



# Solar Mini-Grid

Impact Assessment Report

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## About JREDA:

The Jharkhand Renewable Energy Development Agency (JREDA) is a self-regulatory body under the **Companies Registration Act 21 of 1860**. It was **registered on 19 February 2001** for the development and deployment of renewable energy sources to supplement the state's energy needs. JREDA is the state nodal body for the implementation of renewable energy projects through financial incentives provided by the Ministry of New and Renewable Energy (MNRE), Govt. of India and the Government of Jharkhand.

## About SwitchON Foundation

SwitchON Foundation (regd. Aas Environment Conservation Society) was established began in 2008 to serve as a catalyst for the adoption of sustainable technologies and practices, working at the intersection of climate-resilient agriculture, clean energy, green livelihoods and skills. With a dedicated team of **175+ members**, we operate across 8 states in India, empowering communities with climate-smart solutions. Through sustainability and innovation, we are committed to transforming **10 million lives**, ensuring that love and action for the Earth lead to better livelihoods, improved well-being, and a thriving planet for all.



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## i. Executive Summary

This report provides **an overview of JREDA's rural electrification initiatives under the DDUGJY and the Government of Jharkhand's Rural Electrification Scheme**. It highlights the systematic deployment of solar mini-grids to expand energy access across rural Jharkhand. Under DDUGJY, 246 villages (216 villages with solar mini-grids and 30 villages with standalone systems) in nine districts have been electrified with 3.5 MW capacity, benefiting 14,155 households. Additionally, 371 villages across twelve districts have been covered under the state scheme, electrifying 15,295 households with 7 MW capacity. Together, these initiatives have enabled the electrification of **617 villages** so far, advancing Jharkhand's transition toward decentralized and renewable rural energy systems.

An in-depth understanding of the flow of command, financial outlay for the projects, benefits provided per village and household, district and village-wise power allotment and infrastructure developed has been elaborated with key inferences, discussing the challenges faced and current status of the infrastructure provided. A composite evaluation has been done at a district level on the **impact of solar electrification** using primary datasets of NFHS between 2016 and 2021 (pre and post intervention).

Key indicators considered are access to electricity, access to banking and finance services, access to education, economic growth and the multi-dimensional poverty index to understand the change in overall well-being of the districts. In terms of environmental impacts, reduction in GHG emissions and reduction in stress on water and forest resources have been considered.

The above has been enforced through **field-level studies** via interactions and interviews with beneficiaries from 3 of the 12 listed districts, reporting the socio-economic change in quality of life and gauging challenges with existing solar mini-grid plants.

Critical challenges in the state, based on terrain, climate, social, and economic challenges, have been discussed, supporting the initiative to go off-grid to electrify remote rural communities in the region.



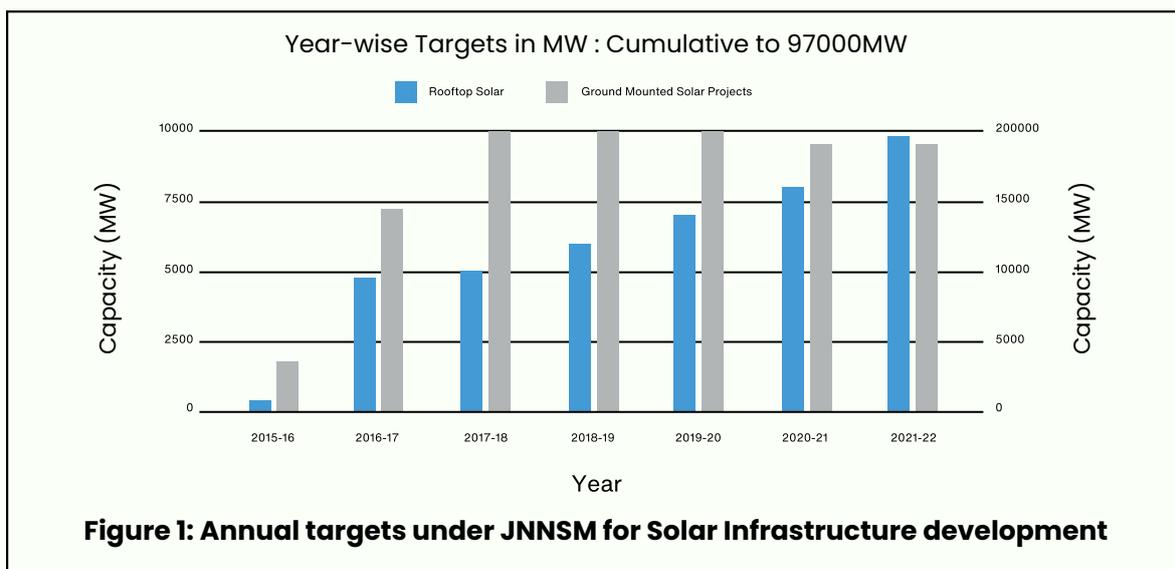
## ii. Key findings and observations

- A total of 246 villages spanning across 9 districts were electrified using Off-Grid Solar PV systems under the DDUGJY Scheme up to 2019
- Under DDUGJY (FY 2017–18), Jharkhand achieved the installation of 3.5 MW solar PV capacity, providing grid-quality power to 13,440 rural households.
- Under the State Rural Electrification Policy, 371 villages across 12 districts were electrified through off-grid solar PV systems as of 1st October 2025.
- **In total, 10 MW of solar PV capacity has been deployed across Jharkhand, ensuring reliable electricity access for 29,450 rural households.**
- In terms of **5-year impact analysis (2016–2021)**, all districts have shown a significant increase in access to electricity, access to banking and finance services. Access to Education has also increased with a sharp drop in the number of illiterate individuals per district, while Primary and Secondary Education attainment has skyrocketed in the past 5 years.
- The Multidimensional Poverty Index (MPI) data reveal that all 10 districts have seen massive development in terms of poverty alleviation and betterment in lifestyle.
- General estimates suggest a cumulative reduction in GHG emission of nearly 28.15KT of CO<sub>2</sub> eqv per year, accounting for the elimination of nearly 52.569 barrels of kerosene for domestic lighting while producing 21,600KWh of electricity per year completely off-grid.
- Field studies showed nearly 55.07% of respondents preferred solar mini-grids as their primary power source, 81.65% of respondents experienced a rise in electrical appliance usage, while 92.40% of households used electrical appliances in the evening, impacting education and reducing women's chore time.
- Key challenges of terrain, climate, social and financial constraints support the installation of Off-Grid DRE in the region instead of integration with the national thermal grid for rural electrification.



## A. Introduction:

India, with its vast rural areas, faced challenges in providing reliable and sustainable electricity to its rural population. The conventional energy infrastructure struggled to reach remote locations, leading to a significant energy deficit in rural India. The National Solar Mission emerged as a strategic response to address these challenges while leveraging the country's abundant solar resources. India's National Solar Mission, also known as the **Jawaharlal Nehru National Solar Mission (JNNSM)**, was launched in 2010 to establish India as a global leader in solar energy. While the primary focus was on grid-connected solar power, the mission also recognized the crucial role of solar energy in rural electrification. The mission set ambitious targets with two successive revisions and includes the deployment of 100 GW (Figure 1) of grid-connected solar power by 2022 (IEA, 2021). A segment of this capacity was dedicated to off-grid solar applications, explicitly targeting rural electrification. The mission aimed to empower rural communities by providing them with access to clean and sustainable energy sources. The NSM has been instrumental in promoting off-grid solar power for local energy requirements in addition to its large-scale grid-connected solar photovoltaic (PV) effort.



In India, the growing population increases energy demand and requires more attention to fulfill current energy needs. Renewable Energy Sources (RES) appear to cope with current energy demand. Coal is majorly utilized for energy generation, whereas renewable energy still requires some effort to reach a significant contribution level. A comprehensive review by Arya et al., 2022 emphasizes that a very high number of Indian rural villages still need electrification. Sometime, transferring power to these villages is not feasible due to high costs, long distances, and significant power losses in a centralized grid. To address the challenge of rural electrification, mini/microgrids (MG) offer a potential clean energy solution, either as standalone systems or in conjunction with the utility grid. The study also discusses the main challenges of MGs like intermittent power, storage system cost, energy cost, power quality, tariff plans, and subsidy. The policies by central and state levels should consider all challenges for rural electrification market planning and its implementation with the consideration of political, environmental, technical, and economic factors

As per a report by Intelicap in 2022, India ranks second in the list of over 100 countries based on readiness for DRE investment, particularly in off-grid solar. After China and the United States, India is in the third position in the largest solar power. India has the world's largest auction for renewable energy and has in recent times embarked on crucial incentives for DRE, together with mini-grid growth.

*While every geographical region can have its own set of constraints, the general implementation strategies for Solar Mini-grids for Rural Electrification can be summarized as follows:*

### **1. Off-Grid Solar Solutions:**

The mission recognized the importance of off-grid solar applications, particularly in remote and unelectrified villages. Solar lanterns, home lighting systems, and solar pumps were identified as key components of rural electrification.

### **2. Financial Incentives:**

To encourage the adoption of solar technologies in rural areas, the mission provided financial incentives and subsidies. This made solar solutions more affordable for both individual users and community-based organizations.

### **3. Capacity Building:**

The successful implementation of the mission relied on building local capacity. Training programs were initiated to educate communities, technicians, and entrepreneurs about the installation, operation, and maintenance of solar systems.

### **4. Public-Private Partnerships:**

Recognizing the need for extensive investment and expertise, the mission actively sought collaborations with the private sector. Public-private partnerships were encouraged to facilitate the deployment of solar solutions in rural areas.

### **5. Monitoring and Evaluation:**

A robust monitoring and evaluation framework was put in place to track the progress of rural electrification projects. This ensured transparency, accountability, and the ability to make data-driven decisions for further improvements.



## B. Objectives of the Report:

This report aims to assess the impacts of solar mini-grids implemented by JREDA under the DDUGJY scheme from FY 2016-17 and 2017-18. The study extends its focus beyond the completion of the DDUGJY scheme, delving into the subsequent initiative by the Jharkhand State government to install additional mini-grids in 371 villages until 1st October 2025. The primary goals include evaluating the extent of electrification and energy access in marginalized rural communities, analyzing the influence on health and education facilities, assessing the impact on income generation and revenue flow for economic development, and gauging the associated environmental benefits. By providing an in-depth analysis, this report aims to offer valuable insights into the effectiveness of solar mini-grids in fostering sustainable development and improving the overall quality of life in remote regions.



