INDIAN INITIATIVES IN DEVELOPMENT OF RENEWABLE SOURCES OF ENERGY

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ABSTRACT— The paper aims at describing the initiatives taken by Govt. of India towards development of Renewable Energy in the Indian Power Sector. Various schemes launched by the State Authority and Regulatory Commissions to promote market for RE-Power have been addressed by the author.

To facilitate implementation of National Action Plan on Climate Change (NAPCC) which calls for significantly increasing the share of electricity generated from renewable energy, the financial burden of all the fluctuations from schedule in case of new solar energy plants and fluctuations within ±30% of schedule in case of new wind energy plants will be borne by all the users of Inter-state grid – Pan India.

Recognizing the strong solar potential in India with high insolation level for most part of the year around 6000 Million Gwh is estimated through an annual radiation of 1600 to 2200 kwh/m² that is compatible with tropical & subtropical regions.

KEYWORDS- Government of India, Generation Based Incentive, Ministry of New and Renewable Energy, National Solar mission, Renewable Power Obligation, Wind Farm Developers .

Abbreviations – CERC(Central Electricity Regulatory Commission), GOI (Government of India), GBI(Generation Based Incentive), MNRE(Ministry of New Renewable Energy), NSM(National Solar Mission), NTPC (National Thermal Power Corporation), NVVN (NTPC Vidyut Vyapar Nigam), PLF(Plant Load Factor), RE(Renewable Energy), RPO(Renewable Power Obligation), REC(Renewable Energy Certificate), STU(State Transmission Utility), WFD(Wind Farm Developers), IWTMA (Indian Wind Turbine Manufacturers Association) ,C-WET(Centre for Wind Energy Technology)

1. Introduction

This paper primarily focuses on the 'Plans & Policy' of the Indian Government in promoting Renewable Sources of Energy. We are not discussing the technology details for Renewable Energy Sources – but the pragmatic approach that has been adopted by Govt. of India in developing the R.E.Generation.

As such the paper is non-academic and deliberate on the objective to establish India as global leader in solar energy and achieve a scale to drive costs to levels required to achieve grid parity as soon as possible. Further it highlights the enabling policy framework for development of 20,000 MW of Solar Power by 2022.

While Indian economy is fast growing, it still has a substantial latent and un-met demand and it is imperative to harness all viable sources of energy for ensuring the energy-security needs of the country. Despite the fact that there had been commendable addition in capacity since independence from around 1300 MW to present over 157000 MW, still the unserved demand is quite substantial. The economic growth of the country depends on its power-development growth-being an crucial infrastructure for taking the country forward. The present installed capacity of 157229 MW is comprising 63.98% Thermal 23.45% Hydro 2.76% Nuclear and 9.81% Renewable. The indigenous reserves and supply of fossil fuels are limited and would get exhausted in few decades. Further, there are growing environmental concerns with regard to their use. It is therefore desirable to shift towards renewable sources of energy generation i.e. hydro, wind, biomass, solar etc. The efforts need to be focused on achieving techno-economical feasibility in harnessing these energy sources. The approach needs to be towards harnessing all possible renewable energy sources – though not on a large scale – but whatever is feasible either to supply electricity locally or feeding it into the larger grid.

The Electricity Act 2003, the policies framed under the Act, and also the National Action Plan of Climate Change (NAPCC) provide for a roadmap for increasing the share of

renewable in the total generation capacity in the country. However, RE sources are not evenly spread across different parts of the country. On one hand, there are states (like Delhi) where the potential of RE sources is not significant. This naturally inhibits to specify higher renewable purchase obligations. On the other hand, there are states (like Rajasthan & Tamilnadu) where there is very high potential of RE sources. In such states potential exists for harnessing RE generation beyond RPO (Renewable Purchase Obligation). However, the high cost of generation from RE sources discourages the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the State Commission.

It is in this context that the concept of REC (Renewable Energy Certificate) assumes significance. This concept seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their renewable purchase obligation. It is also expected to encourage the RE capacity addition in states where there is potential for RE generation as the REC framework seeks to create a national level market for such generators to recover their cost.

2. Renewable energy sector in India:

2.1 Wind

The grid based renewable energy industry in India has seen four main technologies in action – Wind, Small Hydro, biomass and bagasse based co-generation. Out of all three, Wind has been the dominant source.

The wind power industry in India has grown rapidly over the last decade on account of number of factors. The root cause of the development can be traced to few key factors – massive and sustained gaps between the electricity demand and supply, relatively lower cost due to technology-maturity and rapid development of domestic manufacturing industry. The development was further aided by conducive policy-environment.

