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Solar Energy Policies for Commercial Buildings Sector: Experiences from India

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Abstract: In an effort to meet the demands of a developing nation, the Indian energy sector has witnessed a rapid growth. However, the country lacks sufficient domestic energy resources, 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. At the same time, India is still heavily dependent on fossil fuels which is set to lead to multiple challenges like depletion of fossil fuel reserves, global warming and other environmental concerns. Renewable energy, particularly solar is the solution to the growing energy challenges as they are abundant, inexhaustible and environmentally friendly. Given the vast potential of solar energy in India, all it needs is comprehensive policies. It has been seen that there are many initiatives taken by the Indian government, both at the National and the State level for promoting solar energy, but its use and production in the commercial buildings sector is still limited. On studying some of the initiatives of the central and selected state governments, it was found that there were a number of policy related impediments associated with implementation of these initiatives. Thus, there is an urgent need to take steps to minimize these impediments and generate awareness among the stakeholders regarding the government initiatives, so that solar energy can be tapped to its best possible extent.

Keywords: Commercial Buildings, Government Policies, Impediments, India, Solar Energy

Introduction

Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible and environmentally friendly [1]. 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]. Global energy consumption is projected to increase by 48 percent from 1990 to 2040. The combination of the growth in world population and in Gross Domestic Products (GDP) of all the nations, will, in the absence of dedicated policies, lead to a steady growth in energy consumption [3]. Figure 1 illustrates the projected world energy consumption from different sources.

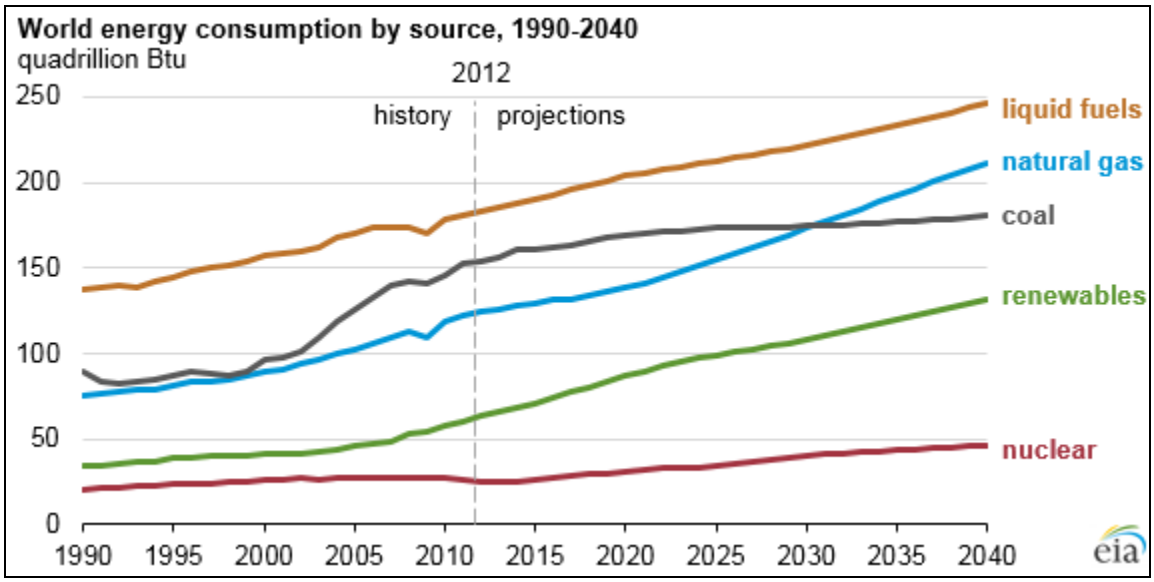

Figure 1. Projected increase in World Energy Consumption [3]

India has 18% of the world's population yet only consumes 6% of its total primary energy. Since 2000, India's energy consumption has almost doubled, and there is enormous potential for additional rapid expansion. Millions have been lifted out of severe poverty over the years by economic growth and focused policy initiatives, but worldwide energy consumption per person is still only about one-third of the global average, and about 240 million people lack access to power. Given these factors, it is reasonable to anticipate sustained high rise in energy consumption despite increased attention being paid to energy efficiency and subsidy reform [4].