## C. The DDUGJY Scheme and Role of JREDA in Rural Electrification:

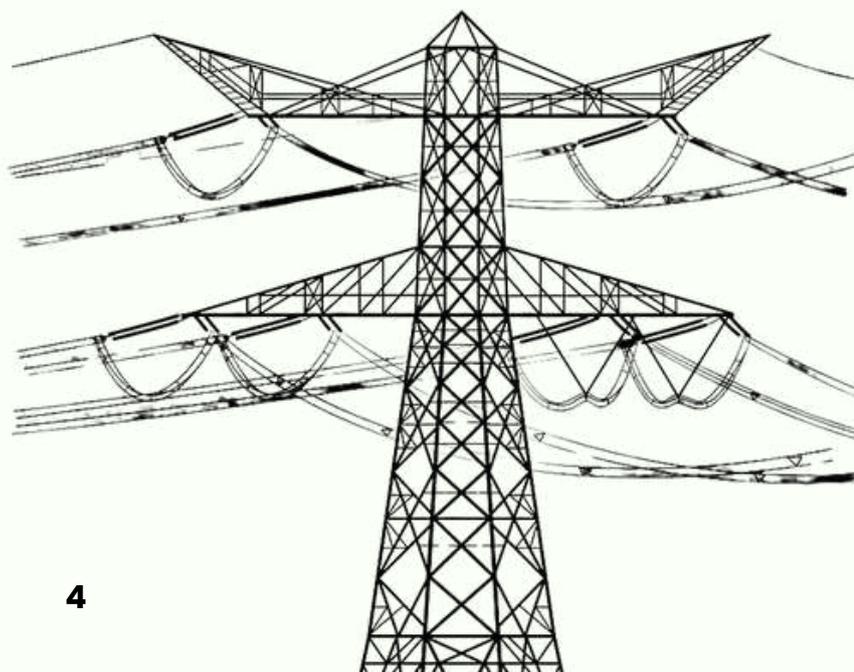
The **Deen Dayal Upadhaya Gramen Jyoti Yojna (DDUGJY)** is a scheme launched by the Government of India vide Office Memorandum F.No.44/44/2014-RE dated 3rd December 2014 and issued by the Ministry of Power to provide continuous power supply to rural India. The scheme aims to electrify all villages and habitations in the country. Launched to enhance power infrastructure and facilitate access to electricity in rural areas, DDUGJY focuses on reducing disparities through the electrification of villages and households. The scheme emphasizes **feeder separation, system strengthening, and last-mile connectivity**. Key objectives include **providing a reliable power supply, boosting agricultural activities, enhancing socio-economic development, and improving the overall quality of life in rural regions**. DDUGJY aligns with the national commitment to achieve universal electrification, promoting sustainable development and inclusivity in rural communities.

JREDA is a state nodal agency for the implementation of renewable energy projects by means of financial incentives made available by the Ministry of New and Renewable Energy (MNRE), Government of India and the Government of Jharkhand. It plays a pivotal role in spearheading rural electrification efforts across the state and is tasked with implementing various schemes and initiatives to ensure sustainable and reliable power access to rural communities.

JREDA is working towards promoting the use of renewable energy sources in the state of Jharkhand. The agency has been instrumental in the implementation of various renewable energy projects, including the implementation of the DDUGJY scheme. **The DDUGJY scheme has been implemented to electrify 246 villages in 9 districts through solar energy in a decentralized mode, specifically targeting unelectrified villages where grid-based electricity is unavailable.** After receiving a list of such villages from the Rural Electrification Corporation Limited (REC), JREDA undertook the implementation process, ensuring that the selected villages receive reliable power access. The electrification of these villages has been done through solar mini-grid and solar stand-alone systems with a total capacity of 3.5 MW. The project is financed by the nodal agency Rural Electrification Corporation, Ministry of Power, Government of India.

Additionally, JREDA conducts feasibility studies, site evaluations, and technical assessments to determine the most effective and sustainable electrification solutions for each village. The agency also actively engages with local communities, addressing their specific energy needs and fostering awareness about renewable energy technologies.

JREDA's commitment extends beyond project implementation to ongoing monitoring and evaluation. The agency oversees the maintenance and performance of installed systems, ensuring their longevity and efficiency. Through its multifaceted approach, JREDA contributes significantly to rural development, empowering communities with access to clean and sustainable energy sources, thereby fostering economic growth, improving living standards, and mitigating environmental impact in Jharkhand.



## C.1. Electrification of 246 Remote Villages under DDUGJY:

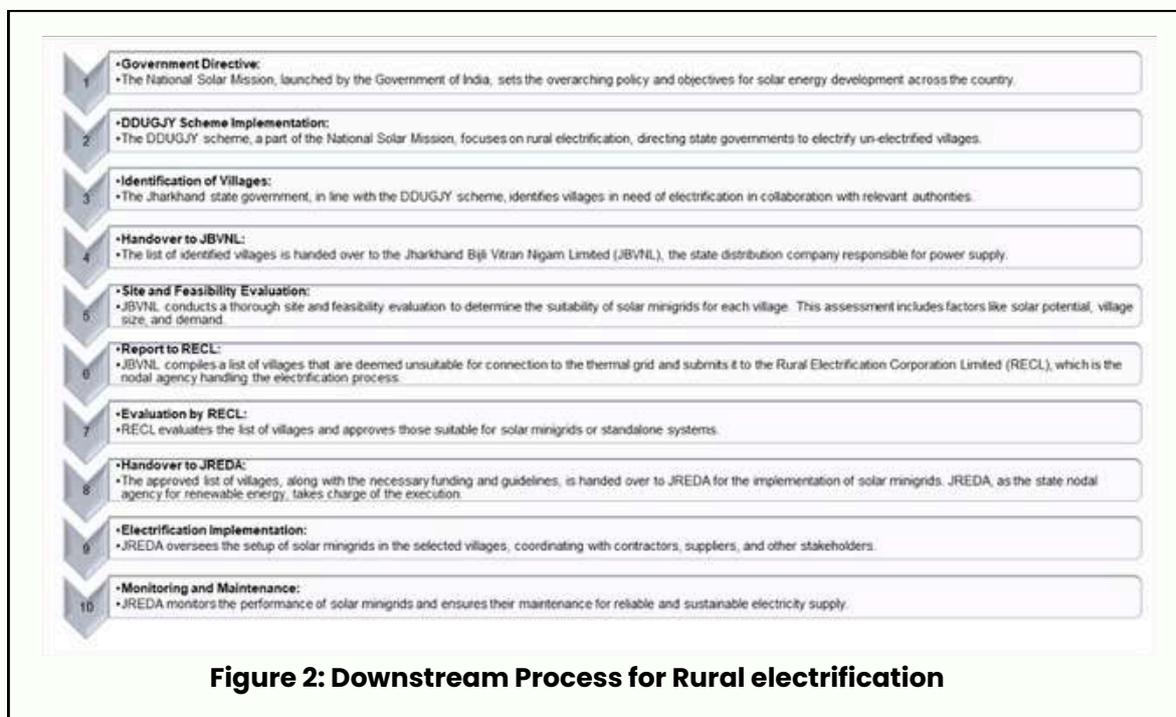
Under the DDUGJY scheme, rural electrification initiatives in Jharkhand involved a systematic process. Initially, a selection of villages across 9 districts was made, guided by the scheme's framework. Jharkhand Bijli Vitran Nigam Ltd (JBVNL), the state-run distribution company (DISCOM) responsible for the distribution of electricity to retail and bulk consumers in the state of Jharkhand, after rigorous site evaluations, identified villages unsuitable for thermal grid connection. This list underwent scrutiny by the Rural Electrification Corporation Limited, the nodal agency overseeing the electrification process. Subsequently, an approved list of 246 villages deemed appropriate for electrification through mini-grids or standalone systems was entrusted to JREDA for implementation, along with financial grants as stipulated (**Figure 2**).



## Financial Structure and Subsidy Support under the scheme:

The financing features of the Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) include the following (DDUGJY Guidelines, 2014):

- **Scheme Cost** : The scheme has a total cost of Rs. **43,033** crore, which includes a budgetary support of Rs. **33,453** crore from the Government of India.
- **Budgetary Support** : The Government of India will provide financial support for the implementation of **DDUGJY**.
- **Separate Bank Account** : Each utility participating in **DDUGJY** must open a dedicated bank account in a nationalized bank with e-banking facilities. This account will be used for receiving funds from REC (**Rural Electrification Corporation**) and making payments related to project execution.
- **Grant Determination** : The eligible cost for determining the grant under DDUGJY will be the project cost approved by the Monitoring Committee or the award cost of the project, whichever is less.
- **Release of Funds** : Funds will be released from the nodal agency (REC) to the utilities through the Public Financial Management System (PFMS). Utilities must enter details of receipts, expenditures, etc., in the PFMS portal.
- **Quality Assurance and Evaluation** : Utilities will be responsible for assuring the quality of DDUGJY works and must formulate a comprehensive quality assurance mechanism.



**Figure 2: Downstream Process for Rural electrification**

## Allotted components as part of the scheme per household:

The electrification work done under Rural Electrification Program stipulated a set of components and facilities to be provided free of cost to each house hold and village in addition to the grid infrastructure and power transmission .The details of components provided under the program are as follows:

### Solar Powered Mini/Micro Grid:

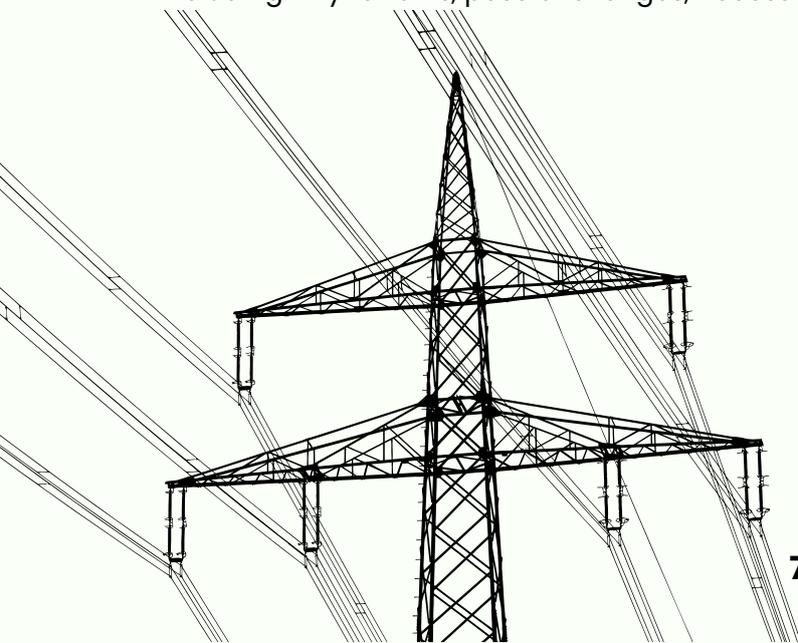
Supply, installation and commissioning of Power Distribution Network (PDN) at the site, which shall operate on the electrical power produced by the SPV Power plant to fulfil the below mentioned requirement as per standards / specifications mentioned therein:

- Installation & Supply of minimum three (3) domestic light points along with 3 nos. LED lamps of 9W/10W/11W each & Installation of one socket point (60W) & one socket point (100 W). Thus a total of 193 W up to 200 W will be taken with proper switching arrangement, in every selected house hold of the village with complete fittings of wiring in proper manner within conduit installed on saddle / casing capping.
- Supply, installation & grouting of 8 meters MS Poles/tubular pole/PCC pole as per ISI/ JBVNL norms for overhead / underground distribution network of cables at village.
- Supply, installation & commissioning of one number of 18 W LED Street light luminary for five households each.
- Supply of 1 number of streetlight per 5 households.
- Supply & installation of earthing kits, stay wire sets with complete set for poles etc.

