

SOLAR ENERGY POLICIES IN INDIA: AN ASSESSMENT OF THE IMPEDIMENTS

Meenal Jain ^a, Meenakshi Mital ^b, Matt Syal ^c

^{a, b} Department of Resource Management & Design Application,
Lady Irwin College, University of Delhi, India.

^c Construction Management, School of Planning, Design & Construction, Michigan State University, USA.

^a Corresponding author: meenal_11287@yahoo.co.in

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Abstract: Energy is the prime mover of economic growth, and is vital to sustaining a modern economy and society. Future economic growth significantly depends on the long term availability of energy from sources that are affordable, accessible and secure. Today, India can well be identified as an energy guzzler. The demand for power is growing exponentially and the scope of growth of this sector is immense. In an effort to meet the demands of a developing nation, the Indian energy sector has witnessed a rapid growth. Despite impressive growth in the generation capacity since independence, India has always experienced shortage in terms of peaking capacity requirement as well as energy. The country lacks sufficient domestic energy resources, particularly of petroleum and natural gas, and must import much of its growing requirements. Given this scenario, it is of paramount importance that the country develops all possible domestic energy sources. However, India is still heavily dependent on fossil fuels to fulfill most of its energy demands. But continuation of the use of fossil fuels is set to face multiple challenges: depletion of fossil fuel reserves, global warming and other environmental concerns, geopolitical and military conflicts and of late, continued and significant fuel price rise. Renewable energy, and specifically solar energy, is the solution to the growing energy challenges as they are abundant, inexhaustible and environmentally friendly. Accelerating the use of solar energy is also indispensable if India is to meet its commitments to reduce its carbon intensity. Given the vast potential of solar energy in India, all it needs is comprehensive policies to be a global leader in clean and green energy. Government has taken a number of steps towards improving the adoption of solar energy at a large scale in the country and making the stakeholders aware of its benefits. Many programs and policies have been initiated at both the National and State level for promoting renewable energy, but

the use and production of solar energy in the country is still limited. This paper makes an attempt to understand the stakeholders' perspective on the impediments associated with the governments' initiatives for solar energy in the country. On studying major initiatives of National government, in the rural and urban scenarios, it was found that there was a gap between the policies and the actual scenario. The awareness level among the beneficiaries was found to be very low. Another aspect tapped is the perspective of the Governments' officials in implementing the policies and programs, both in the urban and rural areas. Thus, there is an urgent need to generate awareness among the stakeholders regarding the government initiatives, so that solar energy is widely accepted and used.

Keywords: Awareness, Government Policies, Impediments, Renewable Energy, Solar Energy

INTRODUCTION

Energy is inevitable for human life and a secure and accessible supply of energy is crucial for the sustainability of modern societies [1]. Energy has been recognized as one of the most pertinent contributors for economic growth and human development universally. There is a strong two-way relationship between economic development and energy consumption. On one hand, growth of an economy hinges on the availability of cost-effective and environmentally benign energy sources, and on the other hand, the level of economic development relies on the energy demand [2]. Today, India can well be identified as an energy guzzler. The demand for power is growing exponentially and the scope of growth of this sector is immense. In an effort to meet the demands of a developing nation, the Indian energy sector has witnessed a rapid growth [3].

India is heavily dependent on fossil fuels for most of its demand. It is evident by the fact that coal accounts

for almost 55% of the country's total energy supplies and about 75% of the coal in the country is consumed in the power sector. Coal is followed by crude oil and natural gas in terms of usage in the power sector [2]. Continuation of the use of fossil fuels is set to face multiple challenges: depletion of fossil fuel reserves, global warming and other environmental concerns, geopolitical and military conflicts and of late, continued and significant fuel price rise. Renewable energy is the solution to the growing energy challenges as they are abundant, inexhaustible and environmentally friendly [1].