However, with the enactment of Electricity Act, 2003 the Wind development has seen a major jump. The Renewable purchase obligation as specified in the act has given fillip to the enhancement of wind-generator in India. It is worthwhile to note that the cost of wind generated power is comparable with the cost of power procured from the competitive market.

Table-1 Indian perspective of Renewable energy (*)[1]

RE-Technology	Estimated Potential (MW)	Status as on 31.10.2009 (MW)
Wind	45,195	10891**
Small hydro (upto 25 MW)	15,000	2520
Grid connected Solar Thermal	6000 Million Gwh per Annum	6
Off-grid Solar PV & thermal		
Biomass	16,248	817
Co-generation (Bagasse)	3,500	1241

** Wind Power Potential in India is enclosed at Annex-I.

* Planned investment details enclosed at Annex-II

However, significant proportion of the prolific and accessible wind tracts in the country have already been harnessed. Going forward the scale of existing developmental rate may not be possible. A move from the tax depreciation reliant development model to a more broad Generation Based Incentive (GBI) development model can augment the present developments.

The Ministry of New and Renewable Energy (MNRE) has also announced the GBI scheme for grid connected wind power projects up to an aggregate capacity of 4000 MW up to the end of XIth plan period (31st March 2012) However, the opportunity in Wind is finite.

2.2 Solar

At this juncture solar power has been given a significant priority by the Govt. of India. India sees solar as an area where it can seek 'Technology & Finance' from the more developed nations in lieu of climate related commitments.

The GOI has approved a new policy on development of solar energy in the country by launching the "Jawaharlal Nehru National Solar Mission". This is certainly a historic and transformational initiative. The mission is one of the eight key National Missions which comprise India's National Action Plan on climate change. It has twin objectives – to contribute to India's long term energy security as well as its ecological security.

The rapid development and deployment of renewable energy is imperative in this context and in view of high solar radiation over the country, solar energy provides a long term sustainable solution.

India's solar potential is indeed large and relatively easy to harness. Among the various RE energy resources solar energy potential is the highest in the country. In most parts of India, clear sunny weather is experienced 250 to 300 days in a year. The annual radiation varies from 1600 to 2200 kwh/m², which is comparable with radiation received in the tropical and sub-tropical regions. The equivalent energy potential is about 6,000 Million Gwh of energy per year. As compared to this, the present level of generation of electricity in 2008-09 from all resources was 0.7 Million Gwh.

The states that have the maximum insolation are Rajasthan and Gujarat. In addition the states of Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Maharashtra and

Chattisgarh also enjoy good insolation levels. Most of these states are in the region where unmet electricity demand as well as the growth of electricity is high.

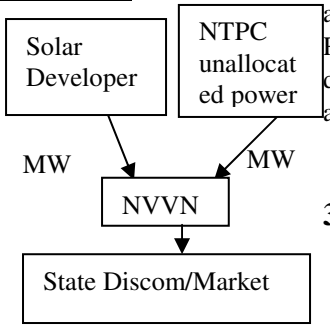
The areas with highest solar potential face limited issues related to land availability (except perhaps Tamil Nadu and Maharashtra) so also the transmission network in the states as well as in the country as a whole is developing fast. The State Governments in the key states of Rajasthan and Gujarat have also proactively initiated several infrastructure development measures including acquisition of 'land banks' in advance, Acquisition of transmission corridors, creation of transport infrastructure etc. for Solar Power Projects.

Solar Power has been attracting very significant developer's interest, but still much needs to be done.

The National Solar Mission (NSM) announced on Nov.23rd 2009, has caused very substantial changes to the solar development scenario. For one, it has moved away from GBI based framework to one that relies on 'bundling' of cheap coal based power with more expensive solar power on a 'MW for MW basis' as given in Fig-1.

With the grid based solar power target set to 1000 MW, the GOI has committed to allot another 1000 MW of coal based power that is presently under the discretionary powers of GOI to allocate to those states that are in shortage. With the higher capacity factors of coal based generation and the relatively inexpensive nature of such generation, the bundled costs are likely to be in the marketable range, as can also be seen by the Table-2 below:-

Fig-1 Bundled Model for Solar



Source-Mercados Analysis

Table-2

Year	Price of traded power USD/kwh
2004-05	0.053
2005-06	0.073
2006-07	0.103
2007-08	0.103
2008-09	0.166

(source CERC)

This move is widely perceived to be innovative, to give a good kick start to solar energy generation in India.

2.2.1 Solar-Plan in India

Apart from the key provision of bundling of Solar Power with coal based generation, NSM has several other provisions that would influence the pace of development of the Solar Industry, including the provisions for technology developments, fiscal incentives, indigenization(localization) requirements, tariff determination processes etc.