### C.1.1. District Wise Details of Electrification:

Rural electrification in Jharkhand encounters multifaceted challenges hindering the provision of reliable electricity to remote areas. Inadequate infrastructure is a significant hurdle, with many remote areas lacking essential power lines and distribution networks, making it hard to extend services. Financial constraints present a challenge, as limited budgets often fall short of infrastructure costs, impeding electrification progress. Distribution inefficiencies persist, with power theft and technical losses contributing to energy wastage. Geographical constraints, including hilly terrains, pose challenges, necessitating alternative solutions like decentralized re-

newable energy. Operational challenges, including a lack of skilled manpower and technical expertise, compromise effective infrastructure maintenance, leading to frequent outages. Low electricity demand in rural areas discourages investment, hindering economies of scale and financial sustainability. These challenges collectively underline the need for innovative, off-grid, and decentralized solutions to address Jharkhand's unique electrification obstacles, ensuring reliable and sustainable power access for its remote communities.

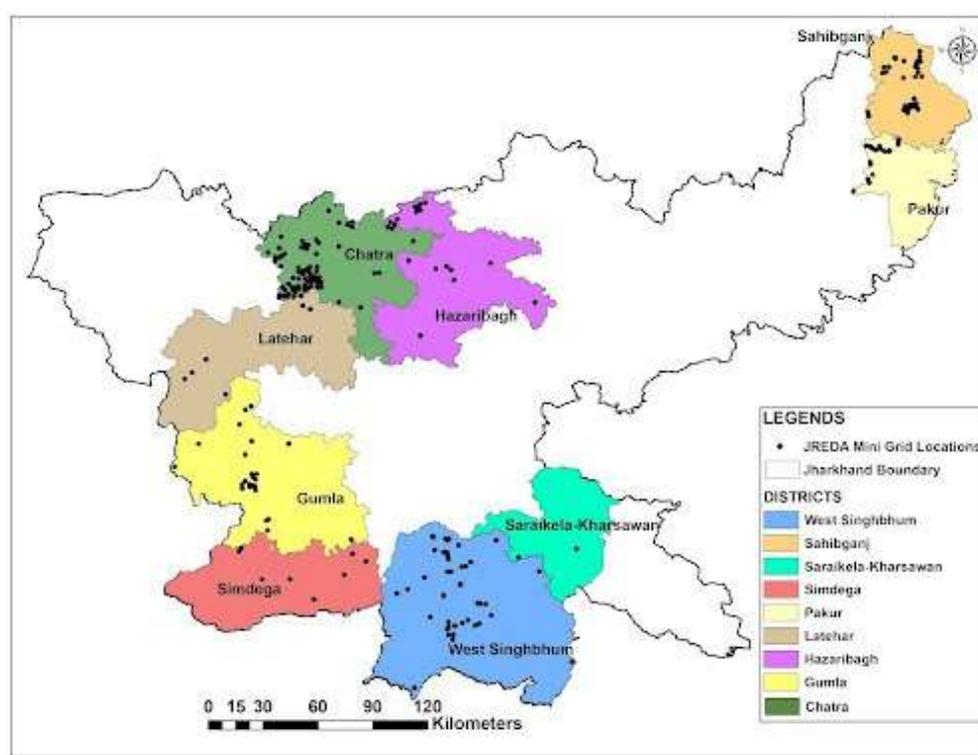


Even in the face of multifaceted challenges as stated above, the program covered 246 villages spread across 9 districts of Jharkhand (**Figure 3**). The choice of villages was based on the installation feasibility, i.e. remote areas where conventional grid transmission lines might not be economical or face geographical/environmental constraints, infrastructure and logistics access for ease of O&M facilities post installation and the overall cost of setup based on the available subsidy and funding.

**Table 1: Districts and Villages electrified under the DDUGJY Scheme in Jharkhand.**

(\* calculation based on a chart from Details of Solar Off-grid Plant under the Government of Jharkhand, 2022)

Sr. No.	District Name	Total Nos. of villages	No. of Mini Grid Village	Mini-Grid Capacity (kWp)	No. of Standalone village	StandAlone Capacity (kWp)	Total Capacity (kWp)	HHs	Lives Touched*
1	Chatra	80	48	1394	12	20.8	917	2289	17065.62
2	West Singhbhum	54	51	916	3	7	923	3600	11016
3	Gumla	23	41	386	0	0	910	1834	4617.54
4	Sahibganj	42	32	307	5	10	1180.5	3051	3696.48
5	Simdega	6	7	169	0	0	104	240	2071.62
6	Hazaribagh	17	17	169	3	2.6	195	460	2031.84
7	Pakur	18	17	139	1	1.4	140.4	533	1630.98
8	Latehar	5	30	0	5	74.4	605	1173	1138.32
9	Saraikele Kharsawan	1	0	0	1	3	3	15	45.9
Grand Total		246	216	3480	30	119.2	3599.2	14155	43314.3



**Figure 3: Locations of Installed Mini-Grids/Stand-alone Systems throughout Jharkhand under DDUGJY Scheme**

As per the scheme, villages which could not be connected to the national thermal grid due to stipulated reasons by JBVNL were handed over to JREDA through appropriate channels of RECL along with necessary fund allocations. JREDA, having performed the necessary site evaluation (**Table 2**), and vide work orders dated between March – November 2017, a total of 216 Minigrids and 30 Standalone systems were installed between June 2017 to November 2020. (**Table 1**) shows the allocation of Minigrids and standalone systems across the Districts and corresponding villages in descending order. of the number of villages electrified per district. Correspondingly, the total capacity installed under minigrids is around 3.48 MW, while standalone capacity installed is around 0.12 MW, for a cumulative total capacity of 3.6MW, catering to a total of 14155 households from the remotest and marginalised communities, impacting nearly 43314 people. The net project costs accounted for nearly 107.18 crores INR

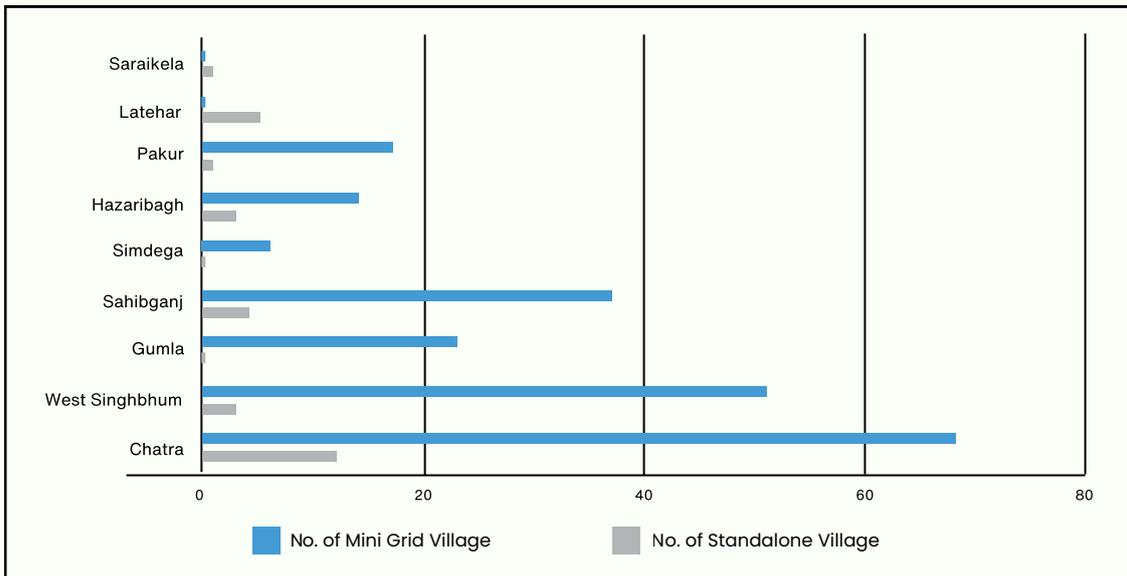
(Source: JREDA DDG Project Closure Report Dt. 19/01/2022)

**Table 2: Checklist of Site Evaluation Parameters for Minigrid/Standalone Systems**

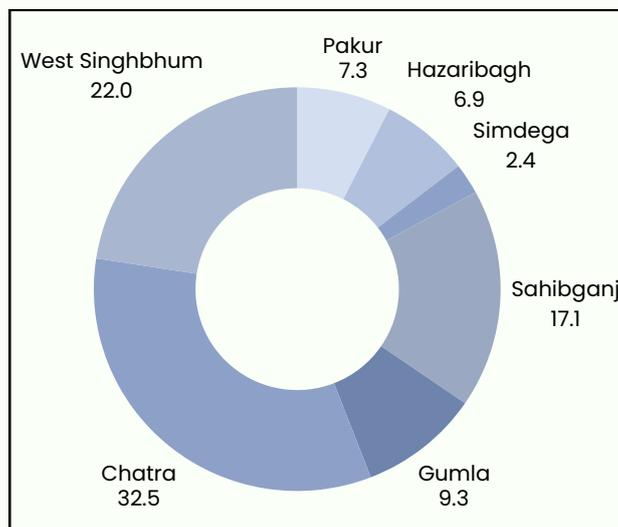
(As per Letter 275(i) dt. 07/10/2023, Deputy Commissioner's Office, Gumla)

Category	Parameters Considered
<b>Village Details:</b>	<ul style="list-style-type: none"> <li>Name of Village</li> <li>Name of Tola</li> <li>Census Code</li> <li>Name of the Panchayat</li> <li>Name of the Block</li> <li>Name of District</li> <li>Village Longitude</li> </ul>
<b>Demographics:</b>	<ul style="list-style-type: none"> <li>No. of Total Households (HH )</li> <li>Available Land Area in Village (in square feet) for 1 kWp Solar Minigrid Plant (min 275 sqft)</li> <li>Village Population (As per Survey)</li> </ul>
<b>Geographical Information:</b>	<ul style="list-style-type: none"> <li>Geo-tag Site Photographs</li> </ul>
<b>Infrastructure and Connectivity:</b>	<ul style="list-style-type: none"> <li>Mobile Phone Service Network Available in Village (Y/N)</li> <li>Nearest Railway Station (KM)</li> <li>Nearest Police Station (KM)</li> <li>No. Of School with Room</li> <li>No. Of PHC/CHC</li> <li>No. Of Anganwadi Building</li> <li>No. Of Temple/Worship Places</li> <li>Any Other Community Building</li> <li>Whether Houses are Close together or scattered</li> <li>Whether Source of water readily available for the site (Y/N)</li> <li>Whether approach Road is available up to the site</li> <li>Distance from nearest Substation (in Km)</li> </ul>
<b>Electrification and Infrastructure:</b>	<ul style="list-style-type: none"> <li>JBVNL Accessibility &amp; Infrastructure</li> <li>Total No. of Solar Street Light required with location</li> <li>Nearest Electrified village distance (in km)</li> <li>Fuel used at Present for lighting purpose</li> </ul>
<b>Livelihood and Contact Information:</b>	<ul style="list-style-type: none"> <li>Name of major Livelihood Activity</li> <li>Average HHs Annual Income (INR)</li> <li>Mukiya Mobile No.</li> <li>Panchayat Secretary Contact No.</li> <li>Other Contact No.</li> <li>Block Development Officer Contact No.</li> </ul>