Accelerating the use of renewable energy is also indispensable if India is to meet its commitments to reduce its carbon intensity. The power sector contributes nearly half of the country's carbon emissions. On average, every 1GW of additional renewable energy capacity reduces CO₂ emissions by 3.3 million tons a year. Investing in renewable energy would enable India to develop globally competitive industries and technologies that can provide new opportunities for growth and leadership [4]. As per Ministry of New and Renewable Energy, India is the 4th largest country with regard to installed power generation capacity in the field of renewable energy. Wind, Hydro, Biomass and Solar are main renewable energy sources in India. The country has an estimated renewable energy potential of around 85,000 MW from commercially exploitable sources [5]. Currently, India has an installed base of over 27,000 MW of renewable energy, which is around 17% of India's total power generation capacity [6].

If we try to look at all the renewable energy sources, it is seen that India is among top 5 destinations worldwide for solar energy development as per Ernst & Young's renewable energy attractiveness index [7]. Because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C – 27.5 °C. This means that India has huge solar potential [8]. Most parts of India have 300 - 330 sunny days in a year, which is equivalent to over 5000 trillion kWh per year - more than India's total energy consumption per year. India is expected to have installed solar energy capacity of 20,000 MW by 2022 [9]. Thus, if we look at the renewable energy potential, solar energy provides great opportunity to be tapped by India to have a sustainable energy scenario. Hence, it is important to understand the initiatives taken by the Indian government to promote renewable sources of energy, with specific reference to solar energy.

Review of literature has shown that there are many programs and policies which have been initiated by the Indian government, both at the National and the State level for promoting renewable energy, but the use and production of renewable energy in the

country is still limited. It is important to understand the programs, policies and incentives started by the government in detail. Further, there is need to understand the awareness and satisfaction level of the end users or the beneficiaries of these renewable (solar) energy projects. The study also envisages to understand the impediments in implementing these initiatives from the perspective of the government and generate a framework for better acceptance and implementation of such programs and policies. Literature review showed that even though information on the policies, programs and incentives is available, the stakeholders' perspective is not yet studied.

MATERIALS AND METHODS

The study was conducted in the state of Chhattisgarh in India which is situated in Central India. Urban Chhattisgarh is one of the few states of India where the power sector is effectively developed. The Chhattisgarh State Electricity Board (CSEB) is in a strong position to meet the electricity requirement of the new state and is in good financial health. Talking about the rural areas of the state, deciduous forests of the Eastern Highlands Forests cover roughly 44% of the state and this is the reason these areas have not yet received grid connected power. Thus, Non conventional energy sources have been accorded very high priority. To cater to this issue, a special agency called CREDA (Chhattisgarh Renewable Energy Development Agency) has been set up, and over 1200 villages in dense forests are being electrified using off-grid energy. CREDA is the nodal agency of Ministry of New and Renewable Energy. This organization comes under the State Government but eventually implements the policies brought out by the Central Government (MNRE).

Four villages namely Kobahara, Rawan, Mahoda and Latadadar were selected which were electrified by solar energy under the Remote Village Electrification Programme. From each village, eight households were selected and one respondent from each household was interviewed based on their willingness to take part in the study. The respondents included both men and women. Also, government officials in CREDA were interviewed to take their perspective on the catalysts and barriers associated with solar energy policies in the state.

For having an insight into the urban scenario, Chandigarh was selected as the locale. Chandigarh is a city and union territory in India that serves as the capital of two states: Haryana and Punjab. Taking in to account the exponentially increasing energy demand, it became obvious to Chandigarh Union Territory that this trend is not sustainable in the long run. It felt that measures such as reducing energy demands and switching from fossil fuel to renewable

energy technologies would go a long way in addressing these concerns. As has been the case with the wide-scale introduction of renewable energy technologies for a variety of applications in the country; Chandigarh UT took initiative to develop Chandigarh city as a solar city. The Chandigarh Renewable Energy, Science and Technology Promotion Society (CREST) is serving as the nodal agency for the city. Institutions were selected in the state, using solar energy. Also, government officials in CREST were interviewed to take their perspective on the catalysts and impediments associated with solar energy policies in the state.