Table-3 Proposed plan: (Under NSM)

Current Installed Capacity (As on 31st Oct., 09)	6 MW
Phase I – By 2013	1000 MW + Demonstration Projects (270 – 400 MW)
Phase II – By 2017	4000 MW (10,000 MW based on enhanced international finance & technology transfer)
Phase III – By 2022	20,000 MW

(Source : NSM of MNRE)

2.2.2 Boost for Solar Energy:

The Electricity Act, 2003 requires SERC (State Regulatory Commissioning) to fix RPO, but do not provide any further guidance. Likewise, the National Electricity Policy, 2005 and Tariff Policy 2006 are silent on the issue. However, the NSM explicitly requires the implementation of Solar RPOs. The levels set out in the NSM are as follows:-

- Solar Purchase Obligation of 0.25% in Phase I (2013) for all states.
- 3% Solar Purchase Obligation by 2022

With the involvement of NVVNL and CERC, the Phase I targets for Solar Purchase Obligation have a reasonable chance of being met.

Further, through NSM the regulatory risks to developers are properly addressed, since CERC instead of State Regulators will determine the tariffs that will be paid to the developers. This will reduce the multiplicity of regulatory agencies and consequently the regulatory risks.

3. Integration with Grid (Handling Imbalances of RE)

The issues related to integration of RE generation (having unpredictable nature) in the larger grid need open approach and harmonious solutions. The key differentiators being:

- Uncertain nature of the wind sources and hence infirm source.
- Sites located in different terriers – from the coastal plains to the hilly hinterland and sandy desserts. Far flung from densely populated areas, and far away from load centres.
- All these makes connectivity technically and commercially complex.
- Unit size being small, negligible Auxiliary

equipments, cooling water requirement and switching in/out in the system does not pose any problem like conventional generating units of large size.
- Quantum jump in wind power demands power evacuation at higher voltage levels.
- PLF between 25 to 35% depending on site.

3.1. Scenario in INDIA

- Wind potential in India – By the C-WET/MNRE is approximately 45000 MW and by IWTMA is approximately 65000 MW.
- Present installed capacity of wind power – Approximately 12000 MW – expected to go up to 15000 MW in next few years.
- In Wind generation – Tamil Nadu leads followed by Maharashtra, Gujarat, Karnataka, Rajasthan and Madhya Pradesh in that order.
- Solar Power added in last year is just 3.10 MW (up to Oct.'09)

3.2 Effect on Grid

- No contribution to short circuit level of grid.
- Do not cause problems of voltage regulations.
- Do not affect Network Stability or Power Swings.
- Do not cause distress to voltage profile of system (The Wind Turbine trips at 80% grid voltage)
- When connected/disconnected – no over/under frequency to the grid – No transients in the system due to large size of grids

3.3 Issues

- Treating Wind Farm Developers (WFD) as vendors instead of extended arm of STU to create infrastructure.
- Since variable cost of Wind generation is zero, wind energy to be considered for absorption as 'must-run' station similar to Run of the River Hydel Power Station.
- Since forecasting & scheduling is also to be incorporated for RE generation – CERC considering to provide enough operational/prediction margin.

4. CERC – Approach in dealing with RE-Generation:

4.1. REC – Regulation

CERC has notified regulation on RE Certificate (REC) in fulfillment of its mandate to promote Renewable sources of energy and development of market in electricity. The framework of REC is expected to give push to Renewable Energy (RE) capacity addition to the country.

4.2. Broad Architecture of REC [2]

- There will be central agency for Registration of RE generators participating in the scheme.
- RE – Generation will have two options – either to sell the renewable energy at preferential tariff fixed by the concerned Electricity Regulatory Commission or to sell the electricity generation & environmental attributes associated with RE generation separately.
- On choosing second option, the environmental attributes can be exchanged in the form of REC. Price of electricity component would be equivalent to weighted average power purchase cost of the distribution company including short term power purchase but excluding renewable power purchase cost.
- Central Agency will issue REC to RE generators
- The value of REC will equivalent to 1 MWh of electricity injected into the grid from RE sources.
- The REC will be exchanged only in the Power Exchange approved by CERC within the band of floor price & a forbearance (ceiling) price to be determined by CERC from time to time.
- The distribution company, Open Access Consumers and Captive Power Plants (CPPs) will have option of purchasing the REC to meet their Renewable Purchase Obligation (RPO).

The Electricity Act 2003, the policies framed under the Act, as also the National Action Plan of climate change (NAPCC) provide for a roadmap for increasing the share of renewable in the total generation capacity in the country.

As per IE Act 2003, clause 86(i)(e) Wind Power to be promoted and regulatory commission have appropriately passed orders for the same including terms for PPA and RP obligation. Connectivity has been considered more critical than power flow.