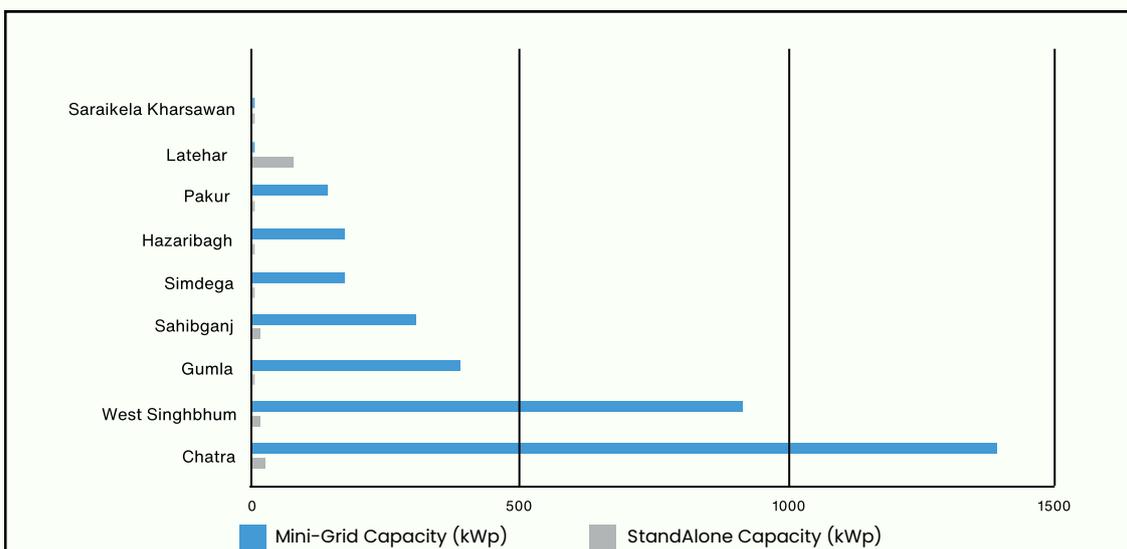
### A. No. Of Mini-Grids/Standalone PVs District Wise



### B. Percentage Share of Mini-Grids/Standalone PVs by District

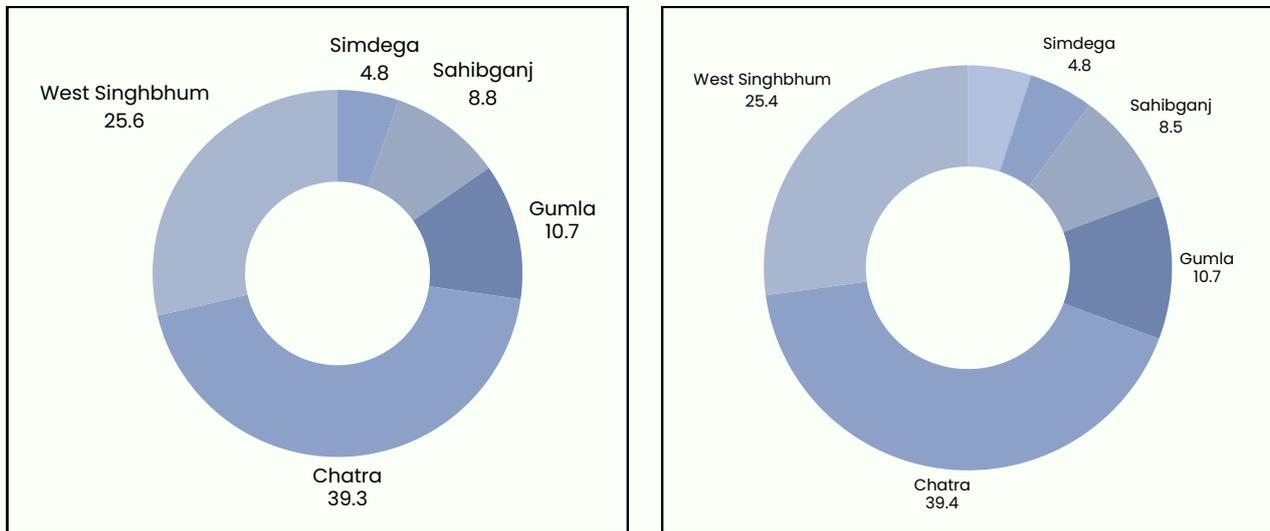


### C. Power Generation from both systems



**D. District-wise Share (%) of Power Generation from Mini-Grids and Standalone PVs**

**E. Households Catered**



**Figure 4: Proportion of Minigrids/Stand-alone Systems District-wise (A), Percentage of Villages Electrified District-wise (B), Distribution of Production Capacity Installed District-wise (C), Percentage of Power Production allotted District-wise (D), and Percentage of Households catered District Wise (E)**

Figure 4 (A-E) exhibit critical observations related to the installation across 9 districts:

**A. Proportion of Minigrids/Stand-alone Systems**

Description: The proportion of Minigrids and Standalone Systems is quite vivid. In most cases Minigrids are the primary allotted infrastructure to cater to a large set of communities. Standalone systems form a relatively minor part of the DRE system except in Latehar and Saraikela Kharsawan where electrification is completely based on Standalone systems.

**B. Percentage of Villages Electrified District-wise**

Description: It is to be noted that out of the 9 districts consisting of 246 villages, 32.5% constitute of villages in Chatra District followed by 22% at West Singhbhum and 17.1% at Sahibganj. Understandably, these villages were in more remote areas yet the population density was significant to feasibly setup DRE Solar grids.

**C. Distribution of Production Capacity Installed District-wise**

Description: In terms of cumulative power generation capacity (Both Minigrid and Standalone Combined), Chatra, West Singhbhum and Gumla seem to be the top three districts with production capacities of 917 KWp, 923 KWp and 910 KWp respectively. Latehar and Saraikela-Kharsawan are both catered completely by standalone systems with capacities of 74.4KWp and 3 KWp respectively.

**D. Percentage of Power Production Allotted District-wise**

Description: In the same context, it is noted that out of the 9 districts consisting of 246 villages with a total production capacity of 3.6 MW capacity, almost 39.3% is allocated to Chatra followed by West Singhbhum and Gumla at 25.6% and 10.7% respectively.

**E. Percentage of Households Catered District-wise**

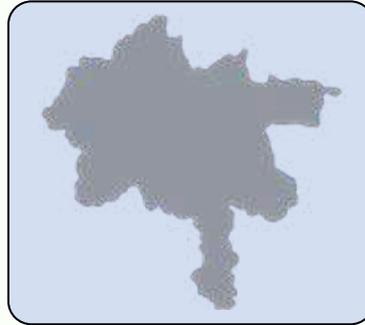
Description: It is also observed that of the 14155 households electrified, 39.4% are in Chatra district, followed by West Singhbhum and Gumla at 25.4% and 10.7% respectively.

**Chatra, West Singhbhum, and Gumla** emerge as districts with substantial benefits, showcasing high power generation capacities and significant household electrification. These three districts, along with **Sahibgunj**, demonstrate a favourable combination of infrastructure allocation, village distribution, and cumulative power generation capacity, making them well-suited for impactful solar rural electrification initiatives.



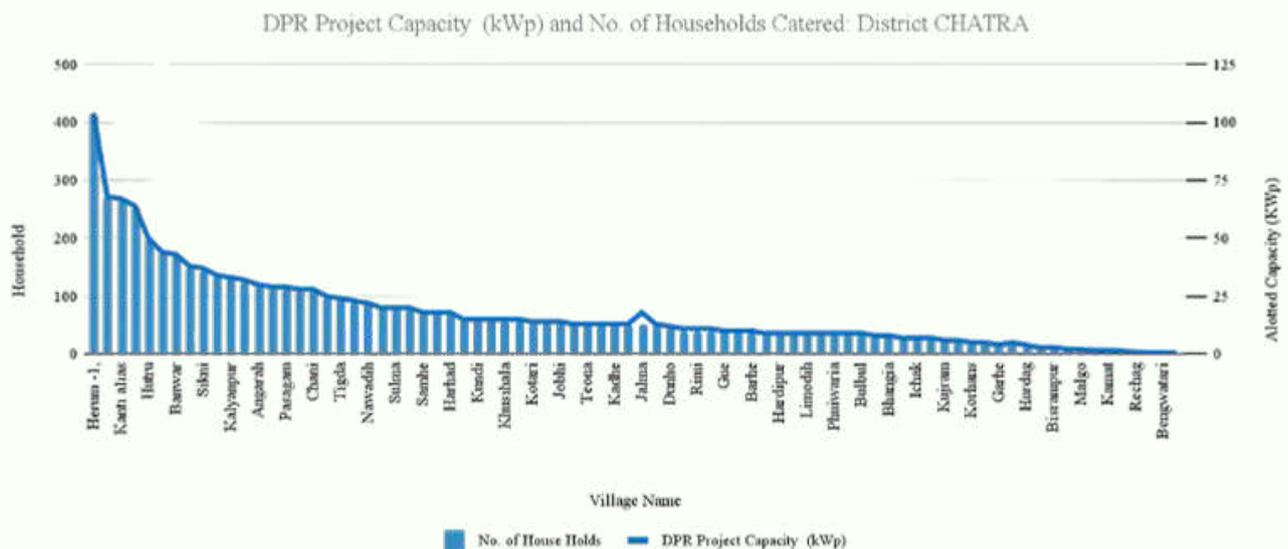
## C.1.2. Village Wise Details of Electrification:

### Chatra :



Chatra, lying on the northern fringes of Jharkhand has an area of 3706 km<sup>2</sup>. Being part of India's 250 most backward districts (NIRD, 2009), Chatra grapples with challenging geographical conditions, featuring hilly terrains and sparsely populated villages with an average population density of 250 per Km<sup>2</sup>. and comprising 1474 revenue villages. Traditional grid expansion faces impracticality due to the scattered settlements and unfavourable topography. Moreover, socio-political dynamics in this tribal-dominated region hinder large-scale grid projects. Solar mini-grids emerge as an optimal solution, offering decentralised electrification catering to remote hamlets. Standalone systems become essential for reliable energy access in isolated pockets, aligning with the unique socio-political landscape.

