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INDIA: - NON-CONVENTIONAL ENERGY SCENARIO 2014-2015

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Abstract:-
India is a country with more than 1.2 billion people accounting for more than 17% of world's population. It is the seventh largest country in the world with total land area of 3,287,263 sq. kilometres. India measures 3214 km from north to south and 2993km from east to west. It has a land frontier of 15,200 km and coastline of 7,517 km. India has 29 states and 7 union territories. It faces a formidable challenge in providing adequate energy supplies to users at a reasonable cost India is facing energy issues for that prime minister and government of India have taken initiative to promote make India Energy from Non-conventional source. They have planning for moving megawatt to gigawatt, to overcome energy crunch. India is coming with grid connected power generating capacity with help of government. Even Prime Minister Narendra Modi has given to private player for Grid Connection and solar Farming. Non-conventional Energy sector is now poised to make a quantum jump from megawatt to gigawatt capacity. India as a country suffers from significant energy poverty and pervasive electricity deficits. In recent years, India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development, even though the base rate may be somewhat low. With an economy projected to grow at 8-9% per annum, rapid urbanization and improving standards of living for millions of Indian households, the demand is likely to grow significantly. This paper explains about current energy scenario of India with illustration and with some charts and graphical representation up-to till date 2015.

Keywords: - Non-Conventional, energy crunch, Quantum, Megawatt, gigawatt.

Introduction:-

Indian Non-Conventional Energy Scenario:-

Over the years, Non-Conventional energy sector in India has emerged as a significant player in the grid connected power generation capacity. It supports the government agenda of sustainable growth, while, emerging as an integral part of the solution to meet the nation's energy needs and an essential player for energy access. It has been realized that Non-Conventional energy has to play a much deeper role in achieving energy security in the years ahead and be an integral part of the energy planning process.

There has been a visible impact of Non-Conventional energy in the Indian energy scenario during the last five years. Apart from contributing about 12.96 per cent in the national electricity installed capacity, Non-Conventional energy based decentralized and distributed applications have benefited millions of people in Indian villages by meeting their cooking, lighting and other energy needs in an environment friendly manner. The social and economic benefits include reduction in drudgery among rural women and girls engaged in the collection of fuel wood from long distances and cooking in smoky kitchens, minimization of the risks of contracting lung and eye ailments, employment generation at village level, and ultimately, the improvement in the standard of living and creation of opportunity for economic activities at village level.

Non-Conventional energy sector landscape in India has, during the last few years, witnessed tremendous changes in the policy framework with accelerated and ambitious plans to increase the contribution of solar energy. For the first time, perhaps, not only is there the perception that Non-

Conventional energy can play a significant role, as also, there is a confidence in the technologies and capacity to do so. Enlarging the scope of the Jawaharlal Nehru National Solar Mission symbolizes both, and indeed encapsulates the vision and ambition for the future. This transformational change is, perhaps, the highlight of the last four years of activities under the Mission. In addition, the launching of Non-Conventional Energy Certificate mechanism helps in the creation of a Pan-India Non-Conventional energy market. The other significant achievements are introduction of solar specific purchase obligations; launching of improved cook-stoves initiatives; initiating coordinated research and development activities in solar PV and thermal; second generation biofuels, hydrogen energy and fuel cells, etc.

Core drivers for development and deployment of new and Non-Conventional energy in India have been:

1. Energy Security: At present around 60 per cent of India's power generation capacity is based on coal. Net coal import dependency has risen from a negligible percentage in 1990 to nearly 23 per cent in 2014. This, in addition to India's increasing dependence on imported oil, is leading to imports of around 28 per cent of India's total energy needs.

2. Electricity Shortages: Despite increase in installed capacity by more than 110 times in 62 years, India is still not in a position to meet its peak electricity demand as well as energy requirement. The peak power deficit during financial year 2001-02 was 12.2 per cent, approximately 9252 MW, however, at the end of Financial Year 2013-14, the peak power deficit decreased to the order of 4.5 per cent and in absolute terms peak deficit was at 6103 MW. Similarly, the shortage in terms of energy availability was around 7.5 per cent at the end of financial year 2001-02 (39,187 million unit), whereas at the end of financial year 2011-12, it reduced to around 4.2 per cent. However, in absolute terms it increased to 42,428 million units. As fallout of this situation, planned and un-planned load shedding measures were required to be undertaken by most of the Utilities to bridge this demand-supply gap.

3. Energy Access: India faces a challenge to ensure availability of reliable and modern forms of energy for all its citizens. Almost 85 per cent of rural households depend on solid fuel for their cooking needs and only 55 per cent of all rural households have access to electricity. However, even with this low access, most rural households face issues with quality and consistency of energy supply. Lack of rural lighting is leading to large-scale use of kerosene. This usage needs to be reduced, as it is leads to increased subsidies and import dependence, and consequent pressure on foreign exchange reserves.

4. Climate Change: India has taken a voluntary commitment of reducing emission intensity of its GDP by 20-25 per cent from 2005 levels by 2020. In the recently concluded 20th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) held at Lima, Peru all parties to the Convention were invited to communicate Intended Nationally Determined Contributions (INDCs) towards climate change mitigation. The increased share of Non-Conventional energy in the coming years will contribute towards achieving this goal.

Non-Conventional Power Installed Capacity

As of December 2014, solar, wind, biomass and small hydropower contribute about 13 per cent of the total installed capacity for electricity. The total installed capacity touched the figure of 33,791 MW with wind power contributing 22,465 MW, Solar 3,062 MW, Bio energy 4,272 and Small hydro 3,990 MW.

Non-Conventional Energy Potential

India has an estimated Non-Conventional energy potential of about 900 GW from commercially exploitable sources viz. Wind – 100 GW (at 80 metre mast height); Small Hydro – 20 GW; Bio-energy – 25 GW; and 750 GW solar power, assuming 3%

wasteland is made available. In addition, there exists significant potential from decentralized distributed applications for meeting hot water requirement for residential, commercial and industrial sector through solar energy and also for meeting cooking energy needs in the rural areas through biogas. Table 1.1 provides details on state wise Non-Conventional energy potential.

Non-Conventional energy has a great capacity to usher in universal energy access. In a decentralized or standalone mode, Non-Conventional energy is an appropriate, scalable and viable solution for providing power to un-electrified or power deficient villages and hamlets. Around 1.1 million households are using solar energy to meet their lighting energy needs and almost similar number of the households meets their cooking energy needs from biogas plants. Solar Photovoltaic (PV) power systems are being used for a variety of applications such as rural electrification, railway signalling, microwave repeaters, TV transmission and reception and for providing power to border outposts. Over 10,000 remote and inaccessible villages and hamlets have been provided with basic electricity services through distributed Non-Conventional power systems.

India has developed extensive data bases for Non-Conventional energy resource in the country. The National Institute of Wind Energy (NIWE), formerly known as Centre for Wind Energy Technology, has developed the Wind Atlas of India. NIWE also collects data from Solar Radiation Resource Assessment stations to assess and quantify solar radiation availability and develop Solar Atlas of the country. National Institute of Solar Energy has assessed the State wise solar potential by taking 3% of the waste land area to be covered by Solar PV modules. The Indian Institute of Science, Bengaluru has developed Biomass Atlas of India, and the Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee has assessed small hydro potential in the country.

A large domestic manufacturing base has been established in the country for Non-Conventional energy systems and products. Companies investing in these technologies are eligible for fiscal incentives, tax holidays and depreciation allowance apart from the remunerative returns for the power fed into the grid. Further, the government is encouraging foreign investors to set up Non-Conventional power projects with 100 percent foreign direct investment. The Indian Non-Conventional Energy Programme has received wide recognition internationally in the recent years. Many countries have evinced interest in cooperation with India for promotion of new and Non-Conventional energy. India has considerable expertise and experience in promoting Non-Conventional energy, both grid interactive and off-grid/stand-along applications for meeting electrical energy needs. India has been interacting with several developed and developing countries for cooperation in new and Non-Conventional energy sector. Bilateral and multilateral cooperation frameworks have been established with 42 countries.

Table1.1 : State wise Non-Conventional energy potential (in MW)

Sr. No.	States/UTs	Wind Power	Small Hydro Power	Bio-Energy			Solar	Total
				Biomass Power	Bagasse Cogeneration	Waste to Energy		
1	Andhra Pradesh	14497	978	578	300	123	38440	54916
2	Arunachal Pradesh	236	1341	8			8650	10236
3	Assam	112	239	212		8	13760	14330
4	Bihar	144	223	619	300	73	11200	12559
5	Chhatisgarh	314	1107	236		24	18270	19951

6	Goa		7	26			880	912
7	Gujarat	35071	202	1221	350	112	35770	72726
8	Haryana	93	110	1333	350	24	4560	6470
9	Himachal Pradesh	64	2398	142		2	33840	36446
10	Jammu & Kashmir	5685	1431	43			111050	118208
11	Jharkhand	91	209	90		10	18180	18580
12	Karnataka	13593	4141	1131	450		24700	44015
13	Kerala	837	704	1044		36	6110	8732
14	Madhya Pradesh	2931	820	1364		78	61660	66853
15	Maharashtra	5961	794	1887	1250	287	64320	74500
16	Manipur	56	109	13		2	10630	10811
17	Meghalaya	82	230	11		2	5860	6185
18	Mizoram		169	1		2	9090	9261
19	Nagaland	16	197	10			7290	7513
20	Orissa	1384	295	246		22	25780	27728
21	Punjab		441	3172	300	45	2810	6768
22	Rajasthan	5050	57	1039		62	142310	148518
23	Sikkim	98	267	2			4940	5307
24	Tamil Nadu	14152	660	1070	450	151	17670	34152
25	Telangana						20410	20410
26	Tripura		47	3		2	2080	2131
27	Uttar Pradesh	1260	461	1617	1250	176	22830	27593
28	Uttarakhand	534	1708	24		5	16800	19071
29	West Bengal	22	396	396		148	6260	7222
30	Andaman & Nicobar	365	8				0	373
31	Chandigarh					6	0	6
32	Dadar& Nagar Haveli						0	0
33	Daman & Diu	4					0	4
34	Delhi					131	2050	2181
35	Lakshwadeep						0	0
36	Puducherry	120				3	0	123
37	Others					1022	790	1812
	Total	102772	19749	17536	5000	2554	748990	896602

Non-Conventional energy has been witnessing over 20 per cent growth in the last five years. From the total Non-Conventional power installed capacity of 14,400 MW at the beginning of 2009, it has reached a capacity of 33,791 MW at the end of December 2014. Wind energy continues to dominate India's Non-Conventional energy industry, accounting for over 66 % of installed capacity (22,465 MW), followed by biomass power (4,165

MW), small hydro power (3,991 MW), solar power (3,063 MW) and Urban & Industrial Waste 107.5 MW. In terms of electricity generation, the Non-Conventional power installed capacity is generating around 70 billion units per year.