RESULTS AND DISCUSSION

An attempt has been made to understand the framework of Governments' initiatives at the Central and State levels. It has been seen that the Central Government, through its Ministry of New & Renewable Energy, prepares the National level Policies and Programs, invests in R&D, and gives subsidies, tax benefits and so on. The State Governments then, through their respective nodal agencies implements the central policies and programs, in addition to making their own policies.

There are three principal government bodies established to promote solar energy in India. The first is the Ministry of New and Renewable Energy (MNRE), which is the primary unit for all matters relating to RE. The second, India Renewable Energy Development Agency (IREDA), is a public limited company established in 1987 to promote, develop and extend financial assistance for RE and energy efficiency/conservation projects. Finally, Solar Energy Centre (SEC) is a dedicated unit of the MNRE and the Government for the development of solar energy technologies and promotion of its applications through product development. Besides this, government has also rolled out various policies and subsidies to promote this sector. In addition, every state has a nodal agency, focusing solely on the issues related to renewable energy.

Government of India has come out with a number of policies and programs for the promotion of solar energy, in India. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. Solar is currently high on absolute costs compared to other sources of power such as coal. 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. It also states that 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.

Taking the said missions forward, the National Action Plan on Climate Change was launched in 2008 which had eight missions under it, dealing with various issues. Under the National Solar Mission, one of the programmes for off-grid power solution is the Remote Village Electrification Programme, brought out by MNRE. This Ministry is implementing this programme for providing financial support for electrification of those remote unelectrified census villages and unelectrified hamlets of electrified census villages where grid-extension is either not feasible or not cost effective. Such villages are provided basic facilities for electricity through various renewable energy sources, particularly solar. The beneficiaries of this scheme are the village households which get solar power for their basic requirements of lighting. In addition, street lighting systems with 11 W CFL is also considered under the project.

The Ministry provides a subsidy of upto 90% of the costs of the Renewable electricity generation systems (including the cost of Annual Maintenance Contract (AMC), if any, for 5 years). The balance cost of projects can be financed through contribution from respective State Government/CSR funds/entrepreneurs investment/loan/beneficiaries contribution or other sources other than Government of India fund. However, it will be necessary that at least half of the balance cost is met from State Government's funding. About 1,400 solar-powered villages in Chattisgarh, that are not connected to the national grid because they are in a remote area, have been enjoying the benefits of electrification under this Remote Village Electrification Programme.

As far as the urban areas are concerned, this scheme is working for developing: Solar energy systems and devices (including solar thermal and solar photovoltaic systems); Energy recovery from urban, industrial and commercial wastes; and Bioenergy and cogeneration in industry. Under MNRE's Energy Efficient Solar/Green Buildings Programme, GRIHA rating system is being promoted for a target of supporting 4 million sq. meter built up area during 11th Plan. So far, 117 projects with 4.98 million sq. meter built up area with 81 projects from Government Departments with 3.22 million sq. meter built up area have been registered for GRIHA certification. Under "Development of Solar Cities Programme" the Ministry had proposed to support 60 cities/towns for Development as "Solar/ Green Cities" during the 11th Plan period with the aim to promote the use of renewable energy in urban areas. The programme is designed to support/ encourage Urban Local Bodies to prepare a Road Map to guide

their cities in becoming 'renewable energy cities' or 'solar cities'. The Ministry of New & Renewable Energy has already initiated various programmes in the Urban Sector for promoting solar water heating systems in homes, hotels, hostels, hospitals and industry; deployment of Solar Photovoltaic (SPV) systems/devices in urban areas for demonstration and awareness creation; design of Solar Buildings and promoting urban and industrial waste/ biomass to energy projects. The Solar City Programme aims to address the energy problem of the urban areas. The Solar City aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, through a combination of enhancing supply from renewable energy sources in the city and energy efficiency measures.

