working period, difficulty in taking transmission lines to load centers and high

cost the projects for tapping geo-thermal energy could not be taken up so far. Jammu and Kashmir State Power Development Corporation Limited (JKSPDC) is identified as the Nodal Agency for tapping geo-thermal energy in Puga Valley of Ladakh."

1.143 When enquired about the infrastructure in place to harness the geothermal capacities, the Committee have been informed:

> "The organizations such as ONGC, NTPC and NGRI have been associated with development of Geothermal Energy and their capacities and infrastructure would be utilized."

1.144 When the Committee asked about the risk involved in the exercise of harnessing the geothermal energy due to the high degree temperature, the Ministry stated as follows:

> "No untoward incidence due to high temperature has been reported so far. However all safety aspects in exploring reservoirs with high temperature will be taken associating expert agencies."

4. R&D activities/projects taken up by institutions and industry

1.145 Regarding the R&D activities for power generation project from geothermal energy, the Ministry stated:

> "The States of Jammu & Kashmir, Chhattisgarh, Uttarakhand, Andhra Pradesh, Maharashtra, Gujarat and West Bengal have taken steps to harness Geothermal Energy in their states. Geothermal resource assessment studies have been taken up by Ministries at various potential sites through National Geophysical Research Institute), Hyderabad. Efforts also been made to develop multi –purpose R&D cum technologies demonstration projects using Geothermal Energy for heating, Cooling, Green House Cultivations and other applications."

1.146 The Ministry in their presentation proposed before the Committee that at least one R&D cum technology demonstration energy power projects on each of the potential States viz Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir and Jharkhand will be setup during 12th Plan to harness geo-thermal energy.

1.147 When asked about the progress made in the initiative in each of the States, the Ministry stated that Jammu & Kashmir, Chhattisgarh, Uttrakhand, Andhra Pradesh, Maharashtra, Gujarat and West Bengal have taken steps to harness geo-thermal energy in their States. Geo-thermal resource assessment studies have been taken up by the Ministry at various potential sites though Natural Geophysical Research Institute.

1.148 Besides the above, the Ministry enumerated other proposed activities regarding R&D and technology demonstration in geo-thermal energy as follows:

(i) Resource assessment
(ii) 3 MW power and off-grid application at Puga (J&K)
(iii) Direct heat application project at Badrinath Complex
(iv) Technology transfer,
(v) Industry based public-private parternship.

IX. TIDAL ENERGY

1. Potential and installed capacities

1.149 According to the MNRE, India has a long coast line of about 7500 km. with the estuaries and gulfs where tides are strong enough to move turbines for electrical power generation. The Gulf of Cambay and the Gulf of Kuchchh in Gujarat on the west coast have the maximum tidal range of 11m and 8m with average tidal range of 6.77m and 5.23m respectively. The Ganges Delta in the Sundarbans is approximately 5m with an average tidal range of 2.97m. The identified estimated potential is of the order of 8200 MW with about 7000 MW in the Gulf of Cambay, about 1200 MW in the Gulf of Kuchchh in the State of Gujarat and about 100 MW in the Gangetic Delta in the Sunderbans region in the State of West Bengal. In addition to large power plants there is a very good and wide spread potential for decentralized tidal/ wave based power plants for which technologies are to be developed to suit the available tide/ wave height and speed. There is a good opportunity for decentralized systems.

1.150 The objectives of the Ministry with respect to tidal energy programme have been stated as under:

(i) To study, assess and create test facilities for harnessing Tidal Energy,

(ii) To harness Tidal Energy for power generation,

(iii) Development of technology for exploiting the Tidal potential in areas with average tidal range less than 3 m and sub-kW to few kW range,

(iv) Apart from the identified sites for tidal power development, it is proposed to carry out studies for identification of the areas having Tidal potential with average tidal range less than 3 m,

(v) Development of Turbine technology suitable for Indian conditions.

1.151 The MNRE stated that potential assessment study has been undertaken by Gujarat State Government and MoU signed in January, 2011 by GPCL with UK & Singapore companies for setting up 250 MW tidal power plant at Mandis Gulf of Kutch and a special purpose vehicle has been formed for 50 MW plant in Phase I.

2. Financial outlay for the 12th Plan and for the financial year 2012-13.

1.152 For the new technology under Tidal Energy programme, the Ministry has proposed a financial outlay of Rs. 170 crore for the 12th Five Year Plan and Rs. 25 crore for the financial year 2012-13. However, only Rs. 1 crore has been approved for 2012-13.

3. Technological mapping/project under tidal energy programme

1.153 When the Committee desired to know whether any assessment has been done on its economic feasibility for power generation from tidal energy, the Ministry in a written note stated:

> "The Ministry has not done any assessment on economic feasibility of tidal energy for power generation. (However, Central Electricity Authority (CEA), Ministry of Power, conducted the economic tidal power study during early 80's on Indian coastline mainly in the states Gujarat and West Bengal based on barrage Technology.

1.154 The Ministry have also stated that the State Nodal Agencies of all the coastal States have been requested to provide the assessment of tidal energy potential on the coast line of their State.

1.155 Further, the Ministry have stated that the tidal power development is likely to give boost to economic development of remote areas especially in Sunderbans and also in other coastal States, A&N islands and Lakshadweep. It is also likely to improve their life by making available electricity in these areas. It may also help in improved navigation

1.156 When asked about the projects taken up under the Tidal Energy Programme of the Ministry, the Committee have been informed:

> "Under the Tidal Energy Programme of the Ministry, a project on for setting up a 3.75 MW demonstration tidal power plant at Durgaduani Creek in Sunderbans, West Bengal to the West Bengal Renewable Energy Development Agency (WBREDA), Kolkata was sanctioned on 18.02.2008. The NHPC Limited has been given responsibility to execute the project. The total project cost is Rs.48.00 crores, out of which 90% (i.e. Rs.43.20 crores) will be shared by the Ministry and 10% (i.e. Rs.4.80 crores) by the

Government of West Bengal. The project was targeted to be completed in about 33 months from the date of sanction. Sanction was also accorded for the release of Rs 1.00 Crore during the financial year 2007-08 and Rs 2.00 Crore during the financial year 2010-11 to the Director, WBREDA. Based on the recommendation of a Committee, the NHPC Ltd. modified the tender documents and floated global tender. Two bidders have participated in the tender. Their technical and financial bids have been evaluated. The cost of the project received finally through the bids is likely to be more than Rs. 238 crores as against Rs. 48.00 crores projected initially by WBREDA."