The main activities/achievements under different programmes of the Ministry during the year 2014-15 are highlighted as under:

Power from Non-Conventional

The gross installed capacity of grid interactive Non-Conventional power in the country stood at about 33.8 GW as on 31st December 2014 as shown in Table 1.2. India occupies the fifth position in the world with a wind power installed capacity of 22.5 GW. During the year 1,333 MW wind power projects were commissioned. The generation from wind power projects during the year was around 30 billion units. The Ministry has taken up a new initiative for implementation of wind resource assessment in uncovered / new areas with an aim to assess the realistic potential at 100 m level in 500 new stations across the country under the National Clean Energy Fund (NCEF). An MoU was signed in October 2014 for setting up a joint venture company towards undertaking the first demonstration offshore wind energy project. Wind energy generators of unit sizes between 250kW and 2.50 MW have been deployed across the country. Biomass power projects including through baggasse cogeneration with an aggregate surplus power generation capacity of about 152 MW have been successfully commissioned. Biomass gasifier based 1MW power plant has been commissioned in Haryana to meet the captive power needs and installation of 50 biomass gasifier and combustion based power projects with cumulative installed capacity of 6.20 MW, to meet the captive demand for electricity and thermal applications are under installation in different States. Small hydro projects with a capacity of 187.22 MW have been commissioned during the year. Solar power projects installations grown by 431 MW capacity solar power plants using solar photovoltaics and solar thermal technologies being commissioned during the year.

Table 1.2 Cumulative Deployment of Various Non-Conventional Energy Systems/Devices in the country (as on 31.12.2014)

Sector	Achievements During 2014-15 (Up To December 2014)	Cumulative Achievements (As On 31.12.2014)
I. Grid-Interactive Power (Capacities In Mw)		
Wind Power	1,333.20	22,465.03
Small Hydro Power	187.22	3,990.90
Biomass Power & Gasification	0.00	1,365.20
Bagasse Cogeneration	152.00	2800.35
Waste To Power	1.00	107.58
Solar Power	430.67	3,062.68
Total	2,104.09	33,791.74
Ii. Off-Grid/ Captive Power (Capacities In Mweq)		
Waste To Energy	8.54	141.27
Biomass(Non-Bagasse) Cogeneration	34.32	561.64
Biomass Gasifiers		

-Rural	0.75	18.23
-Industrial	6.20	153.40
Aero-Genrators/Hybrid Systems	0.13	2.38
SPV Systems	52.77	227.12
Water Mills/Micro Hydel	2.00	15.21
Bio-Gas Based Energy System	0.30	4.07
Total	105.01	1,123.32
Iii. Other Non-Conventional Energy Systems		
Family Biogas Plants (Numbers In Lakh) Solar Water Heating – Collector Area (Million M2)	0.42 0.53	47.95 8.63

Jawaharlal Nehru National Solar Mission

Against Grid connected Power Projects under Phase-I of JNNSM, 1154 MW capacity has been allocated. 11 projects of 50.5 MW capacity (48 MW PV + 2.5 MW ST) under migration scheme and 26 projects of 140 MW capacity under Batch-I are commissioned. 71 projects totaling 90.80 MW of Grid Connected Small Power Projects (RPSSGP Programme) have been commissioned. Solar PV projects totaling 340 MW under Batch-II have been declared commissioned. Solar Thermal Projects of capacity 200 MW have been commissioned. Under Off-Grid Solar Photovoltaic projects, the total capacity sanctioned is 252.5 MW.

Bids for selection under JNNSM Phase-II, Batch-I, were opened on 20-01-2014. After completion of the techno-commercial bid evaluation, financial bids were opened on 21st February, 2014. 26 bidders were found eligible for allocation. VGF quoted in the DCR category was in range of Rs. 1.35 crore/MW to Rs. 2.499 crore/MW while VGF in the OPEN category was in the range of Rs. 0.175 crore/MW to Rs. 2.490 crore/MW. Cut-off VGF for DCR category was Rs. 2.456 crore/MW while for Open category, cut-off VGF was Rs. 1.35 crore/MW. Letters of Intent (LoI).

Grid connected SPV Rooftop Power Plant of 7.52 MWp capacity at Dear Beas, Amritsar were issued on 26-02-2014 and PPAs were signed for 700 MW only out of the 750 MW bid. In case of the cancelled projects, LoI's have been cancelled and Bank Guarantees towards EMD have been encashed by SECI.

Under the Mission, the Ministry has also set up the following schemes:

- Scheme for setting up of over 300 MW of Grid-connected Solar PV Power Projects by Defence Establishments under Ministry of Defence and Para Military Forces with Viability Gap Funding under Phase II/III of JNNSM.
- Scheme for setting up 1000 MW of Grid-connected Solar PV Power Projects by Central Public Sector Undertakings (CPSUs) and Government of India organizations under various Central/State Schemes/Self-Use/3rd Party Sale/ Merchant Sale with Viability Gap Funding (VGF) under Batch V of Phase II of JNNSM
- Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects
- Grid Connected Solar PV Power Projects (3000 MW) by NTPC and other PSUs
- Pilot-cum-Demonstration Project for Development of Grid-Connected Solar PV Power Plants on Canal Banks and Canal Tops

Under the Grid-Interactive Rooftop SPV projects of capacity 310.10 MWp have been sanctioned till December 2014.

Funding has been received from National Clean Energy Fund (NCEF) for various grid connected solar PV rooftop systems, in a number of cities in the country, to be implemented by SECI and State Nodal Agencies. During the year, solar systems having total capacities of 52.77 MWp which includes solar lanterns, solar home lights, solar street lights, solar pumps and power plants were installed in various States.

Achievements for Solar Water Heaters for the year 2014-15 stands at 5,29,000 sq.m collector area against a target of 5,00,000 sq.m collector area. With this achievement, cumulative figure till December 2014 is 8.61 million sq.m collector area.

Approximate 45,000 sq. m. collector areas of various concentrating solar thermal systems comprising of more than 160 systems have been installed so far, including a solar thermal pressurized hot water system set up at a factory in Mysore, Karnataka to save 12000 litres of diesel annually and a solar fluid heating system at a scooter parts manufacturer at Manesar, Haryana. In addition, a number of solar steam cooking systems have been installed at college hostels and religious institutions across the country.

Continued emphasis was laid on research and development in various areas of solar energy technologies and application. The focus was on indigenization of technology, product development and resource assessment. Five new research projects each have been sanctioned under solar photovoltaic and solar thermal technologies during the year.

Non-Conventional Energy for Rural Applications:-

More than 45,000 biogas plants of the approved models were installed across the country with financial support of the Ministry, taking the cumulative installation to over 47.53 lakh biogas plants in all States and Union Territories of the country. The target of 1.10 lakh during the year, is likely to be achieved in full.

Under the National Biomass Cook-stoves Initiative, several pilot projects have been taken up during the year for deployment of improved biomass cook-stoves for demonstration among domestic and large sized community cooking in Anganwadis, Mid-day meal schemes in schools, Tribal Hostels etc. Projects taken up under the recently approved Unnat Chulha Abhiyan are now eligible for Carbon Credits under the CDM mechanism with Sardar Swaran Singh National Institute of Non-Conventional Energy (SSS-NIRE), an autonomous institute of MNRE, located at Jalandhar, Punjab has been designated as Coordinating and Managing Entity (CME).

Rice husk gasifier based 12 village level projects of 32 kWe each have been installed based on sustainable business model by entrepreneurs in various villages of Bihar. In addition, 10 systems are under various stages of installation / commissioning. Off-grid power capacity from biomass gasifier in 10 rice mills and 12 other industries including bakeries for meeting captive demand of electricity and thermal applications have been added. A grid connected biomass gasifier based project of 1 MW capacity in Haryana has been installed for meeting the captive power needs of the industry. Under Remote Village Electrification Programme around 11,308 villages and hamlets have been covered as on 31st December 2014.

Non-Conventional Energy For Urban, Industrial And Commercial Applications

A total of nine projects with an aggregate capacity of 9.54 MW based on municipal and industrial wastes have been completed during the year. Work is in progress at 11 MW, 10 MW, and 12 MW projects at Hyderabad, Pune, and Gazipur–Delhi, respectively. A total of twenty one projects based on urban/ industrial wastes with an aggregate capacity of about 21 MW are under installation. These include projects based on cattle dung, starch industry wastes, poultry litter and biogas at distilleries. Twelve projects of about 5.65 MWeq. based on mix of urban and

agricultural wastes are in progress at Jaipur, Kolkata, Surat, Hanumangarh, Anand and are expected to be completed during 2015.

During the year, a total of 15 biomass co-generation (non-bagasse) projects with a capacity of 34.42 MW have been completed. In addition, twelve projects with an aggregate capacity of about 51 MW are under implementation.

The Development of Solar Cities Programme the Ministry assists Municipal Corporations and Urban Local Bodies in preparation of a Master Plan for increasing energy efficiency and Non-Conventional energy supply in the city. Sanction has been accorded during the year for developing three cities as Solar City. Under the programme 48 cities have been sanctioned of which master plan of 44 cities has been finalized. Four cities, namely Nagpur, Chandigarh, Mysore and Gandhinagar, are being developed as Model Solar Cities. A pilot project on the Grid interactive rooftop small SPV power plant project was successfully implemented in Chandigarh Model Solar City.

The Energy Efficient Solar/Green Buildings Programme for promoting GRIHA rating system continued under implementation. So far, cumulative sanctions to 97 government building projects have been registered for GRIHA certification-cum-rating. Out of the 97 buildings supported by the Ministry for obtaining GRIHA rating, the rating has been accorded to 3 buildings viz. Administration Building for GAIL Compressor Station, Chainsa (4 Star); Indira Paryavaran Bhawan (5 Star), New Delhi; Pimpri-Chinchwad New Town Development Authority (5 star); and Rail Nirman Nilayam (South Central Railways 3 Star).

Research And Development

The Research and Development efforts of the Ministry are directed towards technology development and demonstration, leading to commercialization, apart from strengthening the capacity of R&D/ Academic Institutions and Industry for taking up advanced research for technology development. The ultimate goal is to reduce the cost and improve efficiency in the near future. The prominent projects taken up include advanced research and demonstration of higher efficiency solar cells, solar thermal power generation, hydrogen energy storage and fuel cells development, development and deployment of improved biomass cook stoves, etc. Research & development activities have been taken up with national laboratories, universities, scientific & educational institutions & industry for improvements in the Non-Conventional energy systems and products. The focus is on improved efficiency, cost reduction and technology transfer and demonstration for their commercialization. Twenty two new R&D projects were sanctioned during Solar Hot Water Plant at Sagar Mahal, Melgarh the year, five projects on solar, three on biogas, three projects on hydrogen, and 11 on wind-hybrid systems during the year 2014-15.

