

Solar Energy in India and National Solar Mission: A Review

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Abstract : *In global climate change regime, India has been regarded as a prominent player due to its huge population, developmental needs and great economic potential. Since the Earth Summit 1992, India has been playing a very crucial and pivotal role in shaping global environmental policies.*

Keywords : UNFCCC, CBDR, GHG

Introduction : In global climate change regime, India has been regarded as a prominent player due to its huge population, developmental needs and great economic potential. Since the Earth Summit 1992, India has been playing a very crucial and pivotal role in shaping global environmental policies. In 1972, at Stockholm conference, Indian Prime minister Smt. Gandhi had described “poverty as a greatest polluter” and thus underscored India’s preference to the development to eradicate poverty. Thus, India’s policy stand in international climate change regime has been articulated around the equal right of development for each individual. India had successfully negotiated during the making of United Nation Framework for Climate Change(UNFCCC) and the inclusion of “common but Differentiated Responsibility” in article 7 of the Rio Declaration can be marked as grand success for India and hence for all developing nations.¹

The principal of CBDR explicitly acknowledged the historical responsibility of developed countries in the degradation of the environment and hence, assigned the primary responsibility to the developed countries to avert climate change and its adverse effects. To secure energy needs for the development, India has always been in denial mode to accept any binding commitment to reduce its GHG emission despite being fourth largest GHG emitter (2341000 kts Co₂, 2013)².

This Indian position successfully went through Kyoto Protocol (1997) under immense pressure from the developed countries that India should embrace binding mitigation commitments. Under the furious pressure from the developed countries, just before G-8 summit in Japan (June 2008), Indian PM Dr. Manmohan Singh launched National Action Plan on Climate Change (NAPCC)³The NAPCC, with the outline of its 8 National Mission, was approved by the Prime Minister’s Council on Climate Change (PMCCC), a 26- member apex advisory body, convened barely three week earlier without a thorough discussion.⁴

In launching India’s National Action Plan on Climate Change on June 30, 2008, the Prime Minister of India, Dr. Manmohan Singh stated: Our vision is to make India’s economic development energy-efficient. Over a period of time, we must pioneer graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy. In this strategy, the sun occupies center-stage, as it should, being literally the original source of all energy. We will pool our scientific,

technical and managerial talents, with sufficient financial resources, to develop solar energy as a source of abundant energy to power our economy and to transform the lives of our people. Our success in this endeavor will change the face of India. It would also enable India to help change the destinies of people around the world.”⁵

It can be said that India has added renewable energy as an important alternative to its energy matrix to reduce GHG emission, which is mainly dominated by coal-based power production, To fulfill the international commitments made by India through ‘Intended Nationally Determined Contribution’(INDC) to the UNFCCC. Enormous business opportunities further, impetus the Indian policy makers to explore the potential of alternative energy sources in context of India’s energy security and to meet the huge energy requirement to fuel India’s development.

India is geographically blessed with bright sunlight in most of its part, throughout the year. This nature’s blessing has tremendous potential to produce clean solar power. The National Action Plan on Climate Change also points out: “India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting the decentralized distribution of energy, thereby empowering people at the grassroots level”. Based on this vision a National Solar Mission is being launched under the brand name “Solar India”⁶

The Eight National Mission

The operational content of the National Action Plan lies in the eight different National Missions, which were simultaneously announced by the Indian government. These are as:

1. National Solar Mission
2. National Mission for Enhanced Energy Efficiency
3. National Mission for Sustainable Agriculture
4. National Water Mission
5. National Mission o Sustainable Habitat
6. National Mission for sustaining the Himalayan Ecosystem
7. National mission for A Green India
8. National Mission for strategic Knowledge for Climate Change.

Each Mission says NAPCC, ‘will be tasked to evolve specific objectives’ until financial year 2016-2017.It originally mandated the nodal ministries agencies to submit eight comprehensive mission documents by the end of 2008, to be approved by the PMCCC.⁷

JawharLal Nehru National Solar Mission

The National Solar Mission was launched on the 11th January, 2010 by the Prime Minister. The Mission has set the ambitious target of deploying 20,000 MW of grid connected solar power by 2022 is aimed at reducing the cost of solar

power generation in the country through (i) long term policy; (ii) large scale deployment goals; (iii) aggressive R&D; and (iv) domestic production of critical raw materials, components and products, as a result to achieve grid parity by 2022. Mission will create an enabling policy framework to achieve this objective and make India a global leader in solar energy. Further, Government has revised the target of Grid Connected Solar Power Projects from 20,000 MW by the year 2021-22 to 100,000 MW by the year 2021-22 under the National Solar Mission and it was approved by Cabinet on 17th June 2015.⁸