1.157 When asked about the status of the Durgaduani Creek Tidal capacity power plant in Sunderban, the Ministry in their written replies stated that Government of West Bengal has decided not to continue with the project due to very high project cost and accordingly this project has now been cancelled by the Ministry.

1.158 The Committee have also been informed that the State Government of Gujarat formed a Special Purpose Vehicles (SPVs) with public private partnership and sponsored a study for large scale exploitation of tidal energy across the coastline of Gujarat. This study is based on one of the advanced technologies developed so for. In this technology kinetic energy of tidal currents has been proposed to be harnessed under the water and along the flow of water and without using the conventional methods like water wheel or other types of turbines.

4. R&D in tidal energy

1.159 The MNRE in a note explained that under their Programme Research & Development (R&D) of the Ministry, Research & Development (R&D), Technology Development, Demonstration Projects and the projects on other related activities, are submitted to the Ministry for the financial support. Such projects are scrutinized in the Ministry for support and approval of the competent authority up to the 50% of the cost assessment study and Tidal Energy power project as well.

Part –II

OBSERVATIONS/RECOMMENDATIONS OF THE COMMITTEE

The Committee are aware that conventional sources of energy have their own limitations such as huge expenditure required for mammoth centralized power generation and distribution network, environment pollution, deforestation, limited resources which cannot be replenished in near future, energy security and dependence on imports and exorbitant prices. The Committee feel that with ever growing demand for energy, alternative means of energy will have to be explored so as to reduce our dependence on the fast depleting conventional sources. Our Country has been endowed with adequate natural resources. If potential is identified fully and efforts are made to harness them for country's energy requirements it will not only help in meeting country's energy needs but will also result in substantial savings besides ensuring the availability of green energy. Non-conventional resources have huge potential but hitherto have been largely unexplored and unexploited. To achieve this and take this sector forward the basic requirement is to assess its potential. The work so far in all these areas was only preliminary in nature and tentative in attempt. It is only in the recent past when solar potential has been estimated about 1,00,000 MW and Atlas of wind potential is being revised/updated. In view of the importance of non-conventional energy resources and its optimal utilization, the Committee selected the subject for detailed examination. The observations/ recommendations of the Committee have been set out in succeeding paragraphs.

Non-conventional Energy Resources – Potential vis-à-vis Utilization

2.2. So far there was no definite figures for the available potential of non-conventional energy sources in the country. The MNRE has now estimated the renewable energy power potential in the country to be around 1,89,900 MW of which the solar energy constitute more than 50 per cent followed by wind, biomass, small hydro etc. The achievement till the 11th Plan period have been stated to be near about 25000 MW put together all forms of energies under this sector. This is about 13 per cent realization of the estimated potential. As the solar energy constitute a lion share in the total potential of the sector and the development of solar energy is yet to take off in a significant way, the renewable energy sector has failed to register its presence in the total electricity production of the country. In the entire Indian power sector, as on date the renewable energy contributes only about 12 per cent which shows that the sector is to march ahead henceforth. The Committee have been apprised that there is constant increase in the pace of renewable energy development since 9th Plan onwards in terms of MW, it has increased to about 25,000 MW at the end of 11th Plan (31.3.2012) from about 3,900 MW in the year 2003. Out of this, wind energy has contributed substantially with a shore of 17353 MW. The Committee feel that renewable energy programme is primarily private sector driven and it offers significant investment and business opportunities and hence a conducive atmosphere for attracting private entrepreneurs would give much needed fillip to the sector. The Committee, therefore, recommend that those segment of the renewable energy which have partially developed should be supported by research and development, fiscal incentives and financial support, for increasing the percentage

contribution of the renewable energy in the total electricity generation capacity. Simultaneously, the pace of development in the solar energy sector should also be expedited as unless this sector grows the renewable energy will not have the significant presence in the total electricity scenario of the country and will ever remain a marginalized entity.

(Recommendation No.1, Para No.2.2)

2.3 The Committee note that the potential of renewable energy sources identified in the country is 1,89,900 MW, in which the share of solar, wind power, small hydro power (upto 25 MW), biomass, bagasse, waste to energy is 1,00,000 MW, 49,000 MW, 15,000 MW, 17,000 MW, 5,000 MW and 3,900 MW respectively. Further the revised potential of wind energy by C-wet has been estimated to be around 1,00,000 MW at 80 m. height (yet to be validated). After validation of revised wind potential the total potential of renewable energy in the country would be about 2,50,000 MW. However, the achievement from the resources have been far from satisfactory. As of now wind power has the major contribution followed by small hydro amongst the renewable energy sources. The achievement in other areas are minimal. A scrutiny of state-wise data reveals that the performance in the States with huge potential has been extremely unsatisfactory as the achievement has either been nil or negligible. About 5311 MW potential of wind power is available in the State of Jammu and Kashmir with nil achievement. Likewise, under biomass a potential of 1044 MW and 1364 MW have been identified in the States of Kerala and Madhya Pradesh, but the achievement in these two States are nil and only 8.5 MW respectively. The potential under geo-thermal and tidal energy is yet to be assessed. The Committee feel that most of the

renewable energy potential is either under-utilized or not utilized at all. The approach of the Government into this sphere leaves much to be desired. The Government projection of installed capacity at the end of 12th Plan is also not satisfactory. Even if the projected figure of 54,414 MW (cumulative) capacity is achieved (if at all) the total installed capacity will be around only 29 per cent of the identified potential. This percentage will further go down substantially if the revised potential of wind energy is validated and more potential sites are identified with regard to other sources. The Committee while acknowledging the efforts of the Ministry, recommend the Ministry to come out with a multipronged strategy to fully exploit the identified potential of the renewable energy sources and also to focus in the areas where potential have been identified but achievements are less. The Committee also recommend the Ministry to put sincere efforts for identification and evaluation of new potential sites for maximum exploration of huge potential lying untapped.