Non-Conventional Energy in North Eastern States

As per the directions of the Government of India, 10% of the annual budget of the Ministry is allocated for the promotion of Non-Conventional energy programmes & projects in the North-Eastern States of India including Sikkim. Special emphasis is accorded to the implementation of programmes such as remote village electrification, biogas, small hydro power, village energy security test projects & biomass gasifiers for meeting the lighting, cooking and other electrical needs of the far and remote villages and hamlets in the North-Eastern States including Sikkim.

Technical and Financial Institutions

During the year, National Institute of Solar Energy (NISE) continued to coordinate research & technology and other related work envisaged under the Jawaharlal Nehru National Solar Mission (JNNSM). The Main objective and functions of the NISE are:

- Assist the Ministry in implementing the Jawaharlal Nehru National Solar Mission.
- Responsible for providing thrust to R&D in solar energy and related technologies under the Mission including resource assessment, training, testing/standardization.

Undertake R&D projects on different aspects of solar energy technologies, hybrid systems and storage techniques/systems.

Act as the Secretariat for the work of the R&D Advisory Council. Facilitate the development of a technology roadmap and coordination with the other Centres of Excellence under the Mission, R&D projects in solar energy and other S&T Ministries.

Bridge the gap between existing R&D institutions and Industry, and get the Industry on board, through partnership programmes and projects.

Collaborate with the international S&T organizations and keep track of latest global developments based on technology forecasting and fore-sighting.

Support capacity building and support students, teachers and research personnel to work for higher degrees including Ph.D.

The following activities have been initiated at NISE during 2014-15 (i) Up-gradation of SPV module test facility; (ii) Up-gradation of solar cell test facility; (iii) Expand of battery test facility; (iv) Enlarge SPV water pumping test facility and other labs; (v) Up-gradation of Solar Thermal Labs; (vi) Establishment of IT cell; (vii) Renovation of work shop facility; (viii) Establishment of R&D monitoring cell; and (ix) Setting up of 500 kW SPV power plant.

The National Institute for Wind Energy (erstwhile Centre for Wind Energy Technology) serves as the technical focal point for wind power development in India. During the year, 9 new wind monitoring stations were commissioned in various states. 125 sites have been registered for wind measurement by private sector from various states in India.

National Institute of Wind Energy (NIWE) continued a project to conduct a realistic assessment considering tangible land availability for wind farming for seven wind potential states namely Tamilnadu, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Gujarat and Rajasthan at 100 m level facilitating validation of meso scale based results indicated in the Wind Atlas. 158 Wind monitoring stations are under operation. It is also conducting research on Power Evacuation Studies for Grid Integrated Wind Energy Conversion System, power quality issues in grid connected wind farms, wind shear studies, vortex forecasting and wind turbine wake studies.

The certification unit of NIWE has completed three type certification projects. The unit has also issued letters in connection with grid synchronization for three prototype wind turbine models.

Sardar Swaran Singh National Institute of Non-Conventional Energy (SSS-NIRE), at Wadala Kalan, District Kapurthala (Punjab) is an autonomous Institution of the Ministry focused on biomass energy research and development. During the year, a state-of-the-art research facility for biodiesel, bio-ethanol, gasification, biogas, biomass cook stoves research & testing and for other areas in Bio-energy has been developed at the institution. The testing and certification centre for Cookstoves has begun its operation with testing of available cookstove models as per new BIS norms. In addition, research projects on: Process development for bioethanol production from agricultural residues and Biogas production and utilization of heat and power generation applications using potential alternative feedstocks continued. The project on hydro-cracking of non-edible vegetable oil was completed during the year.

The Indian Non-Conventional Energy Development Agency Ltd. (IREDA), a non-banking financial institution under the Ministry sanctioned loans to the tune of Rs.2,874.15 crore and disbursed

Rs.1,397.19 crore against the annual target of Rs.4,400 crore and Rs.2,500 crore respectively. The loans were sanctioned for the establishment of about 900 MW of installed capacity of power generation. The cumulative sanctions and disbursements as on 31st December 2014 were of the order of Rs.29,151.77 crore and Rs.15,717.06 crore respectively. In addition, to Government of India equity, IREDA also raised resources to the tune of Rs. 416.35 crore up from various external sources Kreditanstalt fur Wiederaufbau (KfW) and Japan International Cooperation Agency (JICA). IREDA has also raised Rs.500 crore from taxable bonds (Series- V) and Rs. 757.65 crore through Tax Free Bonds (Series XIII).

Solar Energy Corporation of India, registered under Section 25 of Companies Act, 1956, as a not for profit Company, under the administrative control of the Ministry to assist the Ministry functioned as the implementing and executing arm of the JNNSM for development, promotion and commercialization of solar energy technologies in the country. SECI has been set up with an Authorized Share Capital of Rs.2,000 crore and Rs.103.35 crore has been released by the Govt. of India as a budgetary support up to 31st March 2014. Under the 750MW VGF scheme under JNNSM Phase II Batch I, PPAs for total 640 MW capacity have been signed with several states across the country. Under the Solar Parks Scheme, 13 solar parks have been given administrative approval for a total capacity of 9,650 MW in 9 states of the country. Under the Grid Connected Rooftop Programme, an aggregate capacity of 60 MWp capacity has been allocated out of which 13.6 MWp capacity is completed.

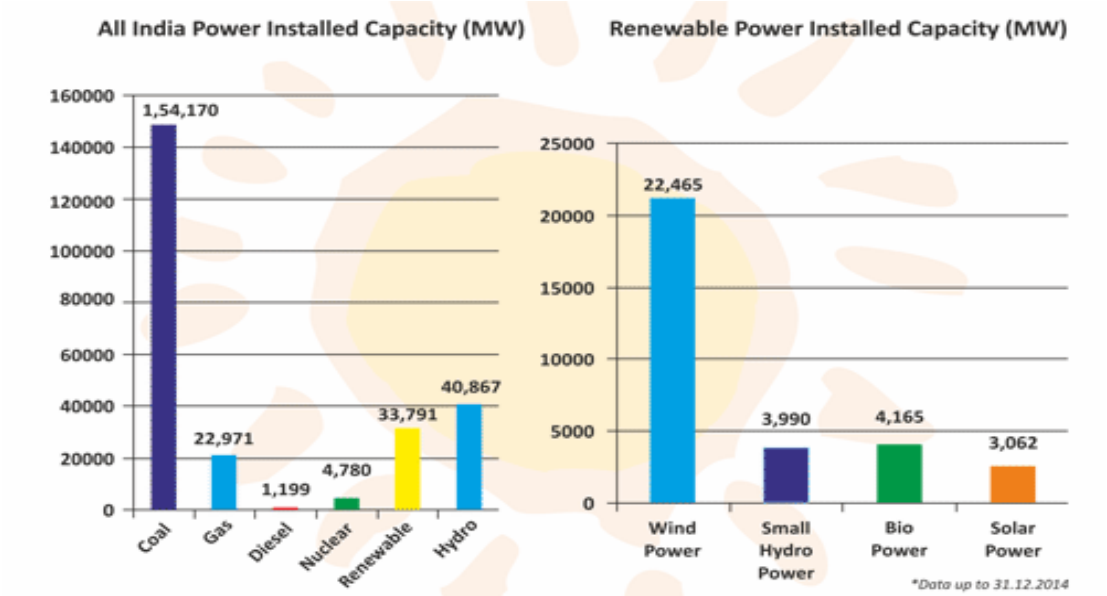
In addition, SECI is also involved with development and sale of low cost solar lanterns, development of mini/micro grid projects for rural electrification, installation of solar street lights under CSR activity.

