

## **Sustainable Energy for Rural India: Sate Village, a Case Study**

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**Abstract:** Access to light is a serious development issue for those living at the Base of the Pyramid (i.e. those who live on less than \$5 per day), especially for individuals living in rural areas. In order to generate our recommendation, we decided to focus our survey on a specific village in Maharashtra - Sate Village near Talegaon, Taluka Maval and District Pune. Sate was chosen due to its location and good accessibility. The main income source of villagers is agriculture. The survey proposes the study of current status of use, awareness and other issues of renewable energy sources in the village. After evaluation recommendations are also proposed so as to enhance access to clean and reliable electricity in rural areas. All these results are presented in this case study.

**Keywords:** Sate village, renewable energy sources, solar energy and bio-mass energy.

### **1. Introduction**

#### **1.1. Project Background and Context**

India, with its rapidly growing population and economy, faces a significant challenge in meeting its increasing energy demands sustainably. As the world's first-most populous country, India's energy consumption is projected to be the fastest growing among all major economies by 2040. The country has made substantial progress in renewable energy, becoming the second-largest source of domestic power production, with a projected increase in renewable energy consumption from 17 Mtoe in 2016 to 256 Mtoe by 2040 [1]. This rapid expansion underscores the necessity for a sustainable and equitable energy transition, especially in rural areas where access to reliable and clean energy remains a challenge.

India's transition to renewable energy in rural areas is marked by substantial growth in solar and wind energy capacity. As of May 2023, renewable energy sources, including hydro, contribute 41.4% to the total installed electricity capacity [2]. This shift highlights India's commitment to clean energy sources and its role in the global renewable energy landscape. The Ministry of New and Renewable Energy (MNRE) has issued frameworks to boost the sector, focusing on areas like textile, agriculture, and green job creation through renewable energy. Solar-powered irrigation systems, for example, have become increasingly prevalent, providing a reliable and sustainable energy source for farming. This not only aids in agricultural productivity but also helps in conserving water resources, demonstrating the multifaceted benefits of renewable energy in rural economies. The budgetary allocation for MNRE in FY 2024-25 was Rs. 35459 crores, which underscores the government's commitment to the promotion of renewable energy.

To check the actual scenario of renewable energy development the survey is undertaken by Physics Department of Camp education society's Dr. Arvind B. Telang Senior College of Arts, Science & Commerce, Nigdi. A village Sate in Maval, Pune, which is on the border of urban & rural area is selected for primary data collection. This project is an initiative in understanding and facilitating the energy transition in a small village in India, with an emphasis on the progressive aspects of energy transition in Maharashtra state. The project's focus extends to examine the distribution aspects of energy in particular renewable energy. The project's methodology integrates the analysis of primary data to gauge the readiness of this village in

harnessing renewable energy and identifying the problems faced by the villagers in utilizing the renewable energy sources. The significance of this project is amplified by India's ambitious goals for clean energy, including achieving net-zero emissions by 2070 and meeting fifty percent of installed capacity from renewable sources by 2030 [3]. These targets highlight the country's commitment to a sustainable energy future.

### **1.2. Motivation behind the study:**

The motivation of the study stems from a dual focus:

Firstly, the study aims to delve into the micro-level intricacies within rural areas to uncover and study the challenges and opportunities faced in adopting clean energy initiatives for the household use, agriculture use and other purposes by local stakeholders. Secondly, the study also aims to analyze and decode the output of government policies regarding clean energy sources.

### **1.3. Objectives and Scope of the Study**

1. To explore the current state of energy usage patterns along the village.
2. To explore the awareness about renewable energy sources among the villagers.
3. To assess the involvement of the village community, Panchayat, and other community-based organizations in motivating use of renewable energy sources and its benefits.

### **Sate Village:**

In order to develop a scalable study model, Sate village is chosen as a model village. The village is located at the borderline of Pimpri- Chinchwad Municipal Corporation, Maval Taluka, district Pune. Sate Village was selected for this project for the reasons including its location, good accessibility from the city area, MIDC area and most importantly, it is a proper combination of rural and urban lifestyle. So that one can understand the specific energy needs and preferences of the potential light consumers. Our team visited three wadies with varying home structures, accessibility, and levels of wealth to understand the different levels of development.