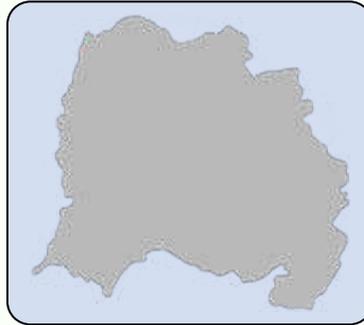
(Source: [chatra.nic.in](http://chatra.nic.in))



**Figure 5: Allotment of Capacity across selected villages of Chatra and the Geographical location of Installation**

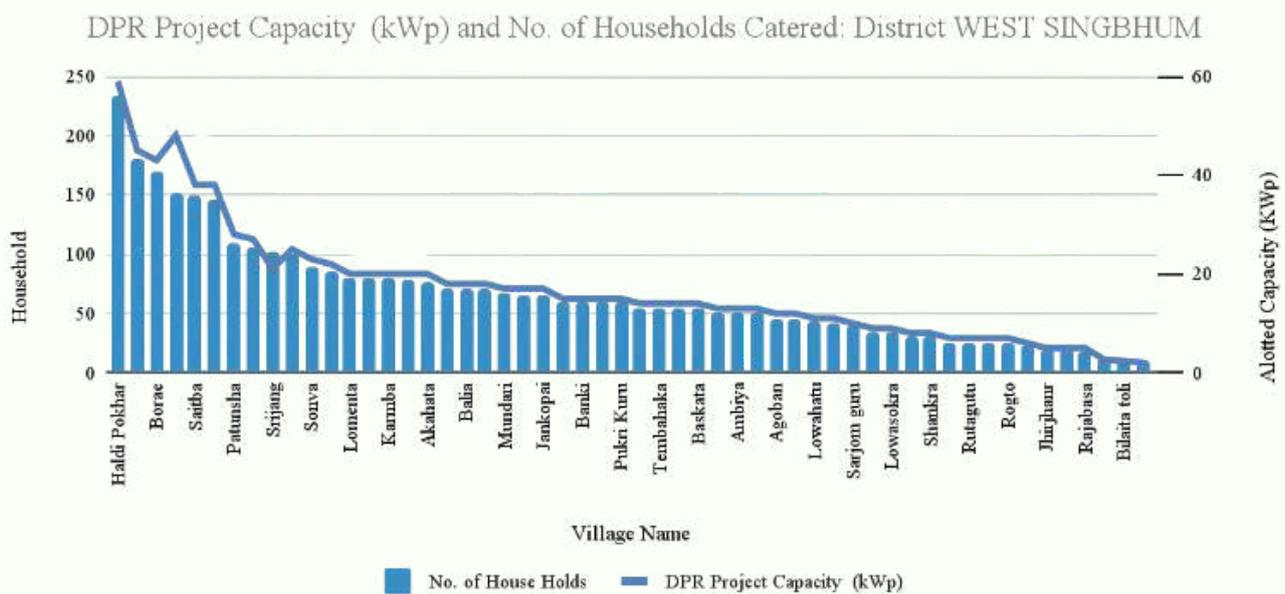
The data from **Figure 5** reveals a varied landscape in village electrification across the district with both high and low household vs allotment counts. Villages like Herum-1 and Herum-2 lead with a total capacity of 104 kWp and 415 households, showcasing efficient utilization. However, villages with lower counts, like Bengwatari with 0.6 kWp and 3 households, present an opportunity for improvement. Additionally, certain regions in Herum could only be catered using standalone systems with allotted capacity of 20.8 kWp. The total allotted capacity stands at 917 kWp for 2289 households, indicating a substantial intervention and impact.

## West Singhbhum :



Marked by dense forests and tribal communities, West Singhbhum, lying to the south of Jharkhand poses environmental and socio-political challenges to conventional grid extension. The varied topography with hills, alternating valleys, steep mountains and deep forests hampers the establishment of an extensive power grid. Additionally, a greater part of the district is rich in iron-ore deposits, limiting development of large communities with nearly 85.4% population living in rural and remote establishments and a mean population density of 210 person per km<sup>2</sup> comprising 1687 revenue villages. In such a context, solar mini-grids emerge as a sustainable alternative, addressing specific socio-political and environmental concerns. Standalone systems are indispensable for ensuring energy equity in remote tribal hamlets where conventional electrification is unfeasible.

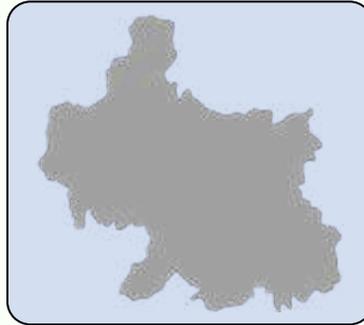
(Source: chaibasa.nic.in)



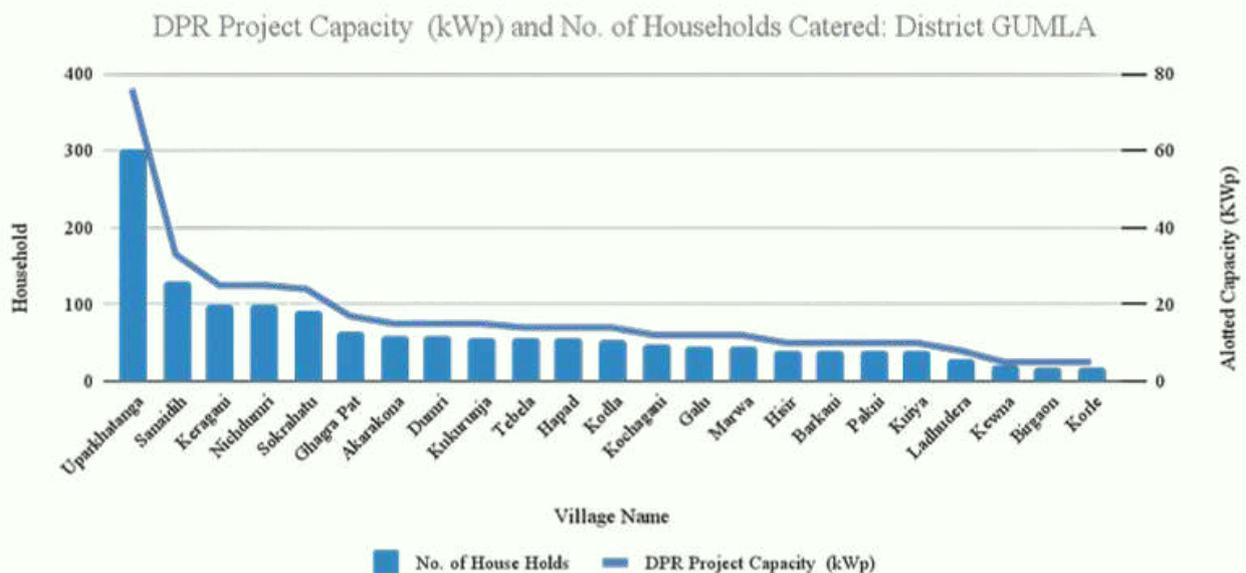
**Figure 6: Allotment of Capacity across selected villages of West Singhbhum and Geographical location of Installation**

The electrification data from **Figure 6** reveals variations in project capacity and household coverage across villages. Haldi Pokhar and Rerda stand out with higher capacities, covering 233 and 180 households, respectively. In contrast, several villages have lower capacities at 12 and 10 households respectively, like Chirkubera and Bilaita Toli. With a total of 923 kWp capacity, the initiative covers 3600 households, indicating a diverse landscape of electrification progress.

## Gumla :



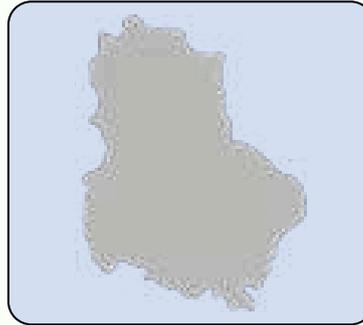
Gumla, lying on the south western fringe of Jharkhand is one of the smaller districts with an area of 5327 km<sup>2</sup> and sparse population density of 193 person per km<sup>2</sup> and a revenue village count of only 952 villages. With its predominantly tribal populace, the district encounters socio-economic challenges that hinder conventional grid expansion. Dispersed settlements and uneven topography create barriers to traditional electrification methods. Solar mini-grids emerge as a crucial solution, providing a decentralized approach to electrification. (Source: gumla.nic.in)



**Figure 7: Allotment of Capacity across selected villages of Gumla and Geographical location of Installation**

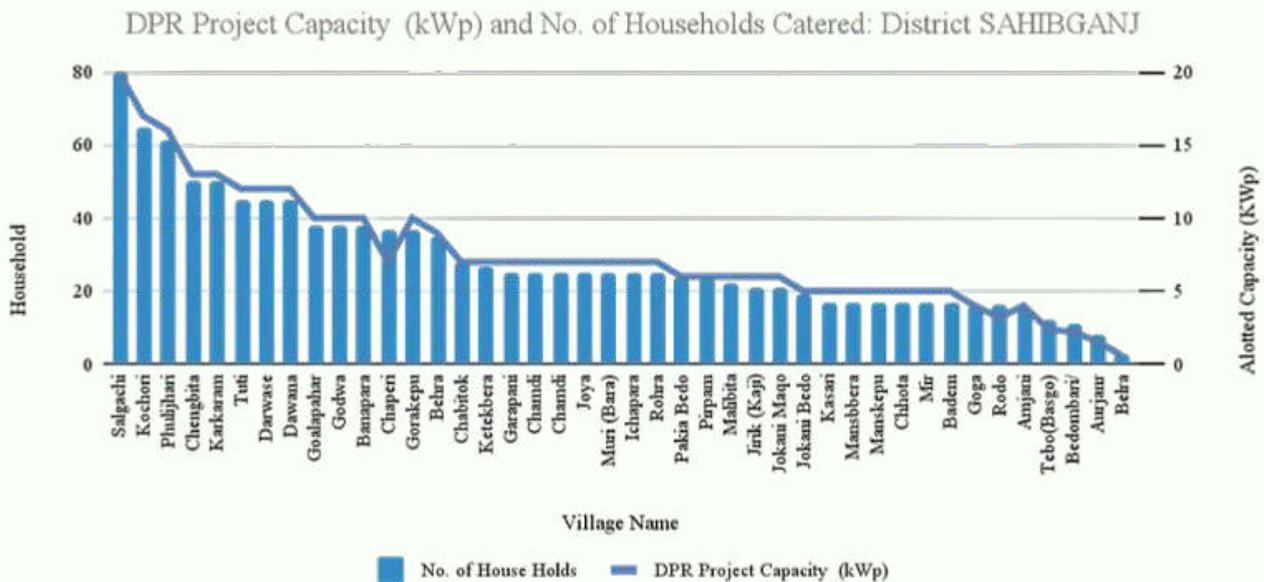
From **Figure 7**, in Gumla, village electrification initiative at Uparkhatanga stands out with a significant capacity of 76 kWp, catering to 301 households. However, smaller villages like Kewna and Birgaon, with lower capacities, serve fewer households (5 kWp for 20 households and 5 kWp for 18 households, respectively). The total capacity allotted across the 41 villages is 910 kWp, electrifying a total of 1834 households.

## Sahibganj:



Sahibganj, situated along the Ganges, covering an area of 1702 Km<sup>2</sup>, faces geographical challenges with riverine as well as hilly terrain with dispersed populations and a population density of 560 person per Km<sup>2</sup>. Nearly 86% of the population is distributed in BPL households in rural and remote areas, Traditional grid expansion is hindered by the complex environmental conditions and demographic distribution. Solar mini-grids become a decentralized solution, adapting to the unique socio-political and geographical context. Standalone systems are essential for riverbank settlements, ensuring energy access where grid connectivity is challenging.