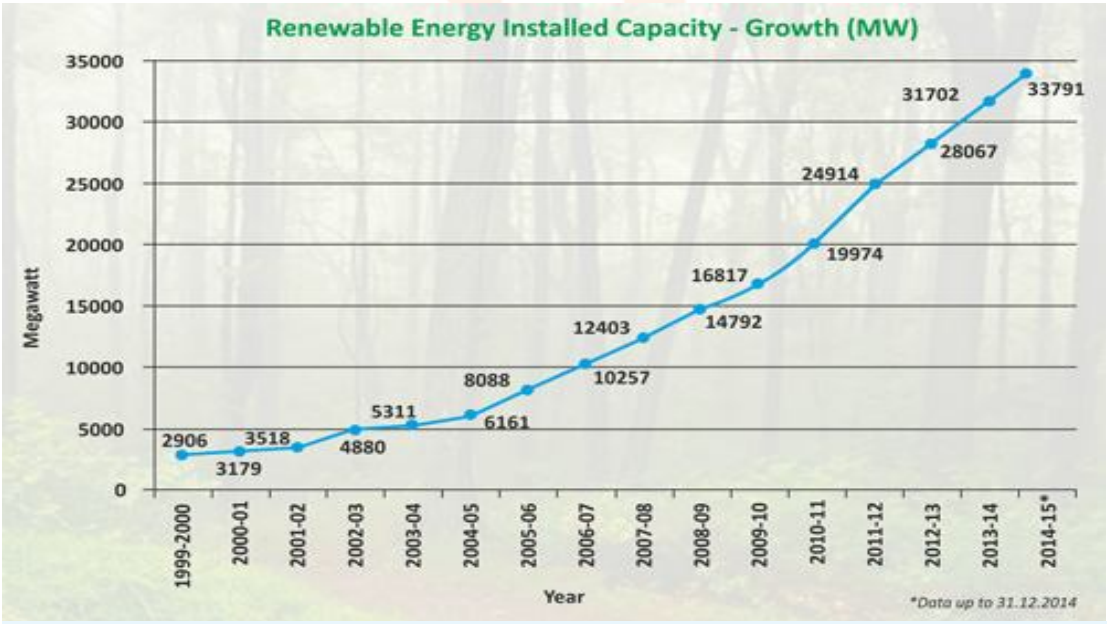
Information and Public Awareness

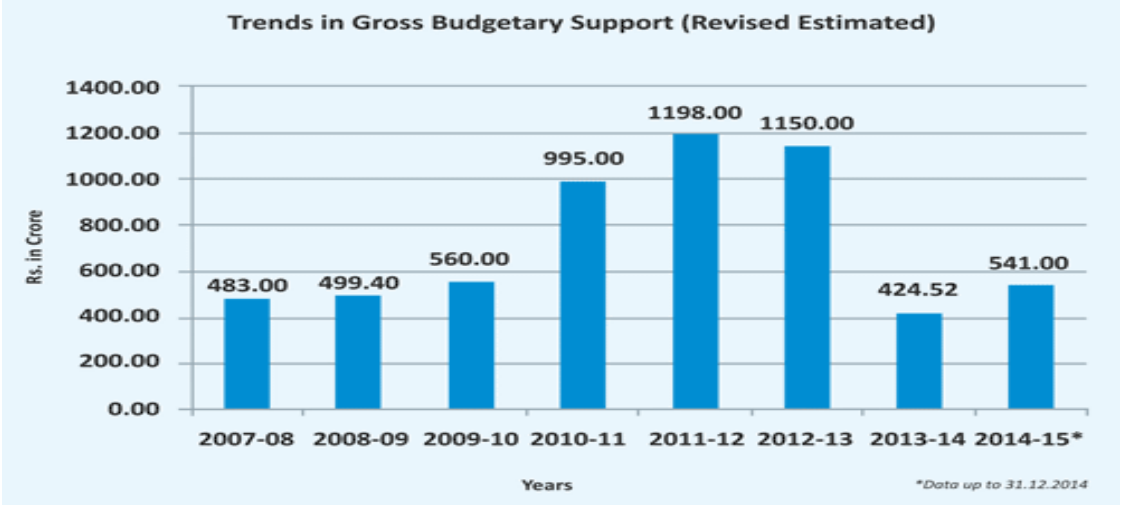
The Ministry continued its programme of Information and Public Awareness through a multi agency approach namely, State Nodal Agencies, Directorate of Advertising & Visual Publicity, Doordarshan, All India Radio, Department of Posts, etc., using the electronic, print and outdoor media. A new 52 episode TV programme has been launched from 21st February 2015 at DD National.

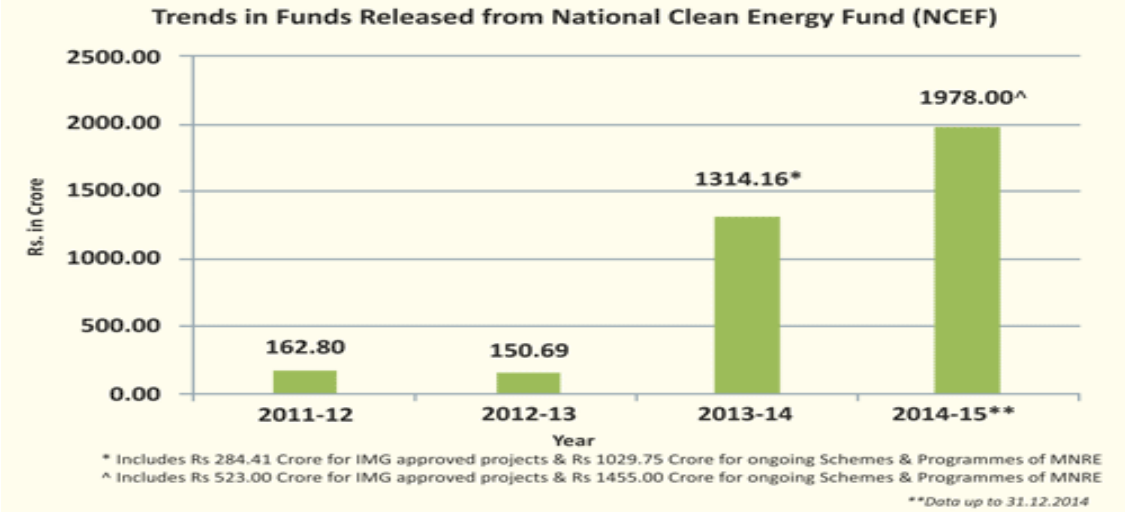
International Cooperation

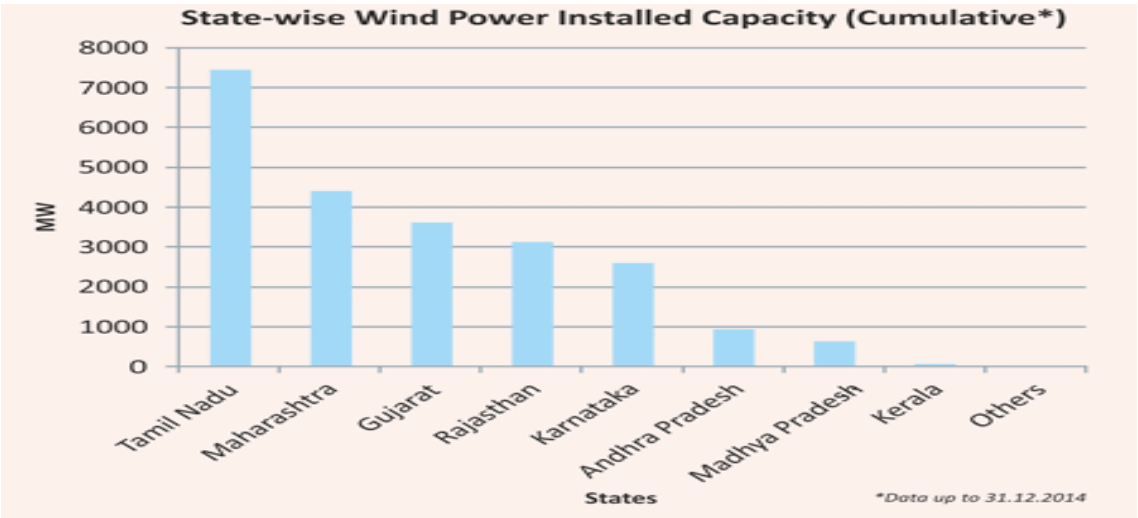
During the year 2014-15, the Ministry of New and Non-Conventional Energy took various initiatives for promoting cooperation with other countries in the field of Non-Conventional energy. Memoranda of Understanding (MoUs) / Agreements / Letter of Intent (LoI) etc were signed and Bilateral / Multilateral Meetings / Joint Working Group Meetings were convened and participated by MNRE. The Ministry also gets support from various international / multinational funding agencies, like World Bank, United Nations Development Programme (UNDP), Asian Development Bank (ADB), and United Nations Industrial Development Organization (UNIDO) and Global Environment Facility (GEF), who are providing project based assistance for Non-Conventional energy programmes in India.

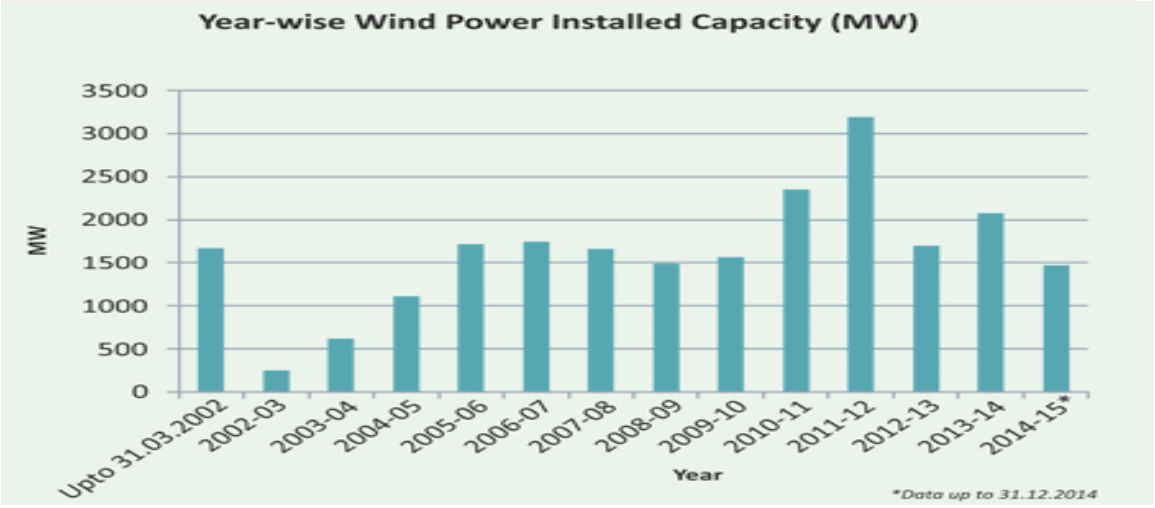

All India Power Installed Capacity (MW)
160000
140000
120000
100000
80000
60000
40000
20000
0
1,54,170
22,971
1,199
4,780
33,791
40,867
Coal
Gas
Diesel
Nuclear
Renewable
Hydro
Renewable Power Installed Capacity (MW)
25000
20000
15000
10000
5000
0
22,465
3,990
4,165
3,062
Wind Power
Small Hydro Power
Bio Power
Solar Power
*Data up to 31.12.2014

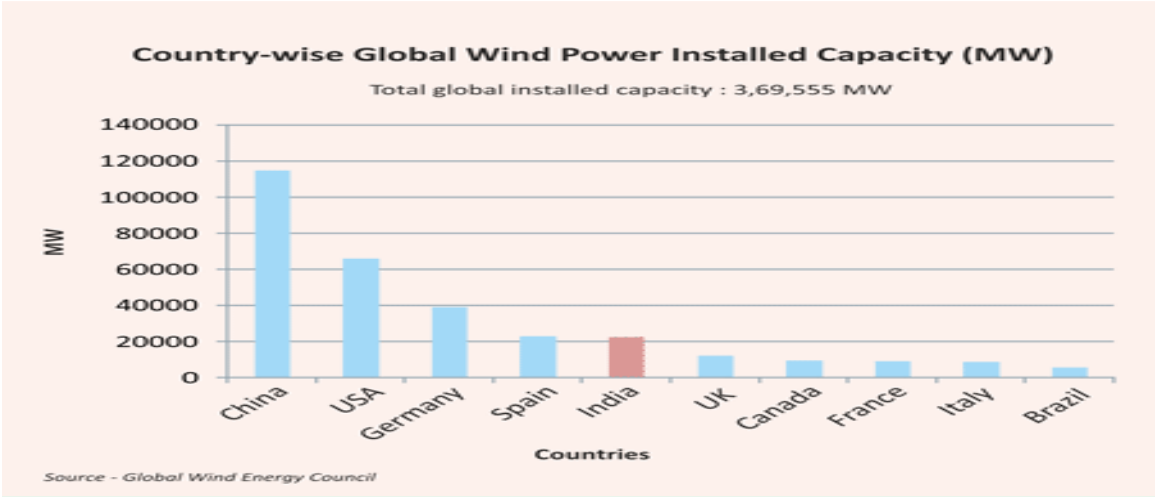

Renewable Energy Installed Capacity - Growth (MW)
Megawatt
35000
30000
25000
20000
15000
10000
5000
0
2906
3179
3518
4880
5311
6161
8088
10257
12403
14792
16817
19974
24914
28067
31702
33791
1999-2000
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15*
Year
*Data up to 31.12.2014