(Recommendation No.2, Para No.2.3)

2.4 The Committee note that the main constraints put forward by the Ministry in bridging the gap between potential and achievement are inherent intermittent nature of renewable energy sources, grid synchronization limitations on account of intermittent nature of supply, higher capital investment, requirement of preferential tariffs, difficulties in servicing and maintenance in difficult areas, etc. The Committee feel that the obstacles highlighted by the Ministry are neither unforeseen nor insurmountable and the implementation of the various projects under the renewable energy programme of the Ministry cannot be left to suffer on account of these administrative and functional bottlenecks. The Committee feel that every sector has

certain obstacle and these have to be dealt with a view to ensure attainment of the goals. Hence, the Ministry is duty bound to ensure that the issues are addressed from all angles and a practical and pragmatic solution is worked out in coordination with all concerned in order to harness the indentified potentials optimally. The Committee take note of the fact that to overcome these constraints the Government has taken various steps and measures which include support of R&D activities, development of new technologies and products that are cost effective, affordable and reliable, provision of fiscal and financial incentives and encouraging private investment. While acknowledging the efforts of the Ministry in mitigating the hurdles, the Committee recommend that the Ministry should take concerted efforts to strengthen the sector on policy front, pricing mechanism, single window clearance, technology inflow, investment models and above all nurturing the spirits of all stakeholders to ensure that the target set for generation of electricity from renewable energy sources are achieved within stipulated time frame. The Committee, therefore, recommend the Ministry to adopt a comprehensive policy for ensuring adequacy of required funds, technological framework, strict and enforceable time schedule, required skilled manpower, time-bound clearances and conducive atmosphere for entrepreneurs. Besides, sufficient public awareness about the importance of renewable energy should also be created with attractive proposals for attracting investments in the sector.

(Recommendation No.3, Para No.2.4)

Wind Energy

2.5 The Committee note that wind energy is the fastest growing renewable energy technology for generating grid connected power amongst various renewable energy sources. Reportedly, a total capacity of 17353 MW has been established up to March, 2012 which is 70 per cent of the cumulative deployment of grid interactive renewable power. The Committee are, however, not satisfied with the achievement so far under the sector. Despite the fact that it is 70 per cent of the total grid-interactive power, it is approximate one-third of its own old estimated potential i.e. 49130 MW. With the validation of wind energy potential at 1,00,000 MW, the achievements in the sector would look very ordinary. In this sector too, the performance in States like Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Karnataka and Gujarat is far from satisfactory. The installed capacity in Andhra Pradesh and Karnataka is only 245 MW and 1933 MW against the estimated potential of 5394 MW and 8591 MW respectively. Further, estimated potential of capacity has not been reported from the States of Central, Northern and North-Eastern regions of the country. The Committee trust that the revised wind atlas must have included the aforementioned potential areas of the country. The Committee accordingly recommend that the Ministry should take urgent steps for validation/approval of revised wind atlas and to initiate projects for the new identified areas across the country.

(Recommendation No.4, Para No.2.5)

2.6 The Committee note with satisfaction that the expenditure in the 11th Plan period under wind energy sector has been on the expected lines except for the year 2008-09 where it was Rs. 8.41 crore against the allocation of Rs. 14 crore. There has been increase in the plan outlay of the 12th Plan which has been pegged at Rs.1,600 crore and for the financial year 2012-13 it has been placed at Rs. 100 crore. However, approval is only Rs.45 crore. About the constraints, land availability, procedure for land allotment, infrastructure for power evacuation and transmission have been cited to be major problems in the development of the sector. The Committee have been apprised that to encourage installation of wind power projects in the country, the Government provides various incentives, viz. fiscal incentives, tax holiday on income from generation, concessional custom duty on import of specified components, excise duty exemption from manufacture of wind electric generators, preferential tariff and Generation Based Incentive (GBI). The Committee appreciate the Ministry's initiatives towards promotion of wind power generation. The Committee are also given to understand that the cost of production of wind energy in India is lower as compared to most other countries. In view of the foregoing, the Committee recommend the Ministry to play a pivotal role for maximum generation of power from wind energy through private entrepreneurs by giving them conducive atmosphere. The Committee also desire the Ministry to strengthen its mechanism through State Nodal Agencies/State Governments for identification of more potential sites and assessment of wind resource and also ensure proper functioning of the projects installed.

(Recommendation No.5, Para No.2.6)

Small Hydro Power

2.7 The Committee note that hydro power projects upto 25 MW capacity are classified as small hydro projects and potential of about 15000 MW has been estimated from 5718 identified sites in the country. Of this potential, about 50 per cent lies in the States of Himachal Pradesh, Uttrakhand, Jammu Kashmir and Arunachal Pradesh. Maharashtra, Chhatisgarh, Karnataka and Kerala are also stated to be having sizeable potential. As on 31st March, 2012, 3395 MW capacity has been installed and projects of about 940 MW are in various stages of implementation. Thus present capacity is about 22 percent of the estimated potential. In Committee's view, the achievement in this regard is far from satisfactory. The Committee, however, acknowledge the efforts of the Ministry for achieving the target of 1400 MW set for 11th Five Year Plan. In view of this, the Committee believe the Ministry would be able to achieve its 12th Plan target of 2000 MW and would also strive to achieve more than the target set. The Committee take note of the initiatives taken by the Government for faster exploitation of SHP potential in the country which among others include formation of a separate sub-group to draw the 12th Plan and the Action Plan for achieving 12th Plan targets and another sub-group to look into the issues of transmission/evacuation infrastructure and environmental aspects including land and forest clearance issues. AHEC, IIT Roorkee has also been asked to prepare a roadmap in this regard. . The Committee find that the sub-group has made suggestions for actions required to accelerate pace of exploitation in this sector such as reviewing State policies to ensure momentum of private sector participation, continuation of subsidies to 12th Five Year Plan for covering risks and making small

hydro projects economically viable and enhancing the scope of micro hydel and water mill scheme. The sub-groups constituted to look into the issue of transmission/evacuation infrastructure, environmental aspects including land and forest clearance issues for renewable energy based power projects has also suggested prudent practices for faster statutory clearances for renewable energy based power projects. The Committee also note the steps taken by the Ministry to study specific areas of concern. The Committee desire the Ministry to consider the observations and recommendations of the sub-groups seriously and implement the same in letter and spirit so that the initiatives of the Ministry are more result oriented. Further, the Committee recommend that for maximum exploitation of SHP potential, more vigorous and all out efforts should be undertaken by involving State Governments and agencies responsible for small hydro development in the identification and utilization of available potential. The Committee also recommend that the Working Group constituted having representatives from MNRE, CEA, the Ministry of Power, Central Water Commission and some of the State Governments may be asked to expedite the work relating to identification of the potential of small hydro sites in the country.

