A Survey: Guiding principles, issues, and policies regarding Solar Energy in India

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Abstract. In this paper, a detailed review of energy resources has been carried out. In the current era, saving energy resources is the primary need for the development of the country. Solar energy is the natural energy resource that strongly supports the nation in many prospects. The government provides various policies that help people for conserving energy. Thusly, it is fundamental to consider energy and its assets. This article mainly consists of massive solar schemes or even greater transmission solar farms which produce power nationally and spread it across the network. In the event that discussion about standard energy assets, at that point it should be utilized increasingly more as it has numerous advantages, for example, no contamination, and this kind of asset is modest. So in the last, it is summarized that without energy resources, human existence isn’t straightforward on the earth. Subsequently, people should be utilized by need.

Keywords: Energy Resources, Renewable energy, Solar Energy, Solar power plant, solar policies

1. Introduction

India's energy agenda mainly focuses on the country's growing energy shortage and its growing energy sources, especially nuclear, solar, and wind. India achieved an average of 63% self-sufficiency during energy in 2017 [1][2]. Solar power seems to be a fast-growing sector in India. The nation's sun electricity generation since about August 31, 2020 reached 35,739 MW. The Government of India would have an additional 20 GW efficiency goal towards 2022, which was four years ahead of time. By 2015, the objective had been raised to 100 GW of solar capability (which includes 40 GW of solar roofing) around 2022, achieving a value of Us$100 billion. India recently built almost 42 power plants to allow essential contributions to power plant developers [4][5]. By the way Solar power is the ultimate energy resource that is not yet owned - no one has yet to tax the sun. In fact, this line has great importance in our lives. As humans know whether there is any energy left or not in the end, but the sun energy will always be left. For this reason, many scientists of today are paying a lot of attention to sun energy [3]. But it is said that if there is any benefit, then there will be some reduction. So it is minuscule that the radiation coming from the sun has a very bad effect on our body. Due to which many skin diseases can occur. Avoiding which is also a very big task of Researcher. The biggest thing is that the government is supporting it. The government has also brought out many rules and regulations so that the benefits of solar energy can reach the common man. Policy infrastructure in the renewable energy sector in India was developed in
1981 by the Commission of Alternative Sources of Energy (CASE) in the Department of Science & Technology. It became an autonomous Department of New Energy Sources (DNES) in 1982 and a full-time Department in 1992 [5][6].

Table 1. India's 10 largest states through deployed solar energy

| State            | Generation of Electricity(MW) | Solar Capability(MW) | Percent (%) |
|------------------|------------------------------|----------------------|-------------|
| Karnataka        | 27,199                       | 5,328                | 19.58       |
| Telangana        | 15,944                       | 3501                 | 22          |
| Rajasthan        | 21,833                       | 3081                 | 14.11       |
| Andhra Pradesh   | 23,726                       | 2829                 | 12          |
| Tamil Nadu       | 30,447                       | 2055                 | 6.74        |
| Gujarat          | 31,382                       | 1607                 | 5.12        |
| Madhya Pradesh   | 21,873                       | 1526                 | 7           |
| Maharashtra      | 43,779                       | 1311                 | 3           |
| Uttar Pradesh    | 25,061                       | 875                  | 3.49        |
| Punjab           | 13,432                       | 845                  | 6.29        |

In this paper, the policies of Solar energy are described in detail. Which is explained one by one about all policies. And it would be natural to say that this is a kind of review paper in which the Solar energy policy given by the government has been told. And by reading this paper, Researcher and Scholar will get a kind of help due to which they can pursue their research.

The rest of this paper coordinated are as follows: In section II, about Solar energy discussed in brief. In section III focus on Policies for Solar Energy. In section IV conclude this paper.

2. Solar Energy

Since about July 2019, this same largest portion of solar Energy implemented through India used to have a floor efficiency of 27,930 MW [9][12]. That segment mainly consists of massive solar schemes or even greater transmission solar farms which produce power nationally and spread it across the network. The next major component has been the 2.141 MW rooftop solar cover, which could be classified through the home rooftop, residential and commercial panels, and even a variety for developments, such as farmhouses, social and cultural centers [7].