Importance and relevance of solar energy for India⁹

1. **Cost:** Solar is currently high on absolute costs compared to other sources of power such as coal. The objective of the Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity. The Mission anticipates achieving grid parity by 2022 and parity with coal-based thermal power by 2030, but recognizes that this cost trajectory will depend upon the scale of global deployment and technology development and transfer. The cost projections vary –from 22% for every doubling of capacity to a reduction of only 60% with global deployment increasing 16 times the current level. The Mission recognizes that there are a number of off-grid solar applications particularly for meeting rural energy needs, which are already cost-effective and provides for their rapid expansion.

2. **Scalability:** India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Hence both technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaics, can effectively be harnessed providing huge scalability for solar in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. Off-grid decentralized and low-temperature applications will be advantageous from a rural electrification perspective and meeting other energy needs for power and heating and cooling in both rural and urban areas. The constraint on scalability will be the availability of space, since in all current applications, solar power is space intensive. In addition, without effective storage, solar power is characterized by a high degree of variability. In India, this would be particularly true in the monsoon season.

3. **Environmental impact:** Solar energy is environmentally friendly as it has zero emissions while generating electricity or heat

4. **Security of source:** From an energy security perspective, solar is the most secure of all sources, since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements. It is also clear that given the large proportion of poor and energy un-served population in the country, every effort needs to be made to exploit the relatively abundant sources of energy available to the country. While, today, domestic coal-based power generation is the cheapest electricity source, future scenarios suggest that this could well change. Already, faced with crippling electricity shortages, price of electricity traded internally, touched Rs 7 per unit for base loads and around Rs 8.50 per unit during peak periods. The situation will also change, as the country moves towards imported coal to meet its energy

demand. The price of power will have to factor in the availability of coal in international markets and the cost of developing import infrastructure. It is also evident that as the cost of environmental degradation is factored into the mining of coal, as it must, the price of this raw material will increase. In the situation of energy shortages, the country is increasing the use of diesel-based electricity, which is both expensive – costs as high as Rs 15 per unit –and polluting. It is in this situation the solar imperative is both urgent and feasible to enable the country to meet long-term energy needs.

Objectives and Targets

The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission has adopted a 3-phase approach, spanning the remaining period of the 11th Plan and first year of the 12th Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013-17) as Phase 2 and the 13th Plan (2017-22) as Phase 3. At the end of each plan, and mid-term during the 12th and 13th Plans, there will be an evaluation of progress, review of capacity and targets for subsequent phases, based on emerging cost and technology trends, both domestic and global. The aim would be to protect Government from subsidy exposure in case expected cost reduction does not materialize or is more rapid than expected.

To achieve this, the Mission targets are:

- To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.
- To ramp up capacity of grid-connected solar power generation to 1000 MW within three years –by 2013; an additional 3000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff. This capacity can be more than doubled –reaching 10,000 MW installed power by 2017 or more, based on the enhanced and enabled international finance and technology transfer. The ambitious target for 2022 of 20,000 MW or more, will be dependent on the 'learning' of the first two phases, which if successful, could lead to conditions of grid-competitive solar power. The transition could be appropriately up scaled, based on availability of international finance and technology.
- To create favorable conditions for solar manufacturing capability, particular solar thermal for indigenous production and market leadership.
- To promote programmes for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022.
- To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022.
- To deploy 20 million solar lighting systems for rural areas by 2022.

Mission Strategy (phase 1 and 2)¹⁰

The Mission has strategy to achieve its targets and objectives mainly through five ways;

A. Utility connected applications: constructing the solar grid is the key driver for promoting solar power would be through a Renewable Purchase Obligation (RPO) mandated for power utilities, with a specific solar component. This will

drive utility scale power generation, whether solar PV or solar thermal. The Solar Purchase Obligation will be gradually increased while the tariff fixed for solar power purchase will decline over time.

B. The below 80°C challenge –solar collector: The Mission is setting an ambitious target for ensuring that applications, domestic and industrial, below 80°C are solarised.

C. The off-grid opportunity -lighting homes of the power deprived poor: A key opportunity for solar power lies in decentralized and off-grid applications. In remote and far-flung areas where grid penetration is neither feasible nor cost effective, solar energy applications are cost-effective. The Government has promoted the use of decentralized applications through financial incentives and promotional schemes. While the Solar Mission has set a target of 1000 MW by 2017, which may appear small, but its reach will add up to bringing changes in millions of households.