(Recommendation No.6, Para No.2.7)

Solar Energy

2.8 The Committee note that India is endowed with a vast solar energy potential where most part of the country receive 4-7 kilowatt hours of solar radiations per square meter per day with 250-300 sunny days in a year. The Committee was apprised that the total solar energy potential in the Country has been estimated to be

more than 1,00,000 MW which is more than 50% of the existing identified renewable energy potential. The Committee were informed that under the first phase of Jawaharlal Nehru National Solar Mission (JNNSM) it has been envisaged to set up 1,300 MW of grid connected & off grid solar plants by March, 2013. The Committee were further informed that a capacity of 3,000 MW has been proposed through Government support and another 6,000 MW through mechanism of Renewable Purchase Obligations (RPOs) and Renewable Energy Certificates (RECs) during the 12th Plan. The Committee have been given to understand that at the end of the 12th Plan the cumulative solar energy capacity would be 10,941 MW. Against this backdrop, the Committee note that as on 31st March, 2012, the total installed solar energy capacity in the Country is only 941 MW which constitutes less than 4 % of the total renewable energy installed capacity in the Country. Under Jawaharlal Nehru National Solar Mission (JNNSM), as on 29th February, 2012, only 188 MW of grid solar power has been commissioned against the target of 1,100 MW. Whereas, projects of only 83.5 MW capacity have been sanctioned against the target of 200 MW off-grid solar applications. Under Solar thermal collectors, against the target of 7 million sq. meters 4.88 million sq. meters have been done.

The Committee take cognizance of the fact that the MNRE have come a long way from 2 MW of grid connected solar power in 2009 to 941 MW in 2012. The Committee find that the solar energy sector has got the much needed boost after the launch of JNNSM. The Mission has facilitated to a considerable degree not only in the cost of setting up solar energy projects but also in tariff bidding due to increase in volumes and competition in the sector. However, the Committee feel that there is need for constant monitoring and effective interventions by the Government to

ensure that targets sets are achieved fully. The Committee also observe that in the first phase of JNNSM many new and small players, not having much experience in the field, have bagged most of the projects by quoting low tariff rate. The Committee being a little apprehensive about their timely commissioning and proper functioning of the awarded projects, strongly recommend that the Government should not become complacent in regard to the monitoring of these projects awarded under the first phase of the Mission. Rather remedial/ proactive measure should be taken to remove the present/ anticipated hurdles in commissioning of these projects as the success of the first phase of the Mission will play a crucial role in shaping up the remaining two phases of the Mission. Needless to emphasize the impetuous the success of the Mission will provide to this sector in bringing the cost down to attractive level. The Committee also recommend that Government should make sincere efforts to convert solar energy targets fixed for the 12th Plan into reality by taking proactive measures to ensure proper funding of the coming up projects, timely grant of various clearances, strict monitoring of the progress of the development of the projects etc.

(Recommendation No.7, Para No.2.8)

2.9. The Committee observe that there has been a rough assessment of the solar energy potential in the country. Though India is endowed with abundant sunshine, it is vital to identify and specify the exact spots to locate projects so that they become viable. The Committee have been informed that to strengthen the solar resource assessment and to meet the requirement of availability of solar radiation data, 51 solar radiation monitoring stations have been set up at sites of high potential in the

country. The data so collected will augment the existing solar resource maps based on satellite imagery. The Committee were also apprised that the first draft of the Solar Atlas under preparation would be completed by December, 2012 and the second version by December, 2013. The Committee find that data in the atlas would be useful for both the Government and the investors and latter would base their projects on the authentic zone-wise data. The Committee, therefore, desire that the preparation of Solar Atlas should be expedited so that the stake holders / private sector participants are aware of the potential sites which will facilitate them to make large scale capital investment in solar energy projects / applications. Needless to emphasize that soon after its finalization the Ministry would make the Solar Atlas Data readily available and accessible to the State Governments and potential investors.

(Recommendation No.8, Para No.2.9)

2.10 The Committee note that the major constraints faced by the solar sector is non- availability of the bank finance, change in the rate of interest in the bank loans, lack of data on the performance and operation and maintenance requirements of the projects. The Committee also find that high cost of solar power is also one of the barriers in harnessing the solar energy potential of the Country. The high cost has been attributed to lower volumes, higher capital cost and import of equipments/technology. The Committee have expressed their concern time and again over the high prices and the poor quality of the solar equipment The Committee are given to understand that under the JNNSM, R&D efforts are being made for accelerating ongoing R&D efforts on different aspects of solar photovoltaic and solar

thermal technologies, including multi disciplinary research, with the objective of improving the efficiency, systems performance and reducing the cost. While acknowledging the R&D efforts under JNNSM, the Committee recommend that R&D related centres and institutions may also be functionally strengthened and financially equipped to meet the various challenges of research and development. The Committee feel that drastic reduction in the cost of solar energy will only be possible through promotion and strengthening of R&D activities in a big way. Though the indigenous equipments are cheaper in comparison to imported, but they have the quality issue, whereas, the imported counterparts are of good quality, but have exorbitant price. The Committee feel that in the given scenario focus of R&D activities on development of quality product at cheaper rate is need of the hour. The Committee, therefore, recommend that the Government should not only provide adequate financial stimulus to the solar sector but also involve/promote/ strengthen the various centres and institutions involved with R&D activities. The Committee also recommend that Ministry should encourage international cooperation mainly for technological advancements and technology transfer with particular emphasis on indigenization of technology with the objective of lowering cost of harnessing solar energy.

(Recommendation No.9, Para No.2.10)

2.11 The Committee note that the Government had approved the policy framework and announced Jawahar Lal Nehru National Solar Mission in January, 2010 with an objective to establish India as a global leader in solar energy. Solar Energy Centre has also been in existence since early 1982 as an umbrella organization to coordinate

all activities with regard to development of solar energy in the country. This Centre is a premier research, technology evolution and demonstration facility of the Ministry. It works on science and engineering aspects of solar energy technology. SEC works in the development of solar energy technologies and practices and contributes to the advancement of related science and engineering. The Solar Energy Centre has also undertaken a number of projects which can broadly be identified in the following categories I) Solar Research Assessment ii) Solar Power Generation iii) Solar Cooling iv) Solar Thermal Process Heat v) Solar Lighting and vi) Referal Test Centre for solar energy devices. On a question regarding role played by SEC in the field of technology advancement it has been stated that the projects undertaken by SEC serve the basic of objective of JNNSM. However, the Committee have also been informed that in order to strengthen the solar resource assessment and to meet the requirement of availability of Solar Radiation data, 51 solar radiation monitoring stations have been set up at sites of high potential in the country. This project is being implemented by C-WET, Chennai, an autonomous institution of the Ministry. The Committee are unable to comprehend as to how the work related to solar energy was assigned to C-WET instead of SEC. Regarding preparation of Solar Atlas, the Committee have been informed that agreement on Shaving Satellite Data from ISRO would begin from April 2012 and first draft will come out in December 2012. Besides, Solar Energy Centre also works as a Referral Test Center for solar energy devices, provides assistance for up-gradation of test facilities to regional test centers etc. The Committee observe that solar potential assessment is the primary function of the Solar Energy Centre. Based on the success of this task, other activities of the Centre gets validation.The Committee feel all activities related to solar energy should have

been entrusted to SEC. C-WET itself is finding it difficult to manage its own affairs efficiently because validation of their own wind atlas revising the wind potential is yet to be finalized. Moreover, C-WET is a specialized body meant for assessment and development of wind energy technology of the country. The Committee, therefore, strongly recommend that SEC should be conscious of its elementary responsibilities and be well-equipped to handle them deftly. No organization can come up strongly without proper base work and hence all the activities with regard to solar energy – resource assessment, development, harnessing, and periodic technological upgradation should be handled in an integrated and coordinated manner by the Solar Energy Centre itself. This will be in fulfillment of the objective for which it has been set up.