India is a fast developing nation with energy being central to achieving its development ambitions, to develop the infrastructure and to meet the needs of the ever growing population. India is on the road to urbanization which is a key factor in increasing the country's energy demands, owing to increased use of fuels, rise in appliance and vehicle ownership and increased demand for construction materials. As a result, there is a need for India's power system to expand to keep pace with electricity demand which rises at approximately 5% per year. There are immense opportunities to carve a more sustainable and innovative way for the energy sector [4]. India has about one-sixth of the world's population, however, it consumes only about one-twentieth of global power output. This is the reason that massive growth is expected in the electricity sector, which will also increase the pressures on the power system [4]. Figure 2 illustrates the growth in GDP in India, leading to increased energy demands:

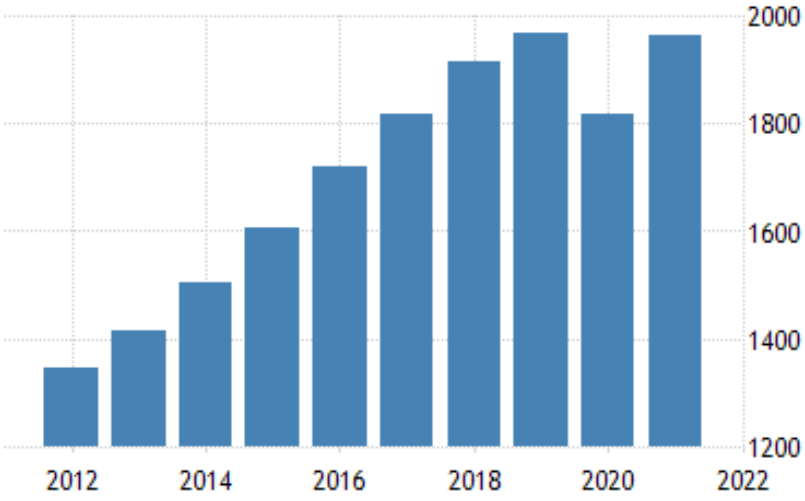

Figure 2. GDP growth in India [5]

India has traditionally been dependent on fossil fuels for meeting most of its energy demands which has been an area of concern [4, 2]. Globally, fossil fuel reserves are shrinking at a fast pace. Moreover, climatic changes driven by fossil fuel combustion, in particular the production of greenhouse gas emissions, directly impact the environment. Energy sector has a key role in this regard since energy during its production, distribution and consumption is responsible for producing environmentally harmful substances.

Modern civilizations depend on a reliable and accessible supply of energy to function. As a result, a faster transition from conventional to renewable energy systems that can meet both the current and future energy demand is urgently required. The answer to these expanding energy problems is renewable energy because it is abundant, limitless, and ecologically beneficial. This has forced the nation to actively pursue alternative energy sources, including solar, wind, biofuels, small hydro, and others [6]. According to estimations, India has more than 300 GW of wind energy potential, 750 GW of solar energy potential, 20 GW of small hydro energy potential, and 25 GW of bio energy potential. India's installed renewable energy capacity has grown dramatically from 28,067 MW in 2013 to 1,47,096 MW in 2021 [7].

The energy that the sun provides, known as solar energy, is what keeps life on earth going. India has significant solar potential, which is estimated by India's National Institute of Solar Energy to be approximately 750 GW. Most portions of India see 300–330 sunny days per year. This is roughly three times the current installed electricity capacity of India [4]. The central nodal ministry of the Indian government for all issues pertaining to renewable energy is the Ministry of New and Renewable Energy (MNRE) [8]. MNRE has been making considerable attempts to promote solar energy in the nation, and the government has launched a variety of policies and programmes to that end. In addition to MNRE, numerous states/UTs have been taking measures to promote solar energy in their respective states since electricity is a subject of both state and central government's legislative and regulatory power [9].