CERC is also considering to exempt RE Generators in its draft approach paper from sharing of Transmission Charges.

All these initiatives by GOI and Regulators would certainly see the green and happy days for RE Generation in India.

5. Social Impact of Rising Energy Prices in India

India is a developing economy and power is an important

infrastructural input for its sustained growth. With the enactment of Electricity Act 2003 – the power development has seen an unprecedented push – which is a welcome sign. The implementation of 'OPEN ACCESS' in the Indian Electricity Grid has provided a means of short term power requirements to be addressed through efficiently created power markets. However, the overall shortage scenario in the country is responsible for high soaring of energy cost – thereby affecting the GDP growth of the country. The conventional sources of energy have limited capacity and resorting to Renewable Technology is the only alternative to plan the long term power strategy. The high cost of energy is unaffordable proposition to common man of India and regulatory intervention to check the price-rise is very much needed and useful. Considering this impact too, the promotion of Renewable Energy is the requirement of the time that has been rightly noticed and adequately addressed by the State authority through "Indian Initiatives in Renewable Energy Development".

6. Conclusion

India is a developing country and for its sustained economic growth the development of power infrastructure plays a significant role. Realizing the fact that Conventional Sources of Energy in the country (and outside) has a limited potential to meet the imposing energy requirement, the well conceived and timely initiated Energy Security Plan has to be formulated for promotion of Renewable Sources of Energy. Accordingly the Govt. of India has initiated several schemes to make the Solar and Wind energy development in the country a techno-commercially viable proposition.

In order to create high potential market for the solar and wind energy and to promote these developers in investing into these technologies, the state authority has seriously worked on various incentive-schemes through launching of 'Jawaharlal Nehru Solar Mission' and also created conducive market through appropriate regulatory measures. Thus the otherwise expensive energy has been made comparable with the energy procured through open-market. The RE developers have been assured the market through imposing 'Renewable Purchase Obligation' (RPO) and developing a mechanism for trading of Renewable Energy Certificates.

Seeking high end technology in RE-generation from developed countries and harnessing the huge solar potential of India is an appropriate step towards development of R.E. in India.

Though, the path is difficult during the initial stages, with the full support of Indian Govt. the development of 'Renewable Energy' in India would certainly turn out to be a 'success story' .

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Annex-I

Wind power potential India:

Sl.No.	States	Potential (MW)	Available (MW)
1.	Andhra Pradesh	8968	127
2.	Gujarat	10645	1255
3.	Karnataka	11531	1030
4.	Kerala	1171	11
5.	Madhya Pradesh	1091	126
6.	Maharashtra	4584	1756
7.	Rajasthan	4858	542
8.	Tamil Nadu	5530	3848
	TOTAL	48378	8695

Annex-II

Planned investment for RE development (11^{TH} Plan Strategy)

a) Support Programme

Program Component	Proposed outlay in Million USD
Information & Publicity	65.91
Extension for RE System	56.81
Monitoring & Evaluation	2.3
Plan Secretariat	11.36
IREDA	56.82
Support to State Governments.	11.36
Support to Industry	227.28
10^{th} Plan spillover liability	22.73
Others, IR, HRD & Training	22.73
Total	477.31

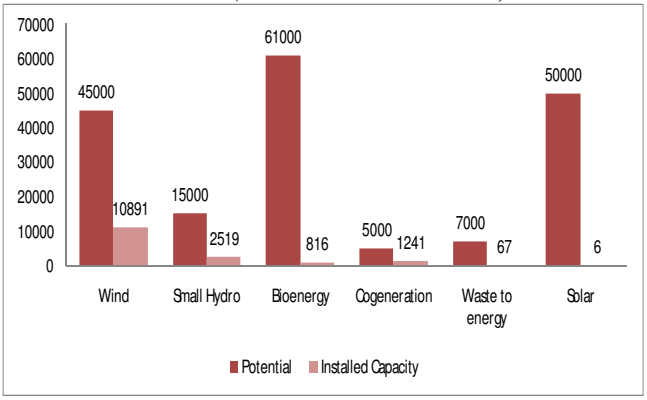
b) 11th Plan Research Design and Development

Program Component	Proposed outlay in Million USD
Bio-mass	34.09
Solar Energy	81.82
Wind Energy	45.46
Small Hydro	11.36
New Technology	90.91
Solar Energy Centre	9.09
C-WET	9.09
NIRE	9.09
Other related Activities	41.36
Total	332.27

Annex-III

RE Potential and Installed Capacity in India (MW)

(Source : MNRE as on Oct'09)



Annex-IV

Map of Wind and Small Hydro Potential in India