(*Recommendation No.10, Para No.2.11)*

Biomass Energy

2.12 The Committee find that the estimated potential of biomass including bagasse co-generation power in the country is 22000 MW and the cumulative achievement is 3135 MW (as on 31.03.2012). The Committee are not impressed to find that only 14 percent of the estimated potential has been exploited so far. Although, the targets set in for 10th and 11th Plan have been achieved yet the fact remains that huge potential is still left untapped in most of the States. Another disquieting fact is the glaring non-achievement in the States of Kerala, Madhya Pradesh & Punjab. In spite of 1044 MW, 1364 MW, 3472 MW potential identified, the capacity installed in these states is nil, 1 MW and 98.5 MW respectively. The Committee have been informed that considerable time is taken in implementing biomass power projects mainly due to

lack of firm data on surplus biomass availability for specific project area, interrupted supplies of biomass, steep price variations in biomass supply due to competitive use of biomass as fertilizer / manures etc., uncertainty associated with tariffs fixation in some potential States / inadequate tariff support from regulatory bodies and lack of working capital requirements for storing huge stock of biomass materials for ensured year round operation, requirement of a number of clearances by different departments of State Governments, high price of biomass as well as variations in its price. For promotion and creation of awareness in the field of biomass power, the Ministry is providing central financial assistance to various States and organising seminar, symposia, training programmes etc. The Committee also find that the Ministry have been interacting with the States to identify single agency to facilitate speedy approval and also has frequent interactions with Forum of Regulators (FOR) and CERC to ensure tariff revision etc. for better viability of the projects. The Committee desire the Government to persistently follow up with concerned States and concerned authorities for timely implementation of the projects. While acknowledging the various initiatives and steps taken by the Government, the Committee feel that a more systematic and objective planning in coordination with States is required for better organization of the resources and maximum utilization of the biomass potential. The Committee recommend that the Ministry should critically review their own performance and work out a concrete action plan to motivate and / or persuade the potential States which have shown lack of interest in the biomass power sector. They should also interact with these States and advice the State Governments to provide suitable incentives so as to attract more private investment in usage of biomass power and instill confidence in the investors. The Committee

have also been informed that the MNRE has constituted a number of sub-groups to study relevant issues relating to biomass power sector. The Committee would like to be apprised of the status and outcome of the sub-groups constituted in this regard. The Committee further recommend that the Ministry should specially focus on dissemination of information and give wide publicity about the authentic data on surplus biomass residues. They should also publicise the Biomass Resource Atlas so that the issue of assessing surplus agro residue availability is resolved.

(*Recommendation No.11, Para No.2.12)*

Urban and Industrial Waste to Energy

2.13 The Committee note that there exist a potential of about 2600 MW power from urban wastes and about 1300 MW from industrial wastes. The Committee are dismayed to find that against the estimated potential, a capacity of only 90 MW has been installed as on 31st March, 2012. The Committee are not satisfied with the poor performance of the Ministry under this sector. Even the pilot projects commissioned have not shown any encouraging results. In the Committee's view the waste to energy is an attractive initiative, as it serves a dual purpose of waste disposal and energy production. Also, the problems caused by solid and liquid wastes can be significantly mitigated through the adoption of environment-friendly waste to energy technologies that will allow treatment and processing of wastes before their disposal. The environmental benefits of waste to energy, as an alternative to disposing of waste in landfills, are clear and compelling, as this would reduce the quantity of wastes, generate a substantial quantity of energy from them, and greatly reduce

pollution of water and air, thereby offering a number of social and economic benefits that cannot easily be quantified. The Committee also find that with increasing industrialization/urbanization and changes in the pattern of life due to economic growth there is generation of increasing quantities of wastes leading to pollution and threat to environment. The Committee note that the Ministry is promoting the generation of energy from waste by providing incentives and subsidies to the investors and project developers. However, seeing the actual achievement under this sector, the Committee feel that the sector needs revamp in all aspects. The Committee, therefore, strongly recommend a detailed analysis of costs and availability of fund, promotion of the research on type of waste and its technological option, studies on resource assessment, technology up-gradation and active involvement of private sector participants. Performance evaluation is also required for effective and efficient implementation of the projects. The Committee also recommend that systematic data should be computed to the extent possible such as the value of recyclable, the amount of environmental pollution from waste sources and quantity of industrial waste generated so as to get a better understanding of this sector. The Committee further emphasise that there should be wide publicity about the significance of using this source of energy besides making available data and key statistics to the potential investors.

(***Recommendation No.12, Para No.2.13)***

Geo-Thermal Energy

2.14 The Committee note that geothermal energy is heat stored in deep interior of the earth that can be used for producing electricity and also for direct heat applications. Reportedly, Geological Survey of India has identified about 340 geothermal hot springs with 10,000 MW potential in the country which are perennial with surface temperatures ranging from 37-90 C which is suitable for direct heat applications. The Committee observe that the geothermal energy potential in India has apparently not been scientifically and systematically assessed nor any utilization reported. The Committee find that the Government has practically done nothing in geothermal sector. Not only this the Government has not made any efforts to enhance awareness or provide incentives or benefits to attract investment in the geothermal sector or induce private parties to explore and harness the untapped energy in this sector as is done in other renewable energy sectors like wind energy and solar energy. Regarding the assessment of the geothermal energy potential in the country, the Committee have been informed that the magneto-telluric (MT) studies were assigned to National Geophysical research Institute (NGRI), Hyderabad. A good potential of geothermal energy has also been reported in the Ladakh region of Jammu and Kashmir. High altitude, difficult terrain, harsh wheather condition, short working period, difficulty in taking transmission lines to load centres and high cost of the projects are some reported hindrances for tapping geothermal energy. The Committee find that in geothermal energy sector, the country is in a seminal stage. They feel that the sector need more research and innovation with escalating environmental problems with the growing needs of energy, the country cannot ignore