**Village Survey:** A survey was administered to Fifty-six households in the village to understand the village's needs preferences, constraints, and opportunities regarding Energy. The questions covered a variety of topics including demographics, income, cooking practices, energy sources used for light, awareness and requirement of renewable energy sources and difficulties to use renewable energy sources. The team interviewed women of the household because they were most aware of the challenges facing their families. In some cases, we were also able to speak with the men of the household as well. Figure 1 shows a member of the team interviewing a woman.



Survey results show the village is very diverse. Households differ by family structure, income source, and income amount. Around 22% adult populations are graduates. Most of the children are attending the village school and learning the in local language Marathi as well as Hindi or English language, both of which are more widely used languages in India. School age children can read and write basic words in English and Hindi. With our limited knowledge, interactions with parents and teachers on their educational benchmarks, it was sure to gauge they have understood the importance of education and are well aware of progress due to education.

Sr. No.	Age Group	Male	Female	Education	Numbers	%
1	0 - 10	07	11	Primary	14	10.14
2	10 – 15	11	05	Secondary	94	68.12
3	15 – 60	90	89	Graduate	30	21.74
4	Above 60	06	14	-----		
	Total	114	119		138	100%

**Table 1: Family Information of Sate Village**

#### **Status of Village Electrification:**

In the sample village Sate, a quantitative survey was to be conducted involving **56 randomly selected houses**. This included all 56 houses with functional electricity connections. The data is tabulated in the following Table 1.

No. of Families	Using Electricity provided by Govt.	Not Using Electricity provided by Govt.	% of families using Electricity provided by Govt.	% of families not using Electricity provided by Govt.
56	56	00	100	0

**Table 1: Data Showing 100% Electrification**

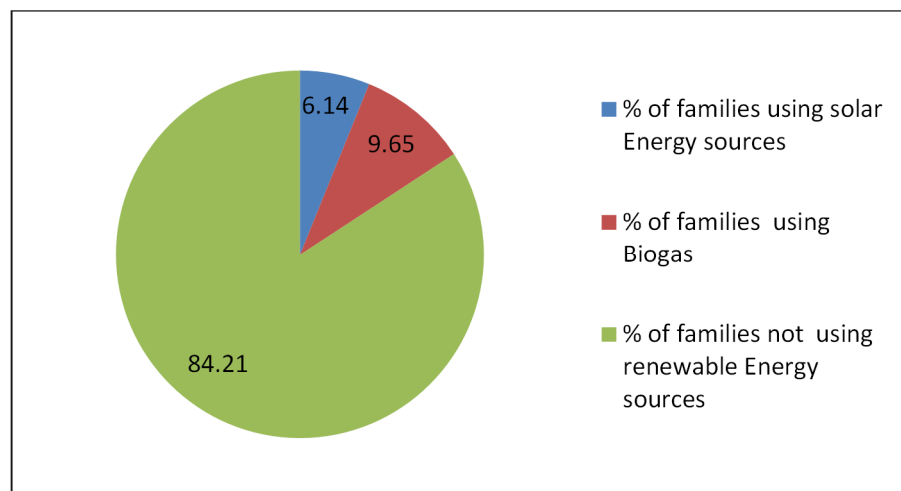
As per the criterion described by the Ministry of Power (2004), a village would be declared as electrified if the basic infrastructure such as distribution transformer and distribution lines are provided in the inhabited locality as well as the Dalit Basti. Electricity is provided to public places like schools, Panchayat Office, Dispensaries and Community Centers etc. During the study it is observed that the Sate village meets the criteria of complete electrification as per government definition. Hence the study concludes that village Sate is 100% electrified village.

It is well known that energy is a basic requirement for economic development and in every sector of Indian economy. It is thus necessary that India quickly look towards new and emerging renewable energy and energy efficient technologies as well as implement energy conservation laws. With this background, it is necessary to develop a sustainable path of energy development from micro level to macro level; from each house to industry. Government of India is continuously promoting and encouraging energy conservation and increased use of renewable energy sources for sustainable development. Fortunately, India is blessed with a variety of renewable energy sources, like biomass, solar, wind, geothermal and small hydropower. Out of these sources which sources are under active use for green energy generation is evaluated during the survey. It is observed that nearly one fourth families are using solar energy in the form of solar light, solar water heater. 15 families out of 56 families were using electricity as well as solar power.