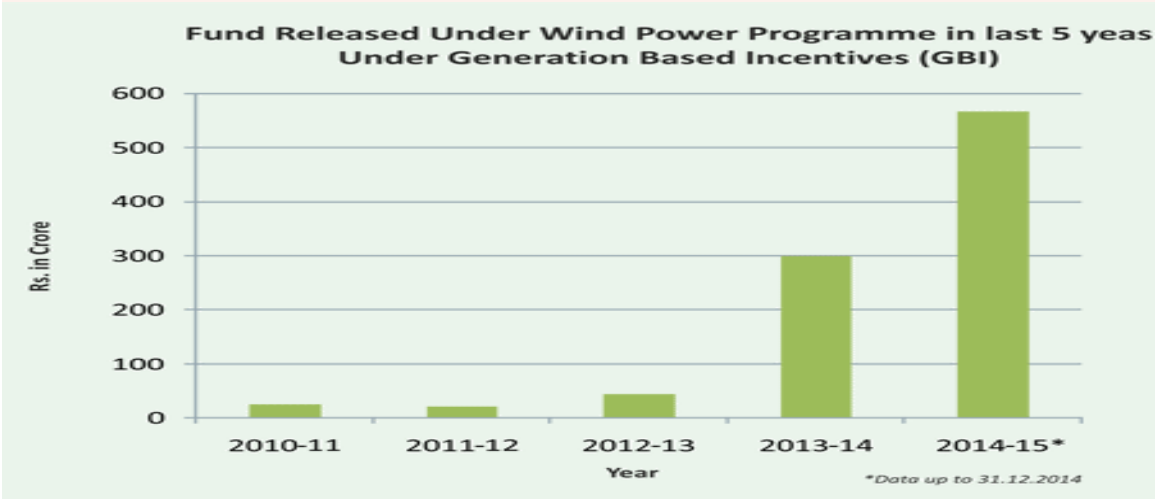

Trends in Gross Budgetary Support (Revised Estimated)
Rs. in Crore
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
483.00
499.40
560.00
995.00
1198.00
1150.00
424.52
541.00
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15*
Years
*Data up to 31.12.2014

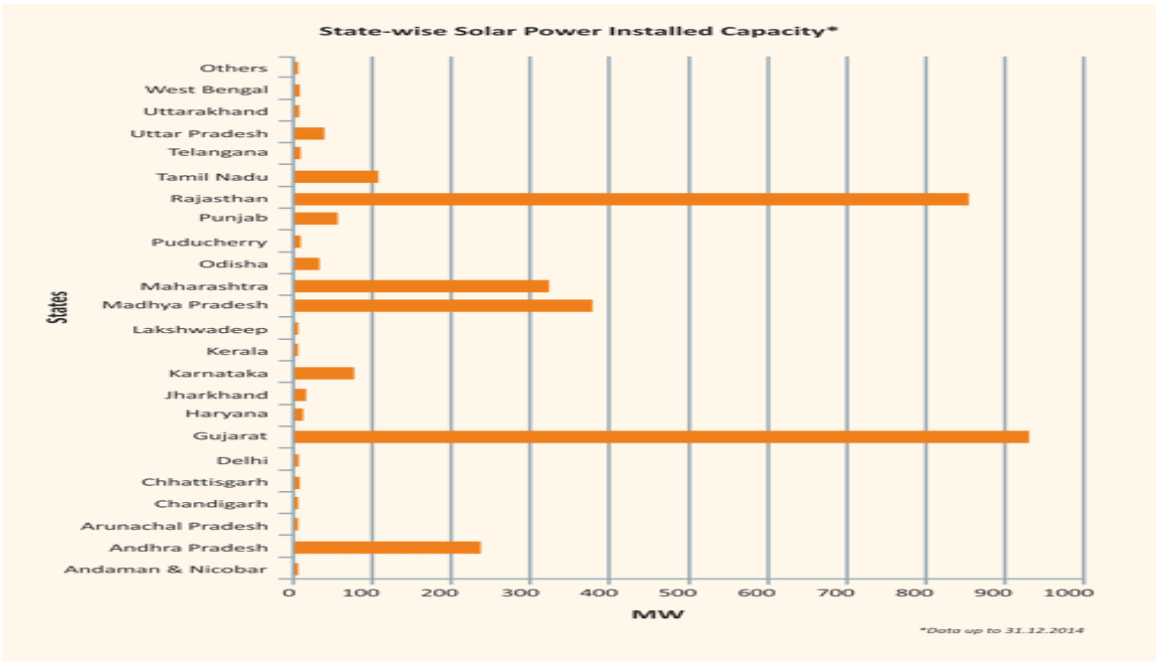

Trends in Funds Released from National Clean Energy Fund (NCEF)
Rs. in Crore
2500.00
2000.00
1500.00
1000.00
500.00
0.00
162.80
150.69
1314.16*
1978.00^
2011-12
2012-13
2013-14
2014-15**
Year
* Includes Rs 284.41 Crore for IMG approved projects & Rs 1029.75 Crore for ongoing Schemes & Programmes of MNRE
^ Includes Rs 523.00 Crore for IMG approved projects & Rs 1455.00 Crore for ongoing Schemes & Programmes of MNRE
**Data up to 31.12.2014

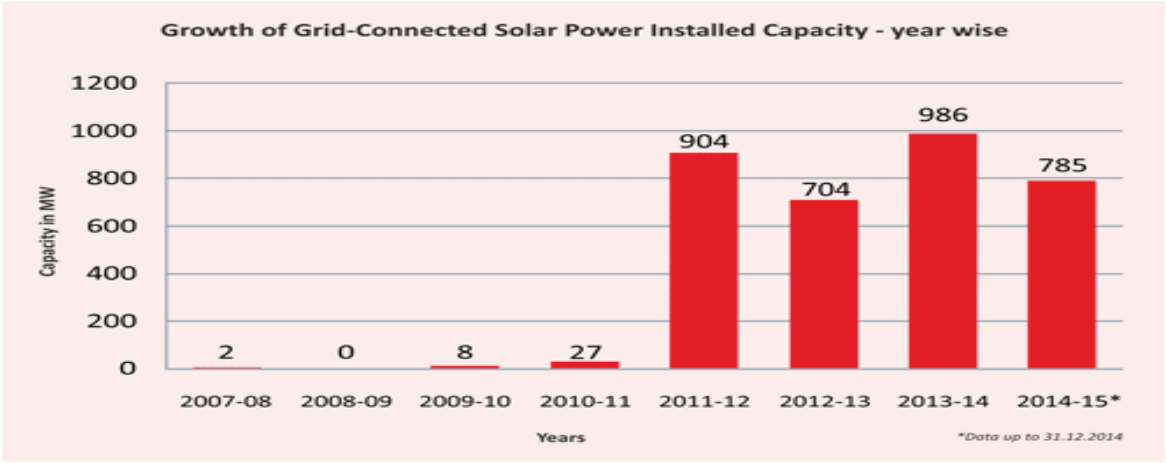

State-wise Wind Power Installed Capacity (Cumulative*)
MW
8000
7000
6000
5000
4000
3000
2000
1000
0
Tamil Nadu
Maharashtra
Gujarat
Rajasthan
Karnataka
Andhra Pradesh
Madhya Pradesh
Kerala
Others
States
*Data up to 31.12.2014

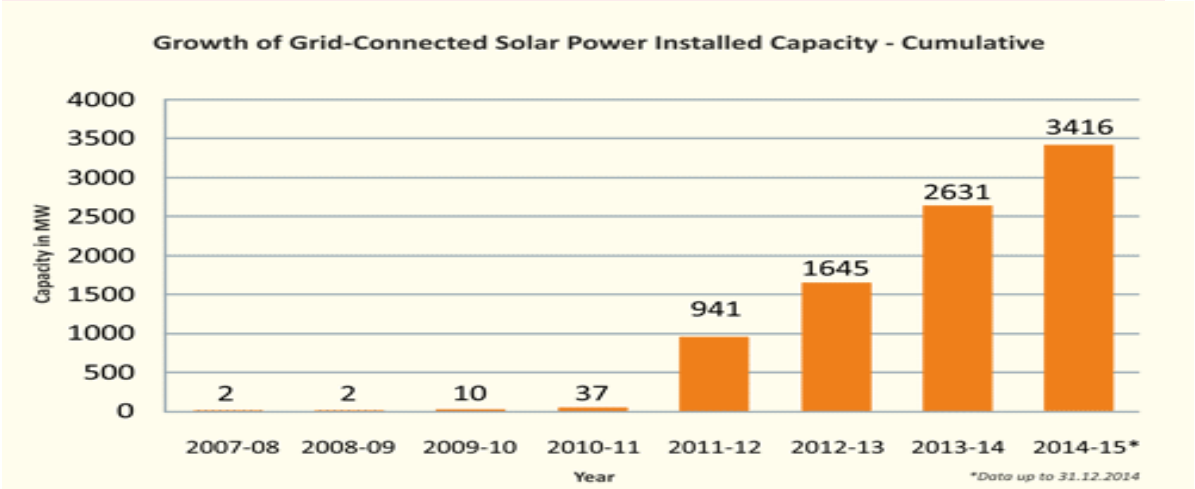

Year-wise Wind Power Installed Capacity (MW)
MW
3500
3000
2500
2000
1500
1000
500
0
Upto 31.03.2002
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15*
Year
*Data up to 31.12.2014

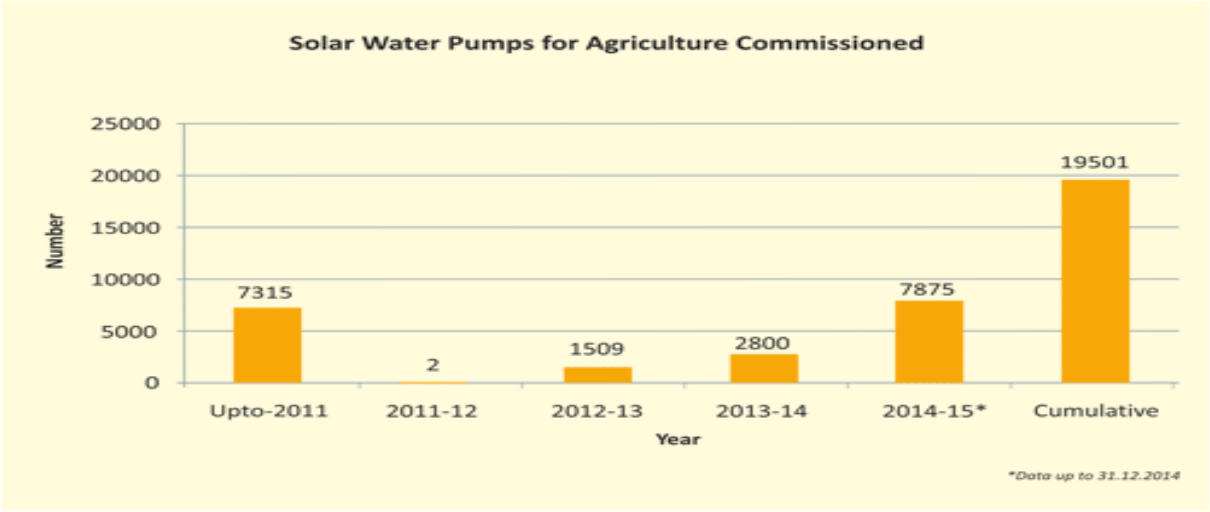

Country-wise Global Wind Power Installed Capacity (MW)
Total global installed capacity : 3,69,555 MW
MW
140000
120000
100000
80000
60000
40000
20000
0
China
USA
Germany
Spain
India
UK
Canada
France
Italy
Brazil
Countries
Source - Global Wind Energy Council