exploration and exploitation of the huge geo-thermal energy potential. The Committee, therefore, recommend that the Ministry should focus their efforts in early exploitations of the existing potential and explore more potential sites. The Committee were apprised that the Ministry has proposed to commission at least one geothermal based power project in each of the potential States viz. Andhra Pradesh, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir and Jharkhand during the 12th Plan period. The Committee feel that commissioning of at least one pilot project of geothermal energy would encourage investors and private participants in the sector. The Committee, recommend that the Ministry should take concrete steps to promote and provide adequate fiscal and financial incentives so as to attract investment in geo-thermal sector. Further, the Committee desire that the Ministry should proactively initiate geothermal based model project in collaboration with other successful countries in the sector and promote technology transfer from each collaboration to develop indigenous technology . Also, the Ministry should take aggressive steps in educating the significance of the geo-thermal energy in present scenario to general public and especially to the major industrial participants by organizing awareness programmes, conferences etc.

(Recommendation No.13, Para No.2.14)

Tidal Energy

2.15 The Committee note that India has a long coast line of about 7500 Km. with the estuaries and gulfs where tides are strong enough to move turbines for electrical power generation. They also note that the estimated potential of tidal energy is about 8200 MW in the country which includes about 7000 MW in the Gulf of Cambay and

1200 MW in the Gulf of Kutchh in the State of Gujarat and about 100 MW in the Gangetic Belt in the Sunderban region in the State of West Bengal. The Committee find that in the tidal energy sector also, India is still in its nascent stage. The Committee find that no pilot project has been set up so far in the tidal energy sector by the Government. In fact, the demonstration tidal power project namely Durgaduani Creek the tidal power plant in Sunderban, West Bengal (3x1.25MW) was sanctioned to WBREDA in 2008 at an estimated cost of Rs.48 crore and targeted to be completed in 33 months from the date of sanction. The WBREDA entrusted NHPC to execute the project as per the MoU signed between the two. The Committee find that the central financial assistance of Rs.3 crore was sanctioned by the Ministry in this regard. The Committee are astonished to find that over the last four years there has been no progress in regard to setting up of the project. On enquiry of the same the Committee were informed that the cost of the project estimate bids stands at Rs.238 crore against the initial estimate of Rs.48 crore and in view of this the Government of West Bengal has decided not to continue with the project. To the utter dismay of the Committee, the project has been cancelled by the Ministry due to its exorbitant cost. The Committee do not approve of this course of action. The initial unrealistic and totally unrelated projection of the project cost reflected a poor estimation and improper planning. The Committee feel that the matter has been unduly delayed thereby escalating the project cost manifold. It clearly reflects the non-serious approach which the Ministry has adopted in harnessing the potential in this sector despite the fact that so far not even a single pilot project has taken. While emphasizing the significance of energy generation through tidal power, the Committee strongly feel that assessment of economic feasibility and viability of the

projects should be evolved in the initial stage itself so that the estimated cost of the projects are rationally fixed. The Committee, therefore recommend that a systematic, scientific proper assessment of the tidal energy potential be worked out especially with the help of State Nodal Agencies in the coastal States forthwith. This would provide relevant data and information to the potential investors in the field. The Committee also emphasize that proper and adequate financial incentives should be given for promotion of investment in the tidal energy sector so as to harness the available potential in the sector. To start with a pilot project has to be initiated by the Ministry in coordination with concerned State Government to assure the private investors that the projects are viable.

(Recommendation No.14, Para No.2.15)

NEW DELHI
22 August, 2012
Shravana 31, 1934 (Saka)

MULAYAM SINGH YADAV
Chairman,
Standing Committee on Energy

Annexure – I

(Vide Para No. 1.7 of the Report)

State-wise details of estimated potential and achievements of grid interactive power capacity as on 31.03.2012.

S. No.	STATES / UT	Wind Power		Small Hydro Power		Biomass Power/ Bagase Cogen.		Waste To Power		Solar Power	
		Potential*	Ach.	Potential	Ach.	Potential	Ach.	Potential	Ach.	Potential**	Ach.
1	Andhra Pradesh	5394	245.55	560.18	217.83	878.00	363.25	123.00	43.16		21.75
2	Arunachal Pradesh	201		1333.68	79.23	8.00					0.03
3	Assam	53		238.69	31.11	212.00		8.00			
4	Bihar	0		213.25	64.30	919.00	15.50	73.00			
5	Chhatisgarh	23		993.11	20.25	236.00	249.90	24.00			4.00
6	Goa	0		6.50	0.05	26.00					
7	Gujarat	10609	2966.28	196.97	15.60	1571.00	20.50	112.00			604.89
8	Haryana	0		110.05	70.10	1683.00	35.80	24.00			16.80
9	Himachal Pradesh	20		2267.81	527.66	142.00		1.50			
10	Jammu & Kashmir	5311		1417.80	130.53	43.00					
11	Jharkhand	0		208.95	4.05	90.00		10.00			4.00
12	Karnataka	8591	1933.50	747.59	882.45	1581.00	441.18	151.00	1.00		9.00
13	Kerala	790	35.10	704.10	149.67	1044.00		36.00			0.03
14	Madhya Pradesh	920	376.40	803.64	86.16	1364.00	8.50	78.00	3.90		2.10
15	Maharashtra	5439	2733.30	732.63	281.33	3137.00	603.70	287.00	5.72		20.00
16	Manipur	7		109.13	5.45	13.00		2.00			
17	Meghalaya	44		229.80	31.03	11.00		2.00			
18	Mizoram	0		166.93	36.47	1.00		1.50			
19	Nagaland	3		196.98	28.67	10.00					
20	Orissa	910		295.47	64.30	246.00	20.00	22.00			13.00
21	Punjab	0		393.23	154.50	3472.00	90.50	45.00	9.25		9.33
22	Rajasthan	5005	2070.65	57.17	23.85	1039.00	83.30	62.00			197.65
23	Sikkim	98		265.65	52.11	2.00					
24	Tamil Nadu	5374	6987.58	659.51	123.05	1520.00	532.70	151.00	5.65		15.05
25	Tripura	0		46.86	16.01	3.00		1.50			
26	Uttar Pradesh	137		460.75	25.10	2867.00	644.50	176.00	5.00		12.38
27	Uttarakhand	161		1577.44	170.82	24.00	10.00	5.00		30-50	5.05
28	West Bengal	22		396.11	98.40	396.00	16.00	148.00		MW sq.km.	2.05

29	Andaman & Nicobar	2		7.27	5.25						0.10
30	Chandigarh	0						6.00			
31	Dadar & Nagar Haveli	0									
32	Daman & Diu	0									
33	Delhi	0						131.00	16.00		2.53
34	Lakshwadeep	16									0.75
35	Pondicherry	0						2.50			0.03
36	Others	5394	4.30					1022.00			0.81
	Total (MW)	**49130.00**	**17352.66**	**15397.25**	**3395.33**	**22538.00**	**3135.33**	**2705.00**	**89.68**		**941.32**
* Being reassesed. Interim revised estimated by C-WET is ~ 1,00,000 MW at 80 m. height(unvalidated), ** Statewise potential not estimated.											