![Solar Panel](image_url)
In 2018, 70 percent of roofing power has been used in the commercial and industrial industries, with only 20 percent were domestic shingle roofs solar [8]. Terrace solar mostly as a percentage of total solar installations will be less than common in several other largest global nations, but which is projected to rise towards 40 GW by 2022 through global standards. A reasonable estimate might indicate when India and had almost 430 MW of home solar roofers, although the UK had even more than 2,500 MW of solar installations in 2018 of around half of Total Indian generating capacity [7] [11]. The lowest section was 919 MW off-grid solar, which might aim to reach communities and residences lacking exposure to the power grid.

Figure 2. Series of Solar Panel utilize for thermal purpose

Exactly do you know that such hours of energy production from either the sun’s rays could satisfy the world’s energy needs in one period? Undeniably, the sunlight is really a strong source of energy, because even though humans can though capture a portion of that power, using this energy by adding solar cells will make an enormous difference to the earth [13] [15]. Though previously dismissed for becoming costly or unreliable, solar power has already proven to have been enormously useful somewhere to the atmosphere, but also with the corporate sector. According to accessible solar panel programs and highly affordable wholesale prices, renewable energy is becoming the major source of power forevermore citizens [14] [32]. The science has advanced greatly in recent years and has even been accompanied by battery systems storing data, rendering solar energy a much more reliable form of sustainable energy. Although no whatever that energy supply you want to examine, there will still be downfalls [19].

Table 2. Solar Energy Pluses and Minuses

| Pros                          | Cons                          |
|-------------------------------|-------------------------------|
| Source of Green Energy        | Expensive                     |
| Reduces bills on energy       | Depends on weather            |
| Various implementations       | Solar Power Generation is high|
| High cost of repair           | Using plenty of room          |
| Growth of technologies        | Pollution Associated          |

2.1. Benefits of Solar Energy

2.1.1. Source of Green Energy

Of almost all of the advantages of solar panels, the much more notable benefits of solar is really a genuinely sustainable energy source [16]. It could be found throughout all places of the globe that are
accessible day after day. Unlike certain other renewable energy sources, they never operate from solar power. Ultraviolet irradiance will also be valid as long because we have the solar, meaning sunshine will also be relevant to humanity with at earliest 5 billion years before, so according to science, the sun would vanish.

2.1.2. Reduces bills on energy

If they fulfill several of those energy requirements only with resources that planetary energy had produced, those energy costs might plummet [17] [19]. How often they save more than that invoice might influence the course of their solar panel including either power or heating consumption. For instance, whether you're a company requiring industrial rooftop solar, that move now has significant advantages since this huge volume of the device can replace big portions including its heating costs. In comparison, not only would you save on the power bill, but there is always the prospect of earning compensation for excess energy where they sell energy to the utility through to the Smarter Export Guarantee (SEG) [22] [24]. Because you are producing greater energy as you are using (considering that your solar panel system is connected to the grid) [20].

2.1.3. Various implementations

Solar energy will be used for a number of applications. They must generate power (solar cells) or steam (solar thermal) [21] [23]. Solar power will be used to generate electricity in fields lacking connections to critical infrastructure, to the determination of moisture content in locations without insufficient freshwater resources and to support spacecraft. Solar energy can sometimes be incorporated into construction equipment. But decades back sharply launched translucent solar power panels [26].

2.1.4. Growth of technologies

Innovation in the solar electricity sector is continuously going ahead which developments can be stepped up at some point. New technologies in particle physics and nanotech will theoretically expand the performance of solar panels could double or also triple the energetic intensity of solar power plants [29].

![Diagram showing the relationships between Source of Green Energy, Benefits, Reduces bills on energy, Growth of technologies, and Various Implementations.](image)

**Figure 3. List of Benefits for Solar Energy**

2.2. Disadvantages of Solar Energy

The major aspect of solar energy (PV form only) is that it cannot produce energy at night time and during gloomy weather [24] [25]. Across India, the issue can be overcome with the installation of pump-storage power plants. In addition, many ongoing and potentially hydroelectric plants can be augmented by additional pump-storage facilities to allow midnight power generation. Most of the pressure drop from groundwater sources can be achieved mainly by solar energy throughout the day [27] [28]. In an effort
to meet food security, India managed to produce disaster resilience, which can only be accomplished by energy security through the use of its water management.