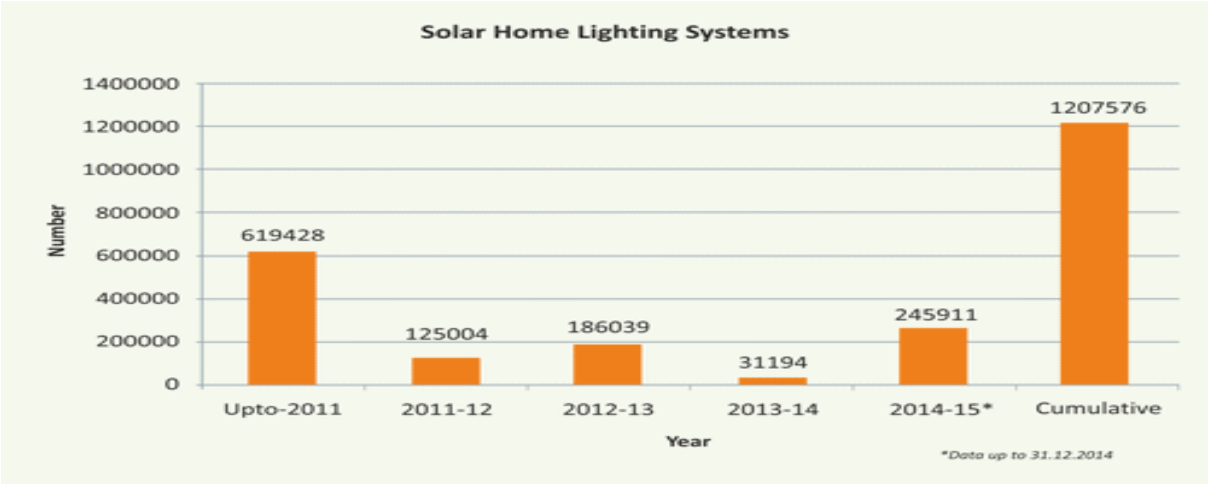

Fund Released Under Wind Power Programme in last 5 yeas
Under Generation Based Incentives (GBI)
Rs. in Crore
600
500
400
300
200
100
0
2010-11
2011-12
2012-13
2013-14
2014-15*
Year
*Data up to 31.12.2014

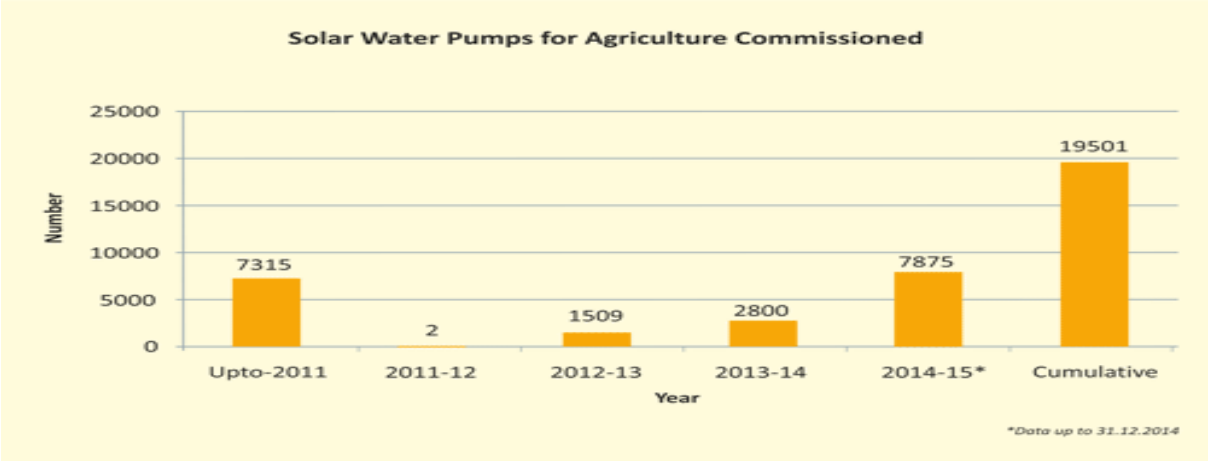

State-wise Solar Power Installed Capacity*
States
Others
West Bengal
Uttarakhand
Uttar Pradesh
Telangana
Tamil Nadu
Rajasthan
Punjab
Puducherry
Odisha
Maharashtra
Madhya Pradesh
Lakshwadeep
Kerala
Karnataka
Jharkhand
Haryana
Gujarat
Delhi
Chhattisgarh
Chandigarh
Arunachal Pradesh
Andhra Pradesh
Andaman & Nicobar
0
100
200
300
400
500
600
700
800
900
1000
MW
*Data up to 31.12.2014

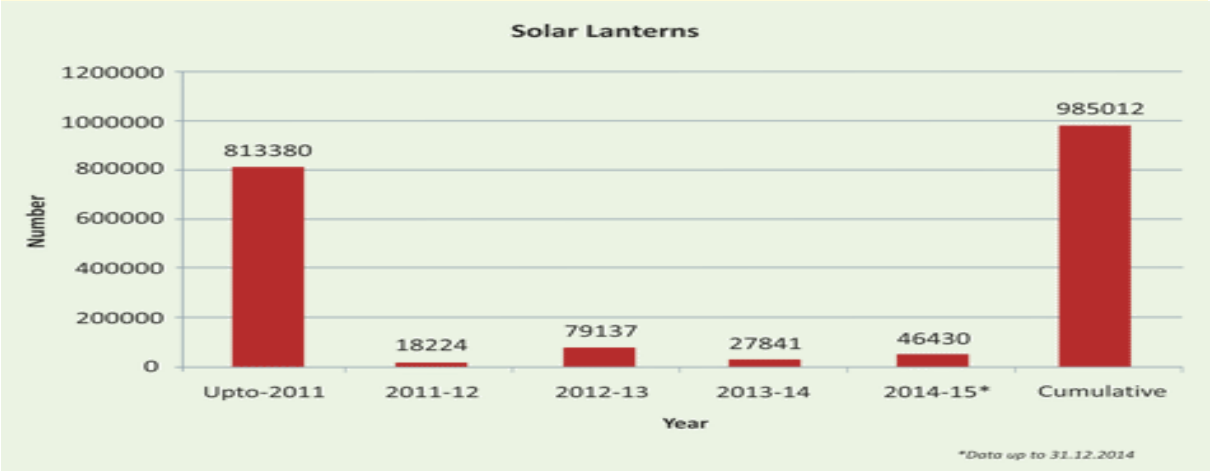

Growth of Grid-Connected Solar Power Installed Capacity - year wise
Capacity in MW
1200
1000
800
600
400
200
0
2
0
8
27
904
704
986
785
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15*
Years
*Data up to 31.12.2014

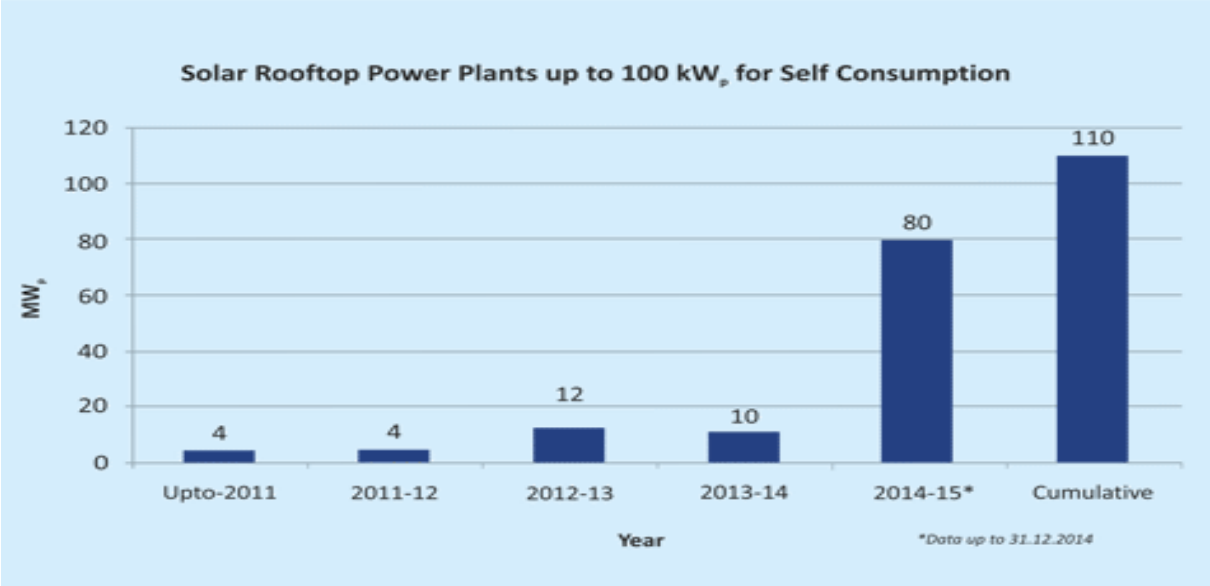

Growth of Grid-Connected Solar Power Installed Capacity - Cumulative
Capacity in MW
4000
3500
3000
2500
2000
1500
1000
500
0
2
2
10
37
941
1645
2631
3416
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15*
Year
*Data up to 31.12.2014