D. Manufacturing capabilities: innovate, expand and disseminate: Currently, the bulk of India’s Solar PV industry is dependent on imports of critical raw materials and components –including silicon wafers. Proactive implementation of Special Incentive Package (SIPs) policy, to promote PV manufacturing plants, including domestic manufacture of silicon material, would be necessary.

E. R&D for Solar India: creating conditions for research and application A major R&D initiative to focus: An ambitious human resource development programme, across the skill-chain, will be established to support an expanding and large-scale solar energy programme, both for applied and R&D sectors. In Phase I, at least 1000 young scientists and engineers would be incentivized to get trained on different solar energy technologies as a part of the Mission’s long-term R&D and HRD plan.

The Road Map

The aspiration is to ensure large-scale deployment of solar generated power for grid-connected as well as distributed and decentralized off-grid provision of commercial energy services. The deployment across the application segments is envisaged as follows:

Table 1: The Solar Mission’s Proposed Roadmap

Sr. No	Application Segment	Target Phase I (2010-13)	Target Phase II (2013-17)	Target phase III (2017-22)
1	Solar Collector	7 Million Sq. Metres	15 Million Sq. Metres	20 million Sq. Metres
2	Off-Grid Solar Application	200MW	1000MW	200MW
3	Utility Grid Power	1000-2000MW	4000-10000MW	20000MW

Source: The Ministry of New and Renewable Energy, GOI, JNNSM, N.Delhi, P.7

Economic Incentives: To achieve the leadership position in solar energy economic incentives to the solar industry is inevitable. Providing adequate loan facility, setting up solar parks, SEZ like facility for component manufacturing, waiver in custom duty, ease of doing business, single window clearance, are some requirements to boost solar revolution in India.

Importantly, Power purchase Agreement is essential part of solar business to ensure the economic viability of solar power. Again, the falling prices of solar power are creating positive sentiment and attracting investment to the solar industry. Upendra Tripathy, formerly secretary of the renewable energy ministry, “When we started, people didn’t believe that solar was for real. They thought it was imaginary given that the tariffs were at Rs18 per unit. They thought it was a story which was being hyped. However, a lot of people including companies and financial institutions got interested. We called for open bidding and whatever was happening internationally, be it in terms of technology or falling solar PV (photovoltaic) prices got reflected here. With no cartels being formed, it helped India,”¹¹

The solar space has already seen a significant decline in tariffs from Rs10.95-12.76 per kWh in 2010-11. The year 2017 has brought the prices further down. India’s solar power tariff hit a new low of Rs2.44 per unit on 12 May 2017 at the auction of 500 megawatt (MW) of capacity at the Bhadla solar park in Rajasthan.¹² The decrease in solar power prices attributed to the decision of the Government of India to cover solar power by Solar Energy Corporation of India Ltd (SECI) under the ambit of tripartite agreement for payment security against defaults by State distribution companies¹³

Towards the Global Leader in Solar Power

India launched an International Solar Alliance (ISA) at the CoP21 Climate Conference, with an announcement by Prime Minister Modi that the revolution in the field would bring power to all citizens, and create unlimited economic opportunity. Over 100 countries falling between tropics of Cancer and Capricorn have assured their participation in the alliance for which India will be providing the initial funding of Rs 175 crore. The alliance brings together sun-rich nations for a research and collaboration initiative that has the potential to change the face of future energy access. It will be a platform to benchmark low-cost solar solutions and will provide unique investment opportunity for the developing world. The initiative places India in a more assertive and constructive position on the international stage, no longer merely accepting the politics of climate change, but now shaping them via its diplomatic and geopolitical influence.¹⁴

Conclusion

Country like India has very much unbalanced in electricity production. Production is less and consumption is very much. Solar power is very good option in India to increase power production. This is also very good for our environment protection and economic development. Solar power is unlimited source of energy and our country also provide suitable climate for this energy but we need some better idea to increase efficiency and decrease production cost. Our government launches some schemes for production of solar power and achieves some successes but we need education and publicity in society for these schemes so that people take some initiative for use renewable energy as much as at a

place of conventional energy sources. Currently we are generating 4.59% of solar energy of total produced renewable energy installed capacity in India. It is very low in comparison of total installed capacity of renewable energy and scope is very much for this solar PV.

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