3. Policies for Solar Energy

The Ministry of New and Renewable Energy (MNRE) [30] seems to be the branch Department under the Ministry of India across all aspects connected to renewable sources of energy. A general objective of that same government is always to produce to install innovative and sustainable technology of replenishing the resources welfare of the nation. Individuals start providing tax and non-tax economic advantages, including certain import duties, corporation tax deductions but also import restrictions [30].

3.1. Mission of the National Solar

Jawaharlal Nehru National Solar Mission (JNNSM) 2010, also known as the Energy Plan, becomes a part of India's National Climate Change Action Strategy (NAPCC). They exist third stages throughout their mission: Stage I (2010–12), Stage II (2013–17) then Stage III (2017–22). Through Stage I, this same Roofs PV and Initially Low Deployment Project (RPSSGP) seeks to advance the production of roofs and surface planetary bodies. The Cabinet of India revamped the Solar Project in 2014. Which is targeting 100 GW of activated solar generation capability around 2022. To accomplish its significant aim, the Government has established a number of initiatives to encourage renewable energy.

3.2. Regulation on Energy, 2003

The Act lays out a structure for the continued success of the electrical market in India. It allows for competitive tariffs and quotas for the option of renewable energy [31]. Mandatory acquisition of green energies for delivery license holders and information sharing of grid connections have been implemented.

3.3. National Policy on Energy, 2005

The policy requires capital controls for electricity derived from renewable energy sources. The goal was to establish accessibility to electricity for everyone and to maximize their cumulative per capita supply to 1000 kWh per year by 2012.

3.4. Policy of Tariff, 2006

It is the Renewable Purchasing Obligation (RPO) framework to maintain a minimum proportion of electricity purchases from alternative energy sources by the Member States. It also sets a separate tariff for solar energy and other clean energy sources.

3.5. Integrated Climate Strategy, 2006

This integrated strategy advocated a special emphasis on the production of green energy and set concrete additional capability goals [32].

3.6. Global Climate Change Action Plan (NAPCC), 2008

The Government of India has released NAPCC’s Nodal Agency Strategic Plans for Economic Development to combat climate change. Its first goal was to speed up the production of solar energy. Not only it set the RPO at 5 percent of the overall grid procurement, but also at 1 percent semester RPO growth for a decade.

3.7. Solar Generation Based Rewards (GBIs)

Implementation of GBI was far below 33 kW for micro-network solar projects. The GBIs are intended to bridge the difference between the basic tariff of INR 5.5 and the tariff defined by the Central Electricity Regulatory Commission (CERC) as infrastructure finance.

3.8. Global Solar Mission Jawaharlal Nehru (JNNSM), 2010
Formerly called the national Solar Mission, JNNSM has been one of the eight main Regional Missions comprising India's NAPCC. The purpose will achieve 20,000 MW of solar array with off solar energy capacity by 2022 with 2000 MW of off-grid throughput [26].

3.9. Renewable Energy Certificates (RECs), 2011

RECs is a process focused on the sector. Enhanced potential for green energies has been added [22]. It sets out the inter-state gaps in the production of renewable energy and the obligation for mandatory institutions to comply with their RPOs at a segregated price for solar and non-solar energy.

3.10. Clean Energy Cess, 2010

The Renewable Energy Cess being established to charge INR 50 for each ton of coal used in the region. The National Renewable Energy Fund (NCEF) has been set up to fund green power initiatives. It provides up to 40% of the overall expense of clean energy projects via the Indian Renewable Energy Development Agency (IREDA). The cessation has now risen to INR 400 per ton of coal utilized [9].

4. Conclusions

This paper basically gives a brief introduction to Solar energy and its Energy policies. It also analyzed how Solar energy is needed in our society for the development of India. Also, discussed various Policies such as Mission of the National Solar, National Policy on Energy, Global Solar Mission Jawaharlal Nehru (JNNSM), etc., which is work under the Ministry of New and Renewable Energy (MNRE). After reading some papers, it was studied that from a few years ago India used to buy solar panels from China which did not last long and their cost was also high, due to which the maintenance cost was very high. But now solar panels are being made in India, due to which people are using solar legs exclusively to generate electricity. Because of this, solar energy is still in trend. And I hope that all the researchers and scholars working on this solar power will get help because of this paper. This paper basically provides guidance for our researchers and scholars.

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