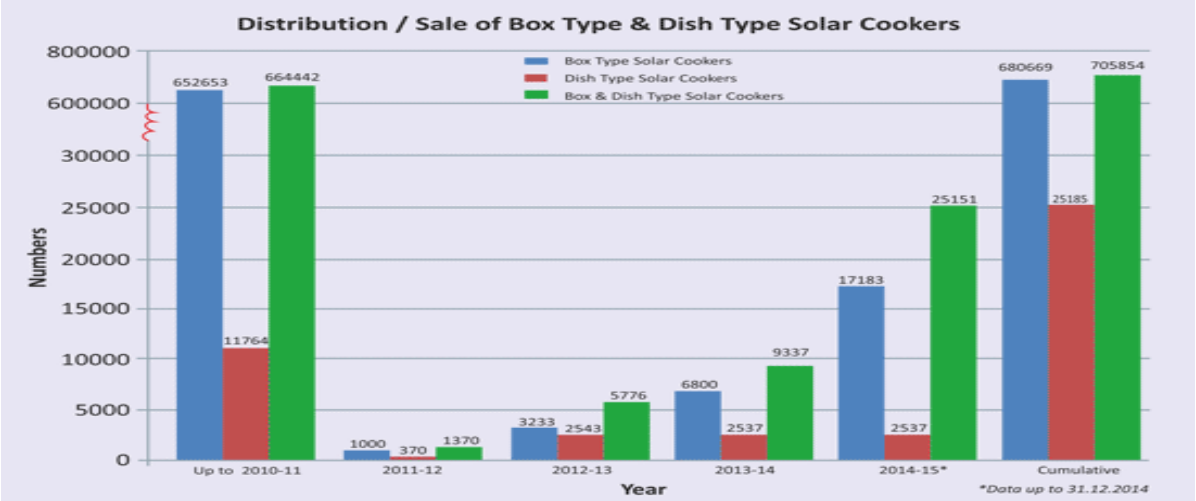

Solar Water Pumps for Agriculture Commissioned
Number
25000
20000
15000
10000
5000
0
7315
2
1509
2800
7875
19501
Upto-2011
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

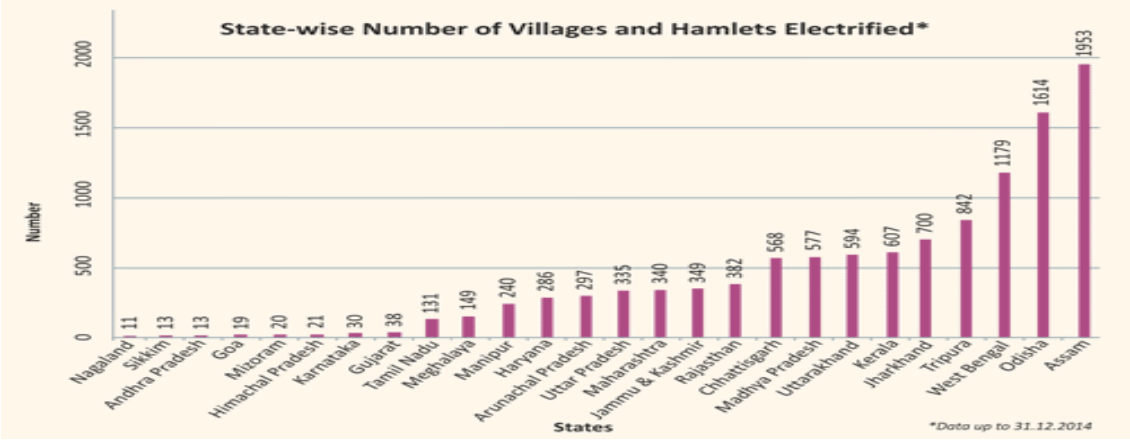

Solar Home Lighting Systems
1400000
1200000
1000000
800000
600000
400000
200000
0
Number
619428
125004
186039
31194
245911
1207576
Upto-2011
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

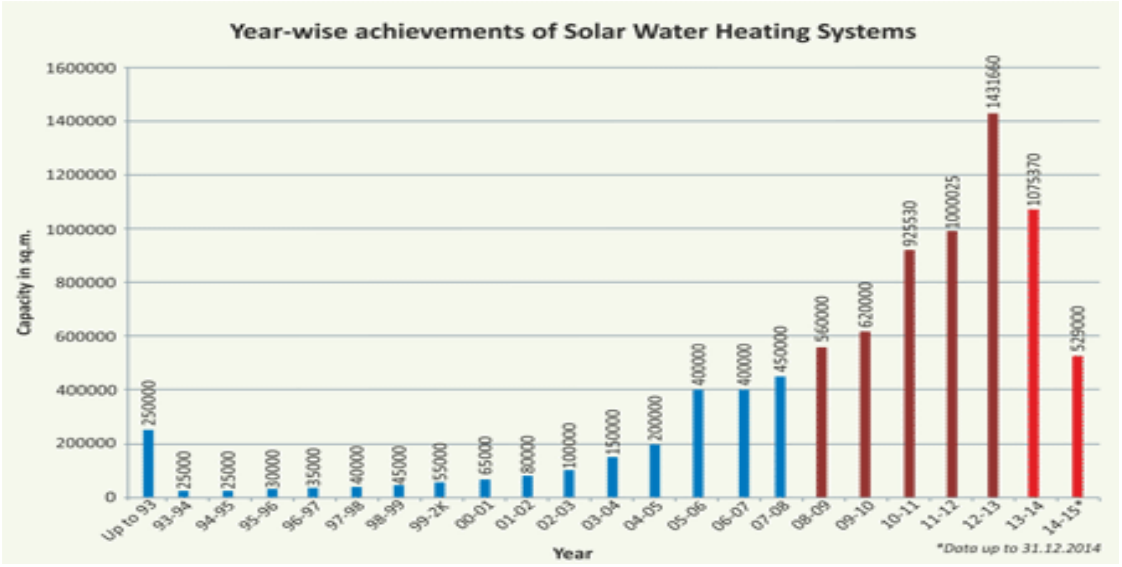

Solar Water Pumps for Agriculture Commissioned
25000
20000
15000
10000
5000
0
Number
7315
2
1509
2800
7875
19501
Upto-2011
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

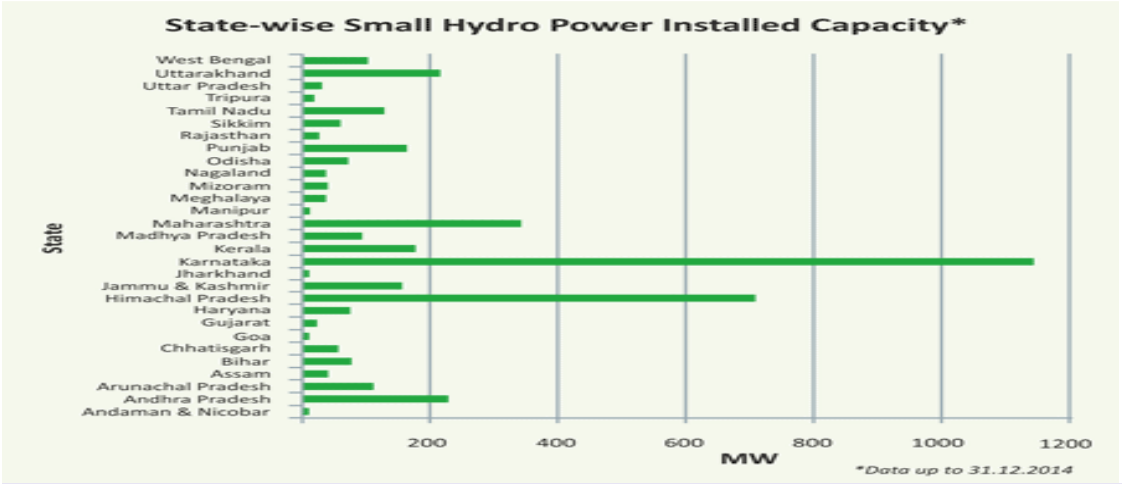

Solar Lanterns
1200000
1000000
800000
600000
400000
200000
0
Number
813380
18224
79137
27841
46430
985012
Upto-2011
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

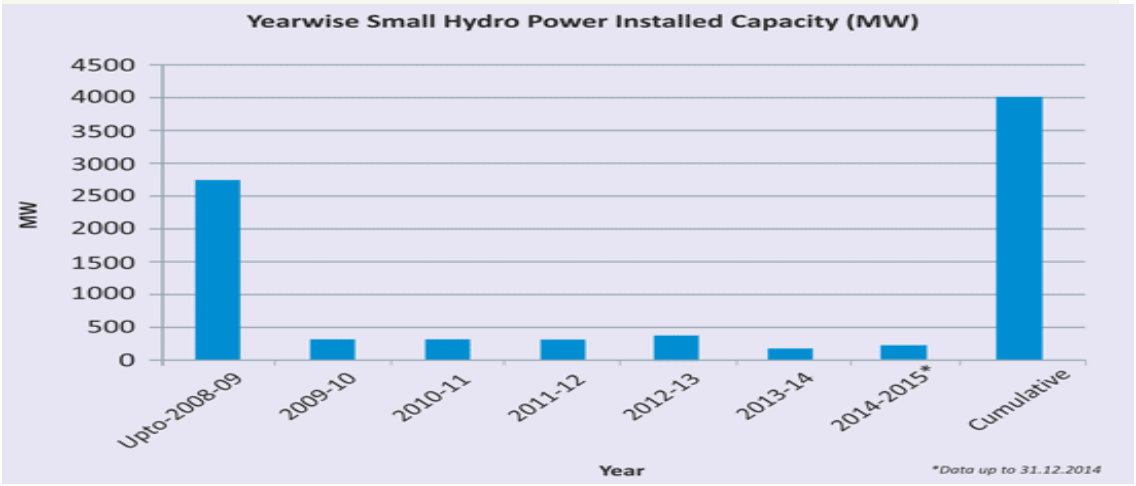

Solar Rooftop Power Plants up to 100 kWp for Self Consumption
MWp
120
100
80
60
40
20
0
4
4
12
10
80
110
Upto-2011
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