Annexure - II

(*Vide Para No. 1.11 of the Report)*

11TH PLAN – YEAR WISE FINANCIAL OUTLAYS VIS-À-VIS EXPENDITURE FOR GRID POWER PROGRAMME

Rs./crore

S. No	Programme	2007- 08		2008- 09		2009- 10		2010- 11		2011- 12	
		Outlay	Exp.	Outlay	Exp.	Outlay	Exp.	Outlay	Exp.	Outlay	Exp. (as on 31.03.2012)
1.	Wind Power	11.50	11.17	14.00	8.41	10.90	10.90	34.90	34.90	22.50	22.50
2.	Small Hydro Power	50.00	49.95	82.50	82.49	107.00	106.94	152.00	151.99	150.60	150.58
3.	Biomass/Bagasse Co-generation	19.00	13.72	18.00	10.12	29.90	29.90	30.00	34.50	52.78	52.78
4.	Urban & Industrial Waste	13.00	8.66	13.55	10.88	14.95	9.27	24.50	23.84	6.62	6.61
5.	Solar Power	4.50	0.93	0.50	0.40	8.99	8.99	30.00	29.94	41.40	41.40

Annexure-III

(Vide Para No.1.35 of the Report)

STATE WISE DETAILS OF SHP POTENTIAL SITES, PROJECTS INSTALLED & UNDER IMPLEMENTATION
(As on 31.03.2012)

Sl. No.	State	Potential sites		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity(MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Andhra Pradesh	497	560.18	63	191.43	19	63.25
2	Arunachal Pradesh	550	1,328.68	100	78.835	121	47.67
3	Assam	119	238.69	4	27.11	4	15
4	Bihar	95	213.25	19	59.8	9	24.1
5	Chattisgarh	184	993.11	6	19.05	7	148.2
6	Goa	6	6.5	1	0.05	-	-
7	Gujarat	292	196.97	5	15.6	-	
8	Haryana	33	110.05	7	70.1	2	3.4
9	Himachal Pradesh	536	2,267.81	125	429.46	33	132.25
10	J&K	246	1,417.80	34	129.33	6	8.91
11	Jharkhand	103	208.95	6	4.05	8	34.85
12	Karnataka	138	747.59	121	851.65	16	141.675
13	Kerala	245	704.1	20	136.87	14	65.55
14	Madhya Pradesh	299	803.64	11	86.16	3	4.9
15	Maharashtra	255	732.63	43	275.125	23	91.2
16	Manipur	114	109.13	8	5.45	3	2.75
17	Meghalaya	101	229.8	4	31.03	3	1.7
18	Mizoram	75	166.93	18	36.47	1	0.5
19	Nagaland	99	188.98	10	28.67	4	4.2
20	Orissa	222	295.47	9	64.3	4	3.6
21	Punjab	237	393.23	46	154.5	12	21.15
22	Rajasthan	66	57.17	10	23.85	-	-
23	Sikkim	91	265.55	17	52.11	1	0.2
24	Tamil Nadu	197	659.51	19	113.05	2	20.5
25	Tripura	13	46.86	3	16.01	-	-
26	Uttar Pradesh	251	460.75	9	25.1	-	-
27	Uttarakhand	444	1,577.44	95	134.62	52	229.45
28	West Bengal	203	396.11	23	98.4	17	84.25
29	A&N Islands	7	7.27	1	5.25	-	-
Total		**5718**	**15384.15**	**837**	**3163.430**	**364**	**1149.255**

Annexure - IV

MINUTES OF THE THIRD SITTING OF THE STANDING COMMITTEE ON ENERGY (2011-12) HELD ON 1ST DECEMBER, 2011 IN COMMITTEE ROOM 'D' PARLIAMENT HOUSE, ANNEXE, NEW DELHI

The Committee met from 1500 hrs. to 1630 hrs.

PRESENT

Shri Motilal Vora - in the Chair

2. Shri Adhir Ranjan Chowdhury
3. Shri Syed Shahnawaz Hussain
4. Shri Baliram Jadhav
5. Shri Shripad Yesso Naik
6. Shri Jagdambika Pal
7. Shri Ravindra Kumar Pandey
8. Shri Vijay Inder Singla

RAJYA SABHA

9. Shri V.P. Singh Badnore
10. Shri Jesudasu Seelam
11. Shri Mohammad Shafi

SECRETARIAT

1.	Shri Brahm Dutt	Joint Secretary
2.	Smt. Abha Singh Yaduvanshi	Director
3.	Shri Rajesh Ranjan Kumar	Deputy Secretary

REPRESENTATIVES OF THE MINISTRY OF NEW AND RENEWABLE ENERGY

Sr. No.	Name	Designation
1.	Shri Gireesh B. Pradhan	Secretary
2.	Shri Rajarshi Bhattacharya	AS&FA
3.	Shri Tarun Kapoor	Joint Secretary
4.	Smt. Sunanda Sharma	Economic Adviser
5.	Dr. N.P Singh	Scientist 'G'
6.	Dr. B. Bandyopadhyay	Scientist 'G'
7.	Shri D. Majumdar	CMD, IREDA

2. In the absence of the Chairman, the Committee chose Shri Motilal Vora, a Member of the Committee to act as Chairman for the sitting in accordance with Rule 258 (3) of the Rules of Procedure and Conduct of Business in Lok Sabha.

3. At the outset, the Chairman, welcomed the members of the Committee and the representatives of the Ministry of New and Renewable Energy to the sitting of the Committee and emphasized the need for exploration and exploitation of maximum possible non-conventional resources to meet the ever growing demand of energy in the country.