Commercial buildings sector in India is consuming about 8% of the total electricity and is growing at a much faster pace as compared to the other sectors [10]. According to the review of the literature, the Indian government has launched numerous policies and programmes at the national and state/UT levels to promote decentralised solar technologies, specifically solar PV and solar thermal, although adoption of these technologies is still very low. The study's objective was to look into the impediments preventing uptake of off-grid solar systems in commercial buildings, and gather suggestions to overcome the same.

Methodology

Six Indian states/Union Territories (UTs) were chosen as the locale of study, based on their total installed solar capacity under different government programmes. Punjab and Haryana were chosen as medium performers, Delhi and Chandigarh as low performers, Gujarat and Rajasthan as high performers. Both government and private commercial buildings were included. Key respondents were managers of the chosen commercial establishments. Secondary sources and questionnaires were used as research tools. Since the majority of the stakeholders who were chosen for the study did not want their names or the names of their organisations to be disclosed, the researcher ensured the confidentiality of the data at every stage of the data gathering process. According to the objectoves of the study, data was both quantitatively and qualitatively analyzed.

Results and Discussion

As discussed in methodology, the study has focussed on commercial buildings, both government and private. As far as building managers were concerned, more than 45% of the officials from the selected buildings who were interviewed were designated as assistant managers/managers. Further, 25% were facilities managers, more than 19% were supervisors and only about 10% were owners/directors. The study has, thus, looked into the perspective of various managerial positions, starting from owners/directors to the level of supervisors in the selected buildings, ensuring a wide range of opinions. The mean number of years spent by the respondents in their respective organizations was 11.31 years, with a standard deviation of 4.71. On the other hand, the mean age of the SPV/SWH system was found to be 2.75 years, with a standard deviation of 1.24. Thus, most of the building managers selected for the study would have been part of the installation process of the SPV/SWH systems in their buildings and could report the associated barriers.

As per the outcomes of the study, it was seen that policy related impediments were one of the major ones hindering growth of solar installation in commercial building sector in the country. Policy related barriers were found to be change in MNRE policies from time to time, lack of transparency in policies, time intensive process of availing government incentives and detailed and intensive documentary requirements. Further, it was reported that the state

nodal agency did not provide any technical support to the building owners regarding application formulation for SPV/SWH systems, poor online mechanism for submission of application for incentives, delayed feedback by state nodal agency/bank after verification and delayed site inspection by state nodal agency after submission of application. Table 1 discusses in detail the different types of policy related impediments reported by building managers.

Table 1: Impediments reported by Building Managers regarding the Government Initiatives for SPV/SWH systems in Commercial Sector

Categories of Barriers	Type of Barriers
Policy-related Barriers	• Policies of MNRE change from time to time without any consultation with state nodal agencies
	• Lack of transparency in policies regarding who will give the benefits, how much benefit will be given and what procedure to follow
	• Time intensive process of availing government incentives in terms of submission of application, site inspection, and detailed and intensive documentary requirements
	• State Nodal Agency does not provide any technical support to the building owners/managers regarding application formulation for SPV/SWH
	• Poor online mechanism for submission of application for incentives
	• Delayed feedback by SNA/ Bank after verification, on the status of submitted application
	• Delayed site inspection by SNA after submission of application

The study revealed that about 46% of the building managers were either dissatisfied or highly dissatisfied with government initiatives for the promotion of SPV/SWH installations in the country. On the other hand, there were only about 38% of the building owners/managers who were either satisfied or highly satisfied with these government initiatives. The overall satisfaction score was computed to be 2.68 (on a scale of 1-5), with a standard deviation of 1.09, which depicts that most of the building owners/managers were dissatisfied.

Looking at the state/UT wise data, it is evident that in the high performing states/UTs, building owners/managers using SPV systems were more satisfied than those using SWH systems. The mean satisfaction score for SPV systems was found to be 3.17, while that of SWH was computed to be 2.83. On the other hand, in the medium and low performing states/UTs, building owners/managers using SWH systems were more satisfied than the ones using SPV systems. The reason being, to increase the installation base in the high performing states/UTs, more emphasis was given to the SPV installations, while medium and low performing states/UTs were initially targeting the low hanging fruit (SWH). Further, the differences in the mean scores of the three categories of states/UTs, divulged that building owners/managers in the high performing states/UTs were more satisfied with the government initiatives than the other two categories of states/UTs, when it came to SPV systems. The mean scores were 3.17, 2.75 and 2.08 respectively for the three categories of states/UTs. On the other hand, for SWH systems, the highest mean was found to be in the medium performing states/UTs. The respective means of the three categories of states/UTs were computed to be 2.83, 2.92 and 2.33.Table 2 summarizes the satisfaction level of building managers.