No. of Families	Using Renewable Energy sources	Not Using Renewable Energy sources	% of families using Renewable Energy sources	% of families not using Renewable Energy sources
56	15	41	26.78	73.22

**Table 2: Data showing % of families using solar energy**

It is also observed that 15 houses are also using the renewable energy sources primarily solar energy along with functional electricity connections. As village Sate is located in Pimpri-Chinchwad Municipal Corporation, near one of the most leading MIDC, it was decided to check the awareness of villagers about the benefits of renewable energy sources. If yes then what is the percentage and how they are using it and if no then what are the difficulties faced to opt the clean energy source. Apart from the hydro-electricity provided by Maharashtra government, other energy sources like solar energy and biomass energy are also used by the villagers. Nearly 16% families use either of the two sources along with hydro-electricity provided by Maharashtra government. In particular, 84.21% of families of the Sate village primarily rely on the electricity supplied by MECB for electricity, 9.65% uses biomass energy and 6.14% families' uses solar energy to meet their energy needs in some extent as shown in the Figure 1.

**Figure 1: Data showing Energy sources in village Sate**

The financial status was evaluated by considering two factors: Source of income and monthly family income. The findings are tabulated as below

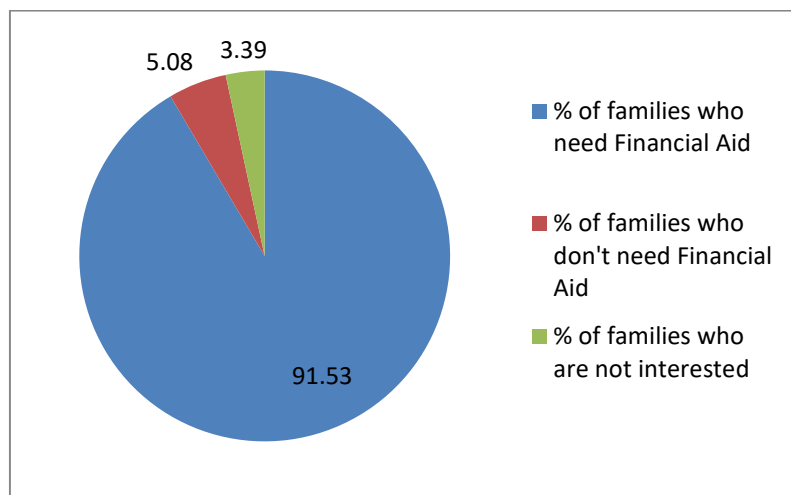
Source	Number of families	Percentage
Agriculture	22	39.28
Service	19	33.93
Business	15	26.79
<b>Total</b>	<b>56</b>	<b>100%</b>

**Table 3: Income Source of families in Sate village**

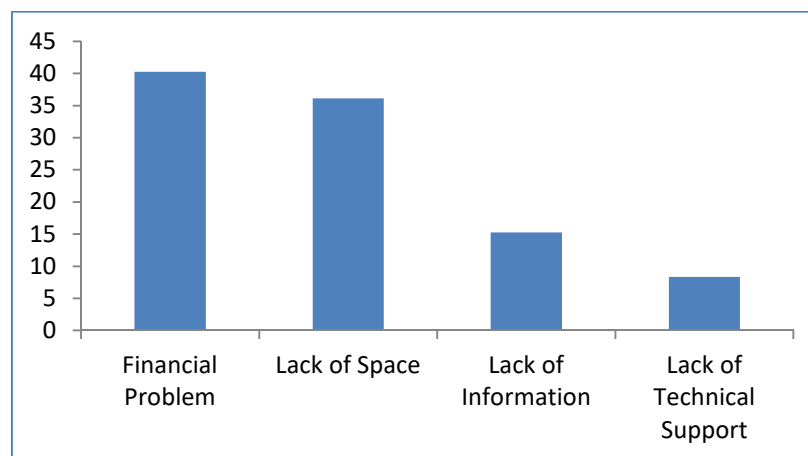
Income range in Rs.	Number of families	Percentage
2000 – 10,000/-	18	32.13
10,000 – 25,000/-	21	37.50
25,000 – 50,000/-	14	25.00
Above 50,000/-	03	05.37
<b>Total</b>	<b>56</b>	<b>100%</b>

**Table 4: Monthly Family Income in Sate village**

Primary source of Sate village is agriculture led by women. Due to proximity of village with the MIDC area men opt service and business for improving the income stability [Table 3]. The monthly family income of nearly 94% families in Sate is between Rs. 4.5 Lacs to Rs. 10 lacs [Table 4]. Therefore according to PRICE (People Research on India's Consumer Economy report) the villagers are in the middle class category. Hence 91.53 % families were interested to install renewable energy setup if Government is providing the financial support for the installation. However 3% families showed no interest at all whereas 5% families didn't want any financial support. The results are shown in Figure 2 below.