Impediments in Solar Energy Policies

Rural Scenario

It was seen that most of the beneficiaries were farmers and belonged to low socio-economic status. The electricity being supplied through solar power was basically used for lighting in the households. Under the projects, basic lighting facilities with two light points (around 9 W each) and one socket (around 40 W) for operating electronic gadgets for each of the willing households in the village may be provided (flexibility of points may be allowed within total 58 W). Thus every household will be eligible for a maximum of 58 Watt unless the house owner himself wants less. The technology for such projects is simple and the source of power abundant, making it the obvious choice for electrification in rural areas. The impediments and problems, as reported by the villagers are as follows: (a) It was reported that the installation costs were borne by the government, both Central and State and the beneficiaries had to pay some monthly amount per CFL that they use. However, it was seen that there was a variation in the amount of money being charged from the villagers per CFL per month. (b) Under the project, the households were eligible to get electricity for six hours a day. However it was reported that the electricity was available only for three to four hours a day. (c) Most of the respondents said that one of the major barriers in the current solar electricity they were getting was that it was not available during night when they needed it the most. Some reported that most of the important events like weddings etc. happen at night but electricity is not available at that time. (d) The villagers also reported that the electricity available to each household should be increased, i.e., they wanted to run more appliances like water pumps, fans, refrigerators and TV, than just a single light bulb. (e) Also, most of the respondents said that they wanted light for the entire night for their kids to study. Thus, in the short time

that the electricity was supplied, the families would start using a lot of appliances like lights, fans, TV etc. and thus, due to overloading, the plant would trip, leading to another problem of discontinuous supply of electricity. It was heartening to know that during the four hours schedule of electricity supply, it is effectively there for only half an hour to one hour. During data collection, the researcher also witnessed that the light kept going on and off.

The perspective of the Government officials on the impediments and problems encountered in implementing the policies and programs is discussed as follows: (a) It was found that although training programmes on use and maintenance of solar power plants are regularly organized by CREDA, the end-users were most negligent and thus, lacked awareness. CREDA was involved in training and capacity building of the local people for laying and maintaining the solar power plants. Every village had a plant operator who belonged to that village and was trained by CREDA. However, it was observed that most of the beneficiaries were not aware of solar energy. Although some of them knew that the electricity was coming from the power plant which was there in the village, few knew that the source was solar energy. Many of the respondents were not even aware of the power plant in their village. It was surprising to see that even the plant operator's wife was neither aware of the power plant, nor its source. (b) The maintenance and upkeep of solar power plants were not up to the mark since the beneficiaries are the most negligent. Thus, major problems were there like thefts of PV panels, overloading and so on. (c) It was seen that cost is the biggest impediment in implementing solar energy policies. Since government is trying to increase capacity of solar power plants in each village, huge investment is required by the government. It was also found that the Nodal agency of each state has to fight with the Central and State governments for finances. (d) Another barrier that was reported by CREDA officials was limited manpower available in the organization. This resulted in many problems associated with training of the local people, maintenance of the power plants and so on.

Urban Scenario

The users' perspective was not found to be satisfactory. They did not seem to be happy with the entire process of availing benefits from government. The government was labeled as the commercial intermediaries. It was reported that crores of rupees were paid to government for having solar plants installed in their campuses. However, the government kept the money for very long period and on repeated letters to the authority did they release the subsidy. Thus, the whole purpose of subsidy was defeated.

The process of availing the government subsidy was reported to be very tedious.