Table 2: Satisfaction level of Building Managers regarding the Government Initiatives for SPV/SWH systems in Commercial Sector

Satisfaction level of Building Owners/ Managers with Government Initiatives for SPV/SWH systems	Categories of selected States/UTs						Total (N=72)	
	High (Gujarat, Rajasthan) (N=24)		Medium (Punjab, Haryana) (N=24)		Low (Delhi, Chandigarh) (N=24)			
	SPV	SWH	SPV	SWH	SPV	SWH		
	N (12)	N (12)	N (12)	N (12)	N (12)	N (12)	N	%
Highly Satisfied	0	0	0	1	0	2	3	4.16
Satisfied	6	4	3	3	1	8	25	34.72
Neutral	2	3	3	1	2	0	11	15.27
Dissatisfied	4	4	6	6	6	0	26	36.11
Highly Dissatisfied	0	1	0	1	3	2	7	9.72
Total	**12**	**12**	**12**	**12**	**12**	**12**	**72**	**100.00**

	High (Gujarat, Rajasthan)		Medium (Punjab, Haryana)		Low (Delhi, Chandigarh		Total (N=80)	*p* value for ANOVA	
	SPV	SWH	SPV	SWH	SPV	SWH		SPV	SWH
Mean	3.17	2.83	2.75	2.92	2.08	2.33	2.68	**0.20***	0.443
Std. Deviation	0.94	1.03	0.87	1.24	0.90	1.30	1.09		

SPV = Solar Photovoltaic systems, SWH = Solar Water Heating systems
1 = Highly Dissatisfied, 5 = Highly Satisfied
*Significant at $p < 0.05$ level

Reasons Cited by the Building Owners/Managers	
Reasons cited for 'Satisfaction'	• Incentives are beneficial to reduce the high cost of SPV/SWH systems • Government is taking significant steps to create awareness regarding SPV/SWH in the commercial sector
Reasons cited for 'Dissatisfaction'	• Government Policies provide only short term advantages, rather they should be aiming at long term benefits • Commercial Sector has fewer incentives than domestic sector • Government policies are inconsistent and incentives are being withdrawn without any notification • Importance of solar energy is not communicated effectively among the commercial users • No strict monitoring for mandatory programmes is there by the Government • Rigorous Documentation is required for capital subsidy which is technical and time consuming

To overcome the policy related barriers, it is suggested that National level policies by MNRE should be framed in consultation with the state nodal agencies, taking into account the specific requirements of different regions and sectors. Further, the policy documents of MNRE and state nodal agencies should clearly spell out the process of availing different incentives. Documentary requirements for incentives like capital subsidy and soft loans should be relaxed and single window system should be there for all the incentives wherein one common application is considered for both capital subsidy and soft loans. Online mechanism for submission of capital subsidy application should be improved, made free from technical glitches and software should be regularly updated. Long term policies and programmes should be framed for SPV and SWH systems, and time frames have to be set by government for each and every step of the process.

Conclusion

Considering environmental concerns, solar energy has emerged as one of India's most significant renewable energy sources to supply its ever-growing need. Off-grid solar energy is crucial for the same reason since it may be used locally and in a decentralized manner. To make the most of this clean energy source and to significantly contribute to meeting the new solar targets, the government of India needs focused policies and programmes. Government must immediately address the impediments to provide the beneficiaries with a supportive policy environment that is simple to comprehend and effective. Suggestions given by building managers have been highlighted in the study to enhance the policy framework and lessen the incidence of impediments that stakeholders have been reporting. India has the potential to play a significant role in the global push toward solar power with focused efforts and higher deployment targets for solar energy.

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