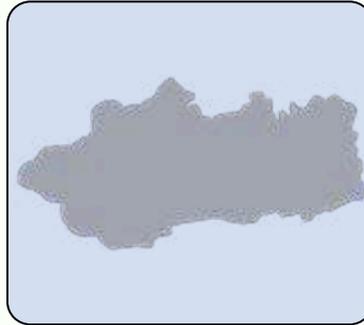
(Source: [sahibganj.nic.in](http://sahibganj.nic.in))



**Figure 8: Allotment of Capacity across selected villages of Sahibgunj and Geographical location of Installation**

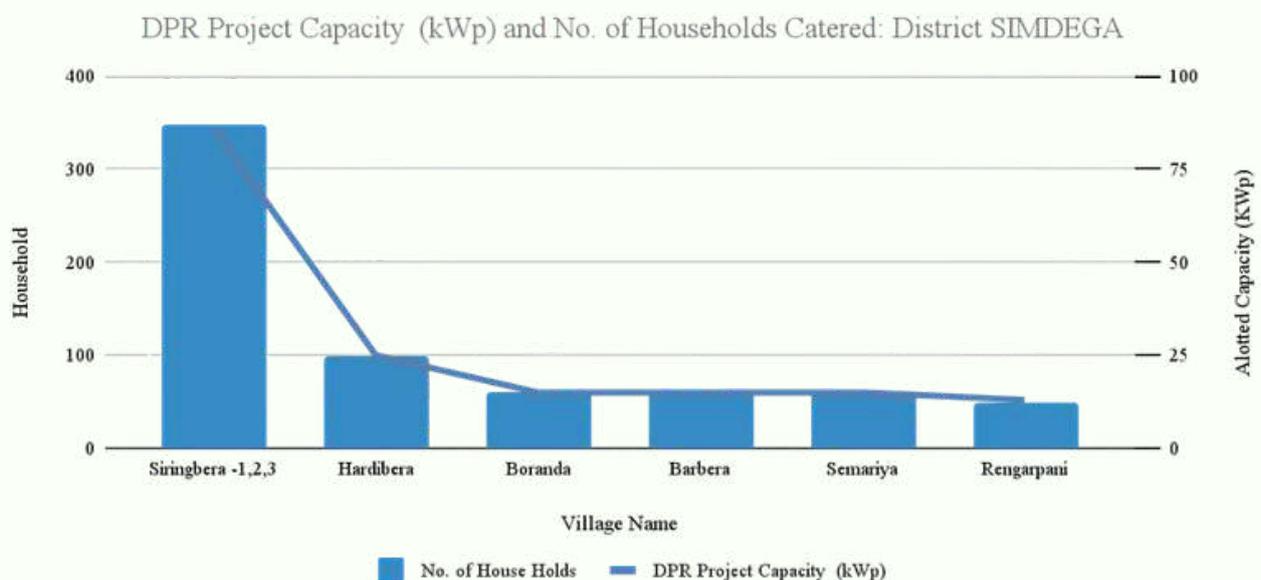
The data from **Figure 8** showcases a varied landscape of village electrification with notable differences in household count and allotted capacity. Villages like Salgachi and Kochori Mago exhibit high household counts of 80 and 65, respectively, indicating a substantial impact on the community. However, Chengbita and Karkaram, with 50 households each, despite similar capacities, may explore avenues for increased allotments to cater to their population. The total capacity allotted stands at 317 kWp across 3051 households.

## Simdega :



Simdega lies on the southern most fringe of Jharkhand and is one of the smaller districts with an area of 3761 km<sup>2</sup> with a highly sparse population density of 160 person per Km<sup>2</sup> and 451 revenue villages. Nearly 70.78% of the population is from backwards Scheduled tribe community residing in complete rural households. Simdega's tribal-dominated landscape and scattered hamlets pose challenges to conventional grid expansion. The socio-political dynamics of the region necessitate a nuanced approach. Solar mini-grids align with the dispersed settlement pattern, providing reliable electrification.

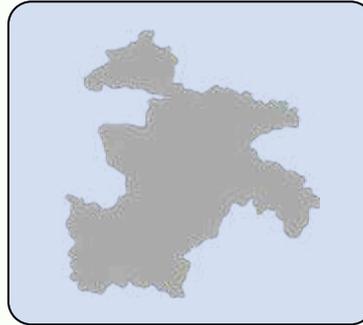
(Source: [simdega.nic.in](http://simdega.nic.in))



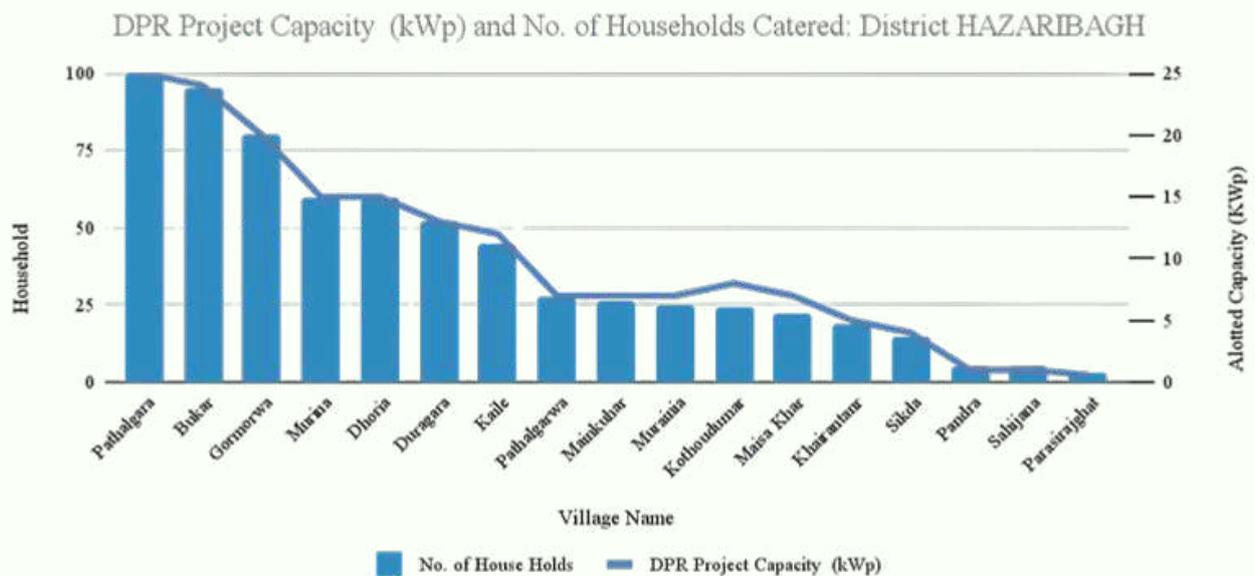
**Figure 9: Allotment of Capacity across selected villages of Simdega and Geographical location of Installation**

The data from **Figure 9** indicates varying degrees of electrification across villages in terms of both project capacity and household coverage. Siringbera-1,2,3 stands out with a high project capacity of 86 kWp serving 347 households, showcasing significant electrification. In contrast, villages like Hardibera, Boranda, Barbera, Semariya, and Rengarpani have comparatively lower capacities and household allocations. The total allotted capacity is 104 kWp for 240 households.

## Hazaribagh :



Hazaribagh is situated in the north part of Jharkhand covering an area of 4313 Km<sup>2</sup> and has 1324 revenue villages. The district has 3 natural divisions based on elevation above sea level with nearly 45% of area demarcated as natural forests. Additionally, the region is popular for coal mines and most residents are dependent on mining for livelihood. Similar to Chatwa, Hazaribagh is part of India's 250 most backward districts (NIRD, 2009). Hazaribagh's diverse topography and dispersed villages, minimize rail and roadway networking hence, limit conventional grid expansion. The socio-political landscape may pose challenges to seamless electrification. Solar mini-grids prove instrumental in providing energy to geographically challenging areas, adapting to the specific socio-political context. Standalone systems cater to households in remote locations, ensuring a comprehensive approach to rural electrification. (Source: <https://hazaribag.nic.in/>)



**Figure 10: Allotment of Capacity across selected villages of Hazaribagh and Geographical location of Installation**

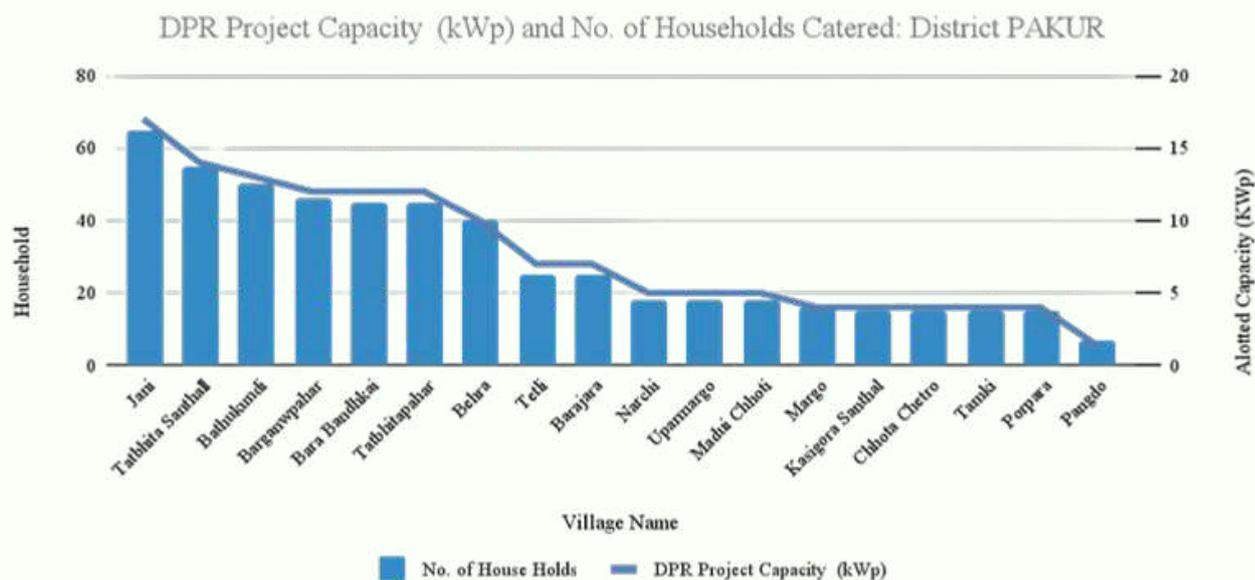
The village electrification data in **Figure 10** showcases a varied allocation of power across different villages in Hazaribagh. Pathalgara and Bukar, with 100 and 95 households respectively, receive substantial allotments of 25 kWp and 24 kWp, indicating a higher capacity for larger communities. In contrast, Parasirajghat, with only 3 households, receives a minimal allotment of 0.6 kWp. The total capacity allotted across all villages is 195 kWp for 460 households.