4. Thereafter, the representatives of the Ministry of New and Renewable Energy briefed the Committee on the subject 'Availability of identified non-conventional resources of energy – their potential vis-à-vis utilization' followed by power point presentation.

5. The Committee inter-alia discussed with the representatives of the Ministry of New and Renewable Energy on the following important points:

i) The various sources of renewable energy potential and their utilization viz. wind power, solar energy, small hydro power, biogas, biomas, geo-thermal energy, tidal power, solid waste energy, etc.

ii) The quality and maintenance system of installed solar panels.

iii) Research and Development Programmes of renewable energy.

iv) The constraints faced by the Ministry in harnessing the various renewable energy resources.

The Members sought clarifications on various other issues relating to the subject and the representatives of the Ministry responded to the same. The Committee directed the representatives of the Ministry to furnish written replies to the queries which could not be responded to during the sitting.

6. The Committee decided to have further evidence of the representatives of the Ministry of New and Renewable Energy on the subject on a later date.

7. X X X X X X X X X X X X

8. X X X X X X X X X X X X

9. A verbatim record of the proceedings of the sitting of the Committee has been kept.

The Committee then adjourned.

MINUTES OF THE SEVENTH SITTING OF THE STANDING COMMITTEE ON ENERGY (2011-12) HELD ON 1ST MARCH, 2012 IN COMMITTEE ROOM 'D', PARLIAMENT HOUSE ANNEXE, NEW DELHI

The Committee met from 1500 hrs. to 1600 hrs.

PRESENT

Shri Motilal Vora - in the Chair

12. Shri Baliram Jadhav
13. Shri Jagdambika Pal
14. Shri Ravindra Kumar Pandey
15. Shri C. Rajendran
16. Shri Gutha Sukhender Reddy
7. Shri Baju Ban Riyan
8. Shri Radha Mohan Singh
9. Shri Vijay Inder Singla

RAJYA SABHA

10. Shri Shyamal Chakraborty
11. Shri Rama Chandra Khuntia
12. Shri Mohammad Shafi

SECRETARIAT

1.	Shri Brahm Dutt	-	Joint Secretary
2.	Smt. Abha Singh Yaduvanshi	-	Director
3.	Shri N.K. Pandey	-	Addl. Director
4.	Shri Rajesh Ranjan Kumar	-	Addl. Director

REPRESENTATIVES OF THE MINISTRY OF NEW AND RENEWABLE ENERGY

Sr. No.	Name	Designation
1.	Shri Gireesh B. Pradhan	Secretary
2	Shri Rajarshi Bhattacharya	AS&FA
3	Shri Tarun Kapoor	Joint Secretary
4	Smt. Sunanda Sharma	Economic Adviser
5	Dr. N.P Singh	Scientist 'G'
6	Dr. B. Bandyopadhyay	Scientist 'G'
7	Shri D. Majumdar	CMD, IREDA

2. At the outset, in the absence of the Chairman, the Committee chose Shri Motilal Vora, a Member of the Committee to act as Chairman for the sitting in accordance with Rule 258 (3) of the Rules of Procedure and Conduct of Business in Lok Sabha.

(The witnesses were called in)

3. The Chairman, welcomed the members of the Committee and the representatives of the Ministry of New and Renewable Energy to the sitting of the Committee. The Chairman pointed out the low cumulative achievement under various renewable sources of energy vis-à-vis potential and emphasized the need for maximum exploitation of the identified potential of the renewable sources of energy and also for exploration of the huge potential still lying unexplored.

4. Thereafter, the representatives of the Ministry of New and Renewable Energy made a power point presentation on the subject 'Availability of identified non-conventional resources of energy – their potential vis-à-vis utilization'.

5. The Committee inter-alia discussed with the representatives of the Ministry of New and Renewable Energy the following important points:

i) The aspect of targets vis-a-vis achievements under various sources of renewable energy viz. Wind energy, Biogas, Solar energy, Small Hydro power, Biomass etc.

ii) Targets and achievement of Phase I under Jawaharlal Nehru National Solar Mission (JNNSM).

(iii) Ministry's plan for potential exploration and further exploitation during ensuing 12th Five Year Plan.

iv) Allocation of funds and utilization thereon under various renewable energy sources.

(v) R & D activities to facilitate exploration and exploitation of the potential and to make the technology cost effective.

(vi) Updation of Atlases of various renewable sources.

The Members sought clarifications on various other issues relating to the subject and the representatives of the Ministry responded to the same. The Committee directed the representatives of the Ministry to furnish written replies to the queries which could not be responded to during the sitting.

6. A verbatim record of the proceedings of the sitting of the Committee has been kept.

The Committee then adjourned.

MINUTES OF THE FOURTEENTH SITTING OF THE STANDING COMMITTEE ON ENERGY (2011-12) HELD ON 16th AUGUST, 2012 IN COMMITTEE ROOM 'B' PARLIAMENT HOUSE ANNEXE, NEW DELHI

The Committee met from 1000 hrs. to 1030 hrs.

PRESENT

Shri Motilal Vora - (in the Chair)

2. Dr. Baliram
3. Shri Jagdambika Pal
4. Shri Ravindra Kumar Pandey
5. Shri C. Rajendran
6. Shri Baju Ban Riyan
7. Shri Radha Mohan Singh

RAJYA SABHA

8. Shri Ram Chandra Khuntia
9. Shri Bhagat Singh Koshyari
10. Shri Jesudasu Seelam
11. Shri Mohammad Shafi
12. Shri D.P.Tripathi
13. Shri Darshan Singh Yadav

SECRETARIAT

1. Shri Brahm Dutt - Joint Secretary
2. Smt. Abha Singh Yaduvanshi - Director
3. Shri N.K.Pandey - Additional Director

2. In the absence of the the Chairman, the Committee chose Shri Motilal Vora, a member of the Committee to act as Chairman for the sitting in accordance with Rule 258(3) of the Rule of Procedure and Conduct of Business in Lok Sabha.

3. At the outset, the Chairman welcomed the Members of the Committee.

X X X X X X X X X X X X X

4. The Committee then took up for consideration the following draft reports:-

i) 29th Report on Availability of identified non-conventional resources of energy – their potential vis-à-vis utilization.

ii) 30th Report on Functioning of Central Electricity Regulatory Commission.

After discussion, the Committee adopted the above draft Reports without any change.

5. The Committee also authorized the Chairman to finalize the above-mentioned Reports taking into consideration consequential changes arising out of factual verification, if any, by the concerned Ministries and also to present the same to both the Houses of Parliament.

The Committee then adjourned.