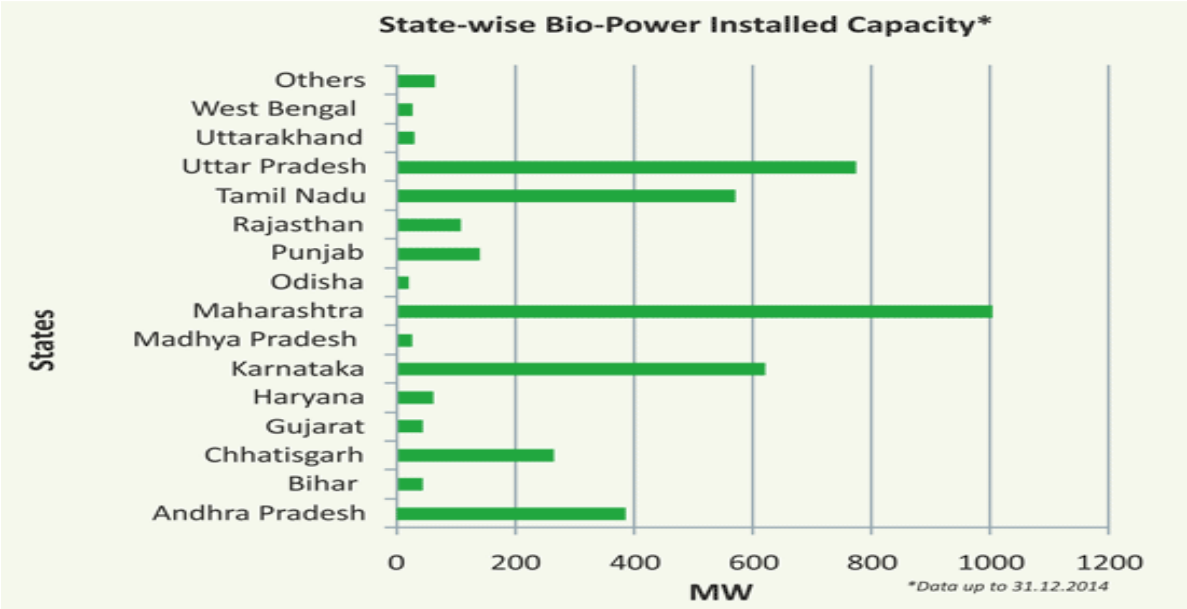

Distribution / Sale of Box Type & Dish Type Solar Cookers
Box Type Solar Cookers
Dish Type Solar Cookers
Box & Dish Type Solar Cookers
Numbers
800000
600000
30000
25000
20000
15000
10000
5000
0
652653
11764
664442
1000
370
1370
3233
2543
5776
6800
2537
9337
17183
2537
25151
680669
25185
705854
Up to 2010-11
2011-12
2012-13
2013-14
2014-15*
Cumulative
Year
*Data up to 31.12.2014

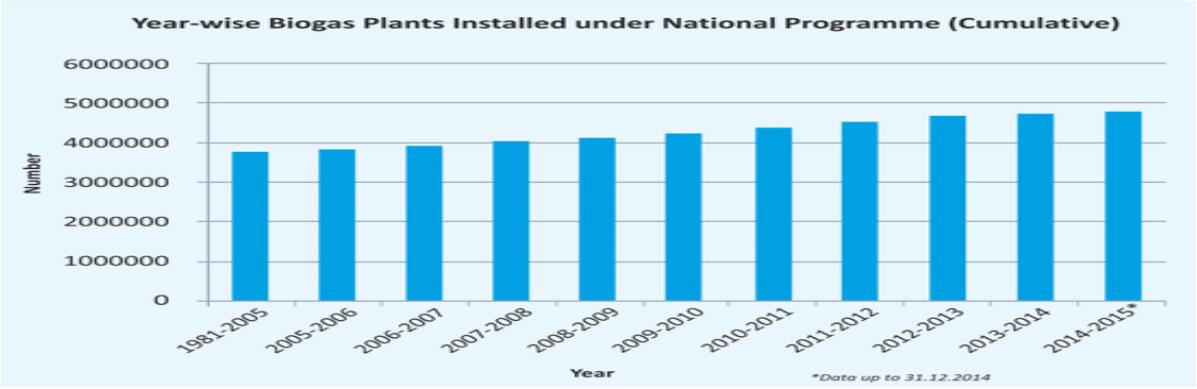

State-wise Number of Villages and Hamlets Electrified*
Number
2000
1500
1000
500
0
11
13
13
19
20
21
30
38
131
149
240
286
297
335
340
349
382
568
577
594
607
700
842
1179
1614
1953
Nagaland
Sikkim
Andhra Pradesh
Goa
Mizoram
Himachal Pradesh
Karnataka
Gujarat
Tamil Nadu
Meghalaya
Manipur
Haryana
Arunachal Pradesh
Uttar Pradesh
Maharashtra
Jammu & Kashmir
Rajasthan
Chhattisgarh
Madhya Pradesh
Uttarakhand
Kerala
Jharkhand
Tripura
West Bengal
Odisha
Assam
States
*Data up to 31.12.2014


Year-wise achievements of Solar Water Heating Systems
Capacity in sq.m.
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
250000
25000
25000
30000
35000
40000
45000
55000
65000
80000
100000
150000
200000
400000
400000
450000
560000
620000
925530
1000025
1431660
1075370
529000
Up to 93
93-94
94-95
95-96
96-97
97-98
98-99
99-2K
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
13-14
14-15*
Year
*Data up to 31.12.2014


State-wise Small Hydro Power Installed Capacity*
State
West Bengal
Uttarakhand
Uttar Pradesh
Tripura
Tamil Nadu
Sikkim
Rajasthan
Punjab
Odisha
Nagaland
Mizoram
Meghalaya
Manipur
Maharashtra
Madhya Pradesh
Kerala
Karnataka
Jharkhand
Jammu & Kashmir
Himachal Pradesh
Haryana
Gujarat
Goa
Chhatisgarh
Bihar
Assam
Arunachal Pradesh
Andhra Pradesh
Andaman & Nicobar
200
400
600
800
1000
1200
MW
*Data up to 31.12.2014


Yearwise Small Hydro Power Installed Capacity (MW)
MW
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Upto-2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-2015*
Cumulative
Year
*Data up to 31.12.2014





Conclusion:-

Energy is vital for development and this means that if India is to move to a higher growth trajectory than is now feasible, it must ensure the reliable availability of energy. The present
energy scenario in India is not satisfactory. The power supply position prevailing in the country is characterized by persistent shortages and unreliability and also high prices for industrial consumers. There is also concern about the position regarding petroleum products. India depends to the extent of 70-80 percent on imported oil, and this naturally raises issues about energy security. These concerns have been exacerbated by recent movements in international oil prices. Electricity is produced domestically but its supply depends upon the availability of coal, exploitation of hydro power sources and the scope for expanding nuclear power, and there are constraints affecting each source. Vibrant functioning society needs energy as its lifeline and the quantum of its use indicates the quality of life being experienced by its members. There is a great disparity in the energy use amongst different regions of the world and even for countries like India where the rural areas are bereft of the benefits of energy and where obtaining food and shelter is a daily challenge. India needs to bridge this divide as soon as possible and this is of paramount importance for any growth which should include all sections of society. Energy is central to achieving the interrelated economic, social, and environmental aims of sustainable human development. But if India is to realize this important goal, the

kinds of energy India produces and the ways it uses them will have to change. Otherwise, environmental damage will accelerate, inequity will increase, and economic growth will be jeopardized. All energy sources are having advantages as well as certain disadvantages but resources are not an end in themselves, and their attractiveness must be seen in the context of societies' energy service needs, of the technologies that convert resources into energy services, and of the economics associated with their use. These analyses have shown that India will have to plan for the fulfilment of its energy needs based on a judicious mix of the natural resources endowed to it, keeping sustainable development in focus and having a minimum carbon foot print. Developed countries of the world also need to understand that climate change is a phenomenon which has no boundaries and the world is facing this threat because of skewed policies followed by them and they are also duty bound to help India attain the goal of achieving energy security for its population by the transfer of
clean energy technology and by making available appropriate funding mechanisms.
India, with its vast population and limited natural resources for meeting its energy requirements, needs to maintain its momentum of growth and this can be made possible only with a clear strategy for use of best possible energy options available. India needs to have a long term strategy for meeting its energy needs by 2050 and a short term goal of 2020 which can be small steps towards attaining energy security by 2050. The broad vision behind energy policy must be to meet energy demands reliably with energy which is clean and affordable and this must be done in an environmentally sustainable manner using different fuels and forms of energy, conventional and non-conventional, as well as new and emerging sources to ensure supplies at all times. India needs to have a consistent energy policy which at times is made difficult as currently there are five ministries (Coal, Petroleum and Natural Gas, Atomic Energy, Power and New and Non-Conventional energy) and each one is concerned with its own turf leading to a lack of synergy and sub-optimal results. It needs to create policies which provide for enabling environment for all the stake holders so that desirable outcomes are achieved. It is not necessary to compare the economics of alternatives as pricing at a given point in time may depend on different prices of fuel and technological developments.
It is imperative for India to have a consistent energy policy, together with relentless pursuit of energy efficiency and conservation, maximizing coal production and improving the rail and port infrastructure as well as development of alternative infrastructure for coal transportation such as coastal rivers because coal, being the cheapest form of energy, will be the flag bearer of India's energy needs. There is also an urgent need to fully exploit the hydro and nuclear potential of the country but here it is important that inhabitants of a particular area are taken
In to confidence so they do not feel alienated from the project. India needs to vigorously raise the level of international diplomacy to gain a foot hold in the exploration of oil, coal and other hydrocarbon resources at a global level. India needs to step up its effort in the direction of coal gasification, carbon sequestration and undertaking projects for bio fuels. As per my analysis it is not possible for India to achieve energy security by concentrating on conventional sources like coal and oil as the world does not have enough of such resources to meet demands which are continually increasing. India needs to look increasingly towards Non-Conventional energy for attaining energy security by 2050 and India's target of getting around 15.9% of total energy need from Non-Conventional sources by 2022 is too modest. India being endowed with year round solar radiation must exploit

this source to the fullest extent as it is abundant and will remain as long as Earth is in existence irrespective of the cost involved today. As rightly said by a renowned nuclear scientist in India, expensive energy is still better than having no energy. Further, India needs to fully exploit the potential of other Non-Conventional energy sources like bio fuels, wind, hydro and even nuclear energy, as projections of energy requirements indicate an approximately three times increase from around 620 Mtoe in 2008 to 2043 Mtoe by 2031-32. It means that India needs to increase the share of Non-Conventional energy substantially as Non-Conventional sources of energy are just not available and India will risk losing growth momentum leading to wide spread inequalities which can have serious social and political ramifications. The world community also needs to understand the challenges being faced by India and help by putting in place innovative financial instruments for financing the energy needs of India and lifting of technical barriers. Finally, India needs to wake up and respond by improving efficiency, boosting infrastructure development and promoting private equity participation as the government cannot raise capital on its own for this purpose. India needs to realize the vast potential of Non-Conventional energy and need to step up effort for attaining the goal of "20 11 20 20" by 2020 i.e. 20% reduction in GHG, 11% reduction in consumption of energy by bringing about attitudinal changes, 20% share of Non-Conventional energy and 20% conservation of energy from the year 2011 till 2020. These targets are attainable and not only provide cleaner energy but also open a new field for providing employment opportunities to millions of people who are unemployed or disguised employment. This momentum then needs to be maintained so that India attains a target of having 70% Non-Conventional energy use by 2050.

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