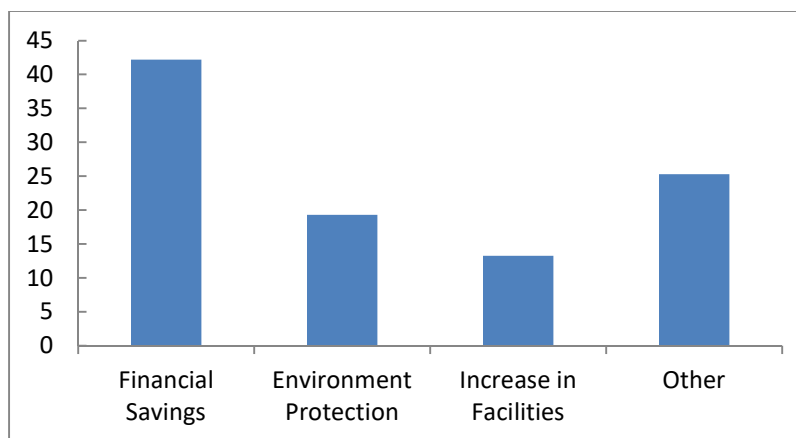


**Figure 2: % of families in Sate who wants financial aid to install renewable energy setup**



**Figure 3: Reasons for not accepting renewable energy setup**

The challenges faced by the renewable energy industry are many. To identify these challenges was also area of interest during the survey. Main challenges found were lack of space and technical support. Also the Figure 3 indicates lack of knowledge and awareness of renewable energy technology makes people reluctant to use it. It is also found that the lack of policies, subsidies, incentives and regulations that favors renewable energy technologies hinders its wide acceptance. Easily available wood and fossil fuel is also a major barrier in the thought process for accepting renewable energy technology. In Sate it is observed that most of the families use wood, coal and fossil fuel for cooking due to its easy availability and cost effectivity.



**Figure 4: Awareness of Sate villagers**

Awareness of green energy is crucial for addressing sustainable future. By understanding the benefits of renewable energy sources and adopting energy efficient practices, individuals and communities can contribute to a healthier planet and a more resilient economy. Preserving habitats, conserving resources are important aspects of using renewable energy sources. How the villagers in Sate look at this issue and how much they are aware about it was surveyed in this study. It is found that people are aware about it. The most motivating factors observed are as below:

1) Cost savings: Even though initial investment in installing the infrastructure of green energy is significant, people are aware about the long term benefits and operational cost effectivity.

2) Environment protection: Solar energy uses reduces gas emission and uses of fossil fuel like wood, coal are reduced thereby decreasing overall pollution.

3) Increase in facility: Use of solar energy and biomass energy provides energy independence from fossil fuel.

### **Conclusion:**

The Sate village is 100% electrified. People are well aware about the benefits of renewable energy sources. Financial arrangement for installing the initial infrastructure is a main challenge. Inherent dependence on fossil fuels remains as challenges in shifting to the renewable energy industry from the age old fossil fuel industry. Still it is observed that solar energy and biomass are the two renewable energy sources used in Sate. Nearly 75% population is not using green energy. Hence there is lot of scope for motivating and encouraging the green energy.

### **Recommendations:**

1) The Ministry of New and Renewable Energy (MNRE) offers subsidies and grants up to 30% for the installation of renewable energy in India. The villagers are unaware of these schemes. Hence the government can run vigorous advertise campaign so that introduction and implementation of support policies to strengthen use of renewable energy can be reached to the common man.

2) Gram panchayat, Ganapati mandals can implement awareness campaigns highlighting the programs like rallies, exhibition at school level, essay competitions etc. to promote use of green energy.

3) Gram panchayat can play an important role in passing the information of different schemes like National Solar Mission of Ministry of New and Renewable Energy more effectively and motivating villagers to adopt renewable energy.

4) Villagers who are already using solar energy for water heating can be encouraged for the adoption of solar-powered pump sets for lifting water. This could involve providing subsidies, incentives or access to financing options to make solar pump sets more affordable and accessible to farmers.

5) NGOs or private companies can offer technical assistance for the installation and maintenance of solar pump systems.

### **References:**

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