**Pakur :**



Pakur, is one of the smaller districts of Jharkhand with an area of 1806 Km<sup>2</sup> and sustains 1250 revenue villages. The district has a relatively distributed population with a density of 498 person per Km<sup>2</sup> but nearly 82.5% of these are in rural and remote areas. It is also part of India's 250 most backward districts (NIRD, 2009). With its tribal communities, rocky terrain with black stone quarries and remote villages, the district faces challenges in conventional grid extension and electrification. The socio-political dynamics may influence the viability of large-scale projects. Solar mini-grids become vital in addressing the scattered settlement pattern, considering the socio-political landscape. Standalone systems ensure energy access to isolated households, contributing to the holistic electrification of the district.

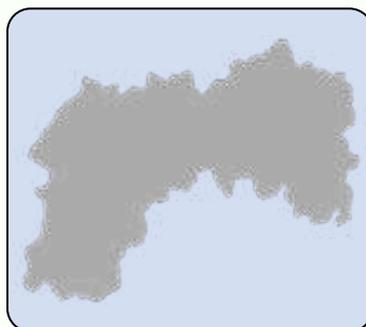
(Source: pakur.nic.in)



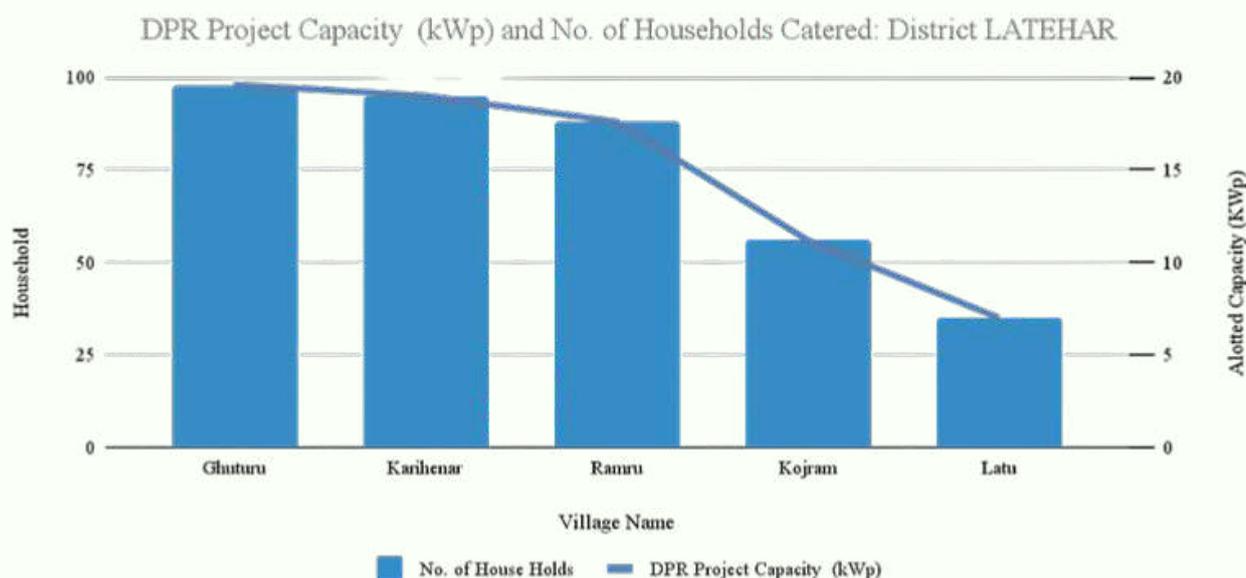
**Figure 11: Allotment of Capacity across selected villages of Pakur and Geographical location of Installation**

The data on village electrification in **Figure 11** reveals variations in the allocation of power capacity across different villages. Jani and Tatbhita Santhall have the highest household counts at 65 and 55, respectively, with 17 kWp and 14 kWp allotted. In contrast, Pangdo has the lowest allotment at 1.4 kWp for 7 households. While villages like Jani showcase efficient allocation, others like Narchi have lower capacity despite a relatively higher household count. The total capacity allotted across all villages is 140.4 kWp for 533 households.

**Latehar :**



Latehar, lying on the western fringe of the state has an area of 3622 Km<sup>2</sup> spread across 773 revenue villages and is also part of India's 250 most backward districts (NIRD, 2009). Nearly 66% of the populace is of SC/ST origin living in remote rural households amidst dense jungles and mountainous areas. Such scarce distribution and challenging topography hinder conventional grid expansion. The socio-political context may influence the acceptance of extensive electrification projects among the tribal communities. Standalone systems become necessary for households in isolated areas, providing a sustainable energy solution. (Source: [latehar.nic.in](http://latehar.nic.in))



**Figure 12: Allotment of Capacity across selected villages of Latehar and Geographical location of Installation**

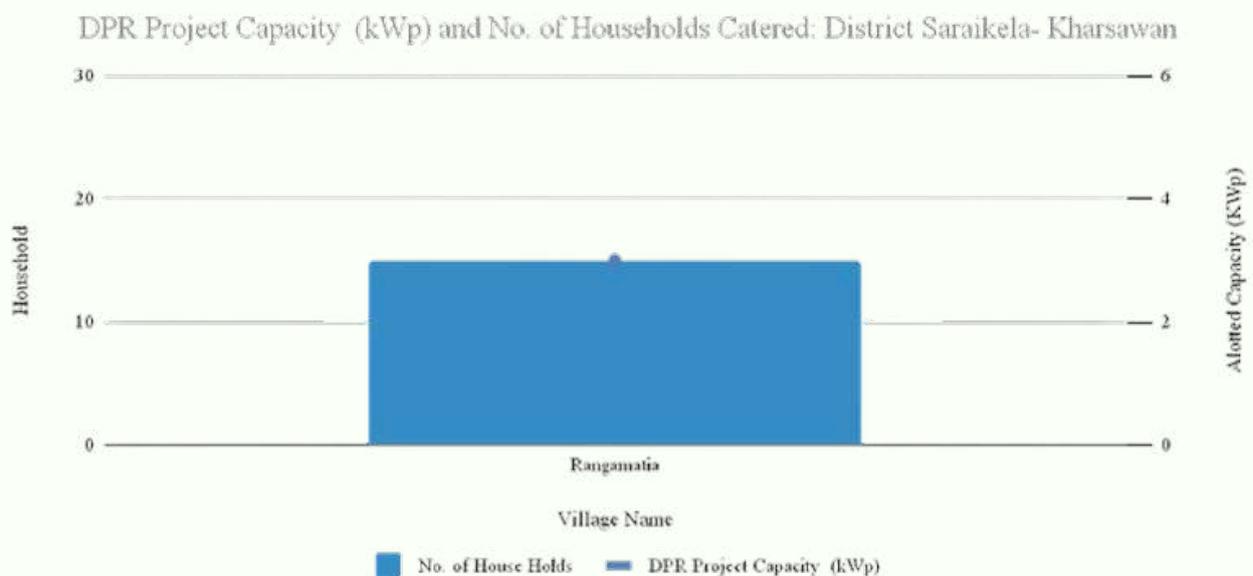
The data from **Figure 12** illustrates the electrification scenario in five villages, emphasizing the varying ratios of power allotment to household counts. Ghuturu and Karihinar, with 98 and 95 households respectively, received higher capacity allotments of 19.6 kWp and 19 kWp. In contrast, Latu, with 35 households, received a lower capacity of 7 kWp. The total allotted capacity is 605 kWp for 1173 households. Standalone systems proved to be the feasible solution owing to the remoteness of the villages.

**Saraikela  
Kharsawan :**



Saraikela Kharsawan, lying on the south easter fringes ia another small district with an area of 2724.5 Km2 encompassing 1148 revenue villages and a moderate population distribution of 400 person per km2. Nearly 75.71 % of the population lives in rural households with a mix of tribal and non-tribal populations. Saraikela Kharsawan faces challenges in conventional grid extension primary due to a mix of forested lands, hillocks and a mesh of serpentine rivers and rivulets. It is also part of India’s 250 most backward districts (NIRD, 2009) and the socio-political landscape may require nuanced planning for electrification projects. Standalone systems seem to be the only feasible solution to cater to households in extremely remote pockets, ensuring an inclusive approach to rural electrification.

(Source: [seraikela.nic.in](http://seraikela.nic.in))



**Figure 13: Allotment of Capacity across selected village of Saraikela Kharsawan and Geographical location of Installation**

Only one village, Rangamatia, could be electrified with an allocated power capacity of 3 kWp for 15 households. This suggests a relatively equitable distribution, providing each household with 0.2 kWp. However, it’s notable that standalone systems were deemed feasible here, indicating a decentralized approach for very small communities in very remote areas. Additionally, this suggests that there is massive scope for DRE in terms of electrification in the district.

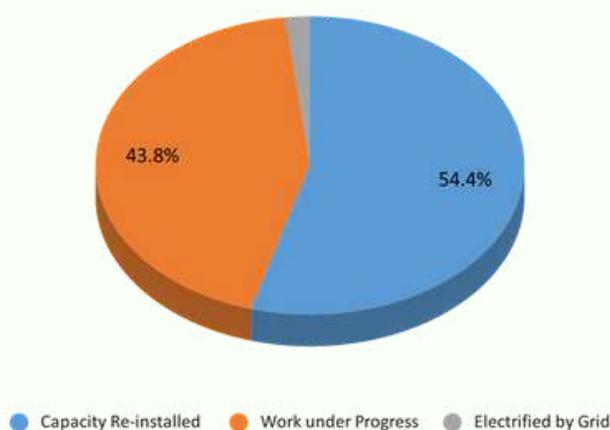
## C.1.2. Current Status of Solar Mini-grids installed under DDUGJY

The solar mini-grids installed under the DDUGJY scheme during FY 2016–17 and 2017–18 were initially covered under a five-year Comprehensive Maintenance Contract (CMC). **Upon the completion of the contractual period, JREDA initiated a retendering process to ensure continued operation**, repair, and maintenance of all installations across the concerned districts. The reinstallation and maintenance work are currently progressing in a phased manner.

**As of 1<sup>st</sup> October 2025, approximately 54% of the total installed capacity—equivalent to about 1.8 MW—has been successfully reinstalled and made operational**, while around 43% of the systems remain under active repair and maintenance. The remaining installations are scheduled for completion within the next operational cycle. Through these reinstated mini-grids, more than 7,280 rural households have already begun to receive reliable solar-powered electricity, improving household energy access and rural productivity.

Notably, two villages—Pathalgara in Chauparan block of Hazaribagh district and Saitba in Goilkera block of West Singhbhum district—have transitioned from solar-based power to conventional grid connectivity.

Status of the Re-installation of the Mini-Grids under DDUGJY Scheme



**Figure 14: Current Status off Solar Mini-Grids installed under DDUGJY Scheme**



## D. Jharkhand Government Rural Electrification Scheme and Role of JREDA:

One of the main goals of the Government of Jharkhand is to make sure that every village in the state has access to electricity. Many of these villages are located in remote and difficult areas where extending the conventional grid is not practical. To overcome this challenge, the government has turned to renewable energy as a more suitable and long-term solution.