The perspective of the Government officials on the impediments and problems encountered in implementing the policies and programs in urban areas (Chandigarh) is discussed as follows: (a) *Connectivity at the Grid level* – It was reported that since there is no connectivity at the grid level for the energy generated by solar energy, the stakeholders are not motivated enough to go in for the same. The batteries where the energy is stored need proper maintenance which is a serious concern for the users. In addition, conversion losses are encountered, reducing the efficiency of the plants. These problems are encountered with the Solar PV systems. It was suggested that a system of metering needs to be in place to motivate the users. Metering could be of two types. Firstly the Net metering system, wherein you are able to sell back the energy generated from solar to the grid, at the same price at which you are getting the energy. Second type of metering is the Feed-in tariff, wherein you are able to sell solar energy at a higher rate than the conventional grid power. It was reported that such initiatives would motivate the stakeholders for going in for more and more solar energy in their premises. (b) *Cost* – Another issue being raised by the officials was the cost of solar systems, especially the solar panels. It was suggested that free imports should be allowed to bring down the costs of Solar PV Panels. It was reported that cost is a serious issue when we talk of private commercial buildings. (c) *Renewable Purchase Obligations* – Some of the officials reported that Renewable Purchase Obligations (RPOs) should be mandated in states. They suggested two solutions for the same, either solar becomes cheap or the government purchases solar at higher rate through RPO. (d) *Channel Partners costlier* – Another very important issue being reported was that channel partners were costlier than the market rates of the same solar product. It was reported that Government of India has released advanced subsidy to these channel partners. These partners quote higher prices in lieu of the subsidy that they directly give to the customers. Another issue in the same context is that since the subsidy is very high, the channel partners quote higher prices. (e) *Awareness Generation* – Another important issue being reported by the government officials was awareness generation. They said that awareness is lacking more in the solar heating sector. Also, they reported that clarity about the government programs is not there. Technology, cost of production etc. have to be elaborated to the stakeholders. Also, most of the corporates are not aware that DG sets are costlier than the solar system. In addition, the operations & maintenance costs of solar are comparatively very low. (f) *Motivating the masses* –

Another issue is that, in spite of generating awareness, it is very difficult to motivate the masses towards the use of solar energy. Unless they see something beneficial in some particular endeavour, they do not want to go for it.

Thus, all the above came out as the main impediments in solar energy policies' and their implementation which need to be worked upon.

CONCLUSION

Continuation of the use of fossil fuels is set to face multiple challenges: depletion of fossil fuel reserves, global warming and other environmental concerns, geopolitical and military conflicts and of late, continued and significant fuel price rise. Solar energy is the solution to the growing energy challenges as they are abundant, inexhaustible and environmentally friendly. Thus, government being the main regulatory body in the country, it has an important role to play in promoting renewable energy in the country. National Solar Mission was taken as the main policy initiative by the Government, under which attempt was made to understand the impediments associated with the initiatives in rural (Chattisgarh) and urban (Chandigarh) areas.

After conducting the research, many major impediments came out both from the implementers' and the users' perspective in both the rural and urban areas such as lack of awareness, high costs involved, discontinuous supply of electricity, less capacity and so on. It is suggested that solar power projects be developed taking care of the local needs of the people. The local people ought to be involved at every stage to have a clear understanding of their requirements so that the project can be made to suit their needs.

Another benefit that it would incur is that when people are involved in something, they feel connected to it and thus, problems like overloading can be taken care of. In addition, when the problem of overloading is taken care of, the problem of erratic electricity supply would also be solved. Another major area of concern is monitoring of these solar power plants. Proper monitoring teams need to be made to overcome the problems of thefts etc. Also, the capacity of the solar power plants need to be increased so that more appliances could be run and problem of overloading could be taken care of. Another area that needs attention is the amount of time the electricity is supplied for. It is suggested that the electricity be supplied for at least twelve hours a day and especially during nights.

Awareness is a major area that requires immediate attention. Training programs needs to be developed in local languages, spreading education on the benefits of solar energy and proper use and maintenance of

the plants being installed in the village. Local people can be trained to keep a track of the plants. Another important issue is the involvement of women. Women are the main end users of electricity in the households as they spend most of their time indoors and do most of the household chores. Empowering them would result into empowerment of the entire society. Thus, specialized training programmes need to be created for women and delivered from time to time. Also, it is suggested that the government releases the subsidy at the initial stage so that the very purpose of subsidy is not defeated. All these measures would help take this movement of solar energy to great heights.

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ABOUT THE AUTHORS

Name: Ms. Meenal Jain
Email : meenal_11287@yahoo.co.in

Name: Dr. Meenakshi Mital
Email: meenakshimital@gmail.com

Name: Prof. Matt Syal
Email: syalm@msu.edu