In particular, solar energy is being used to power villages that are otherwise beyond the reach of traditional supply lines. **The state government has shown its strong commitment to this effort through the Jharkhand State Solar Policy, 2022. Under this policy, a 100% state grant was proposed in the financial year 2021–22 to support rural electrification projects.**

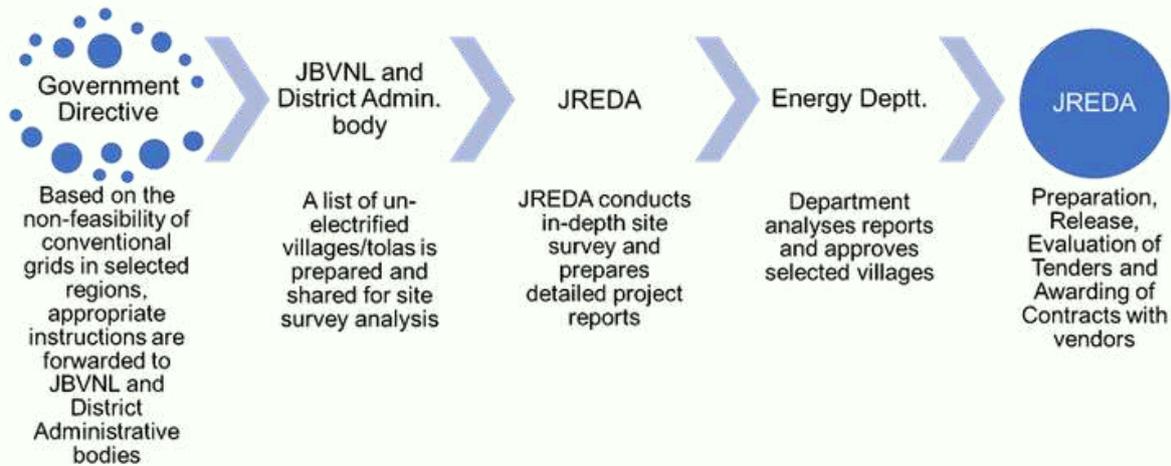
The work of JREDA is aligned with the state's broader vision of providing affordable, reliable, and clean energy to rural and tribal communities. **The plan aims to solarise 1,000 villages** and, at the same time, create new employment opportunities.

To make this possible, JREDA is working with other government departments and village-level committees. These committees help gather information about each village's economy, population, existing power situation, and infrastructure needs. **The policy focuses on setting up mini and micro-grids in villages where electricity supply is still irregular, with a target of 110 MW.** Special priority is also given to essential sectors like healthcare, education, agriculture, and livelihoods. For households with very low demand, standalone solar home systems are being provided. This ensures that even the poorest families have access to clean and dependable energy.

**Till now, JEREDA has reached a fabulous milestone of 371 mini grid villages in the state, while reaching a capacity of 7 MW solar mini grid installation, by which a total number of 15295 households have been benefited till 1st October 2025.**



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**Figure 15: Sequence of steps for selection of new villages and release of tenders, and issuance of fresh contracts**

### D.1. District Wise Details of Electrification:

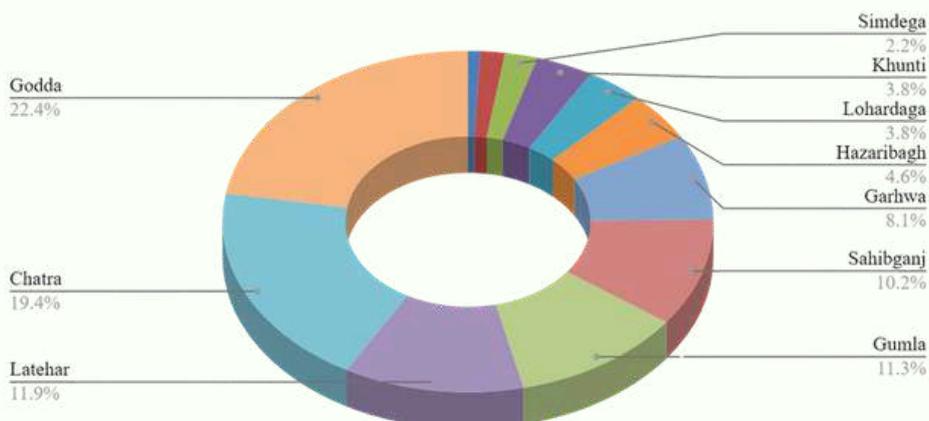
JREDA has been instrumental in implementing the Rural Electrification Programme across 371 villages in districts such as Chatra, Hazaribagh, Sahibganj, Garhwa, Simdega, and others (**Table 3**). Leveraging Solar Mini and Micro Grid systems, JREDA has successfully extended electricity access to remote villages where conventional grid connectivity was either unfeasible or economically non-viable. Following detailed site assessments and issuance of work orders, all mini-grids were installed across the identified villages up to September 2025. These installations collectively account for over 7 MW of solar capacity, benefiting approximately 15,295 rural households with reliable, clean, and sustainable energy access.



**Table 3: Electrification of 371 Remote villages by JREDA under the Jharkhand Govt. Rural Electrification Scheme**

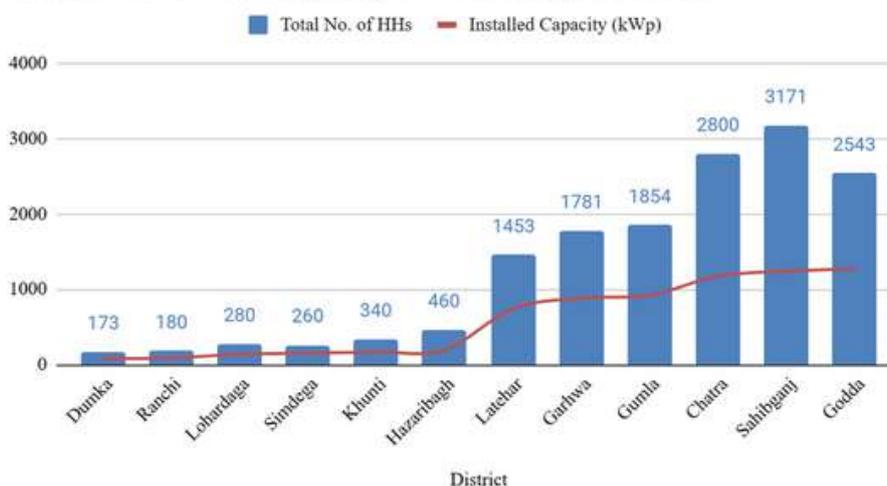
Sr. No.	Administrative Division	District	Total No. of Solar Mini Grid Villages	Total No. of HHs	Installed Capacity (kWp)
1	North Chotanagpur	Chatra	72	2800	1177
2	North Chotanagpur	Hazaribagh	17	460	195
3	Santhal Pargana	Dumka	3	173	85
4	Santhal Pargana	Sahibganj	38	3171	1240.5
5	Santhal Pargana	Godda	83	2543	1270
6	Palamu	Gumla	42	1854	920
7	Palamu	Latehar	44	1453	745
8	Palamu	Garhwa	30	1781	884
9	South Chotanagpur	Khunti	14	340	170
10	South Chotanagpur	Lohardaga	14	280	140
11	South Chotanagpur	Ranchi	6	180	90
12	South Chotanagpur	Simdega	8	260	154
<b>Grand Total</b>			<b>371</b>	<b>15295</b>	<b>7070.5</b>

Percentage of Villages Electrified (Districtwise)



**Figure 16: District-wise Percentage of Villages Electrified under Jharkhand Government Rural Electrification Scheme**

Districtwise Allotted Capacity & Beneficiary Household



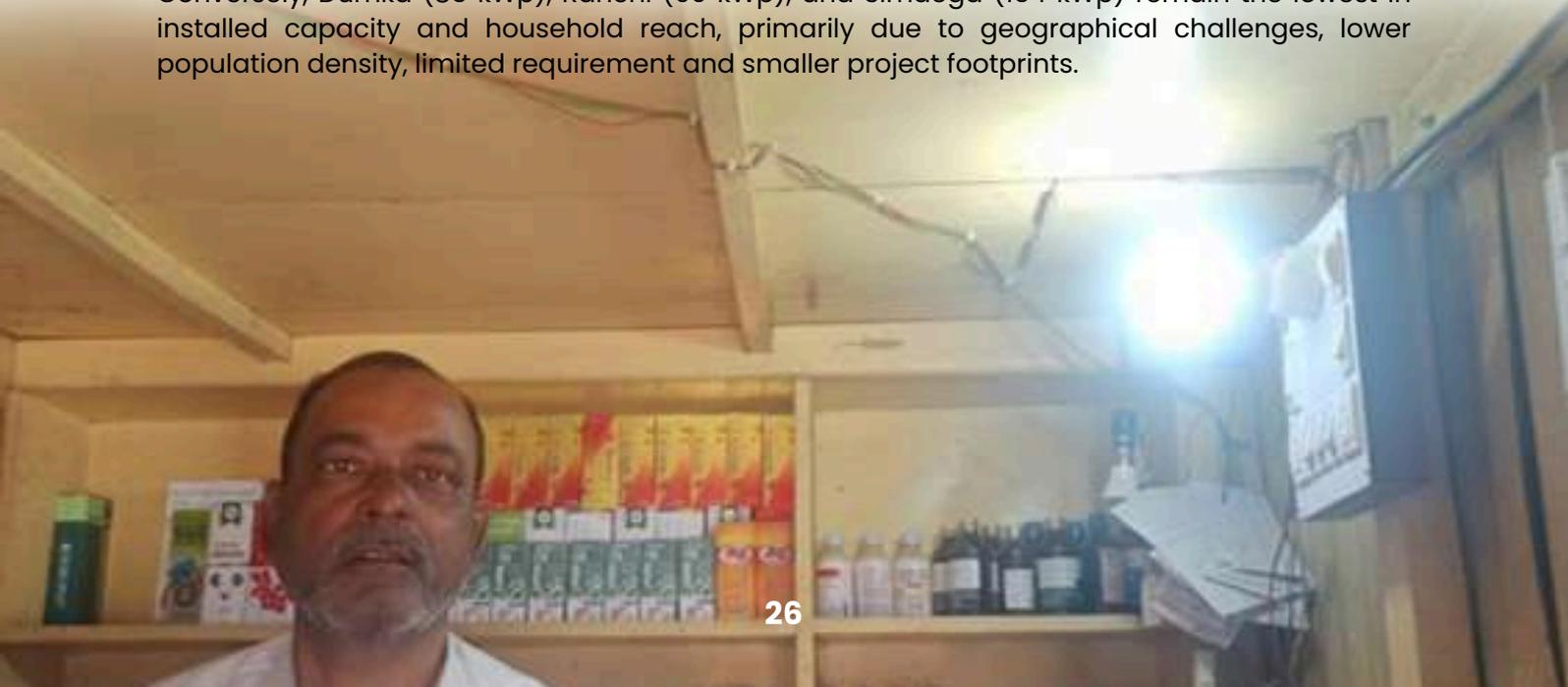
**Figure 17: District-wise capacity and benefitted households under Jharkhand Government Rural Electrification Scheme**

In Jharkhand, the spatial distribution of solar mini-grids under the Rural Electrification Programme demonstrates a clear regional concentration across specific districts. **Godda** continues to lead in village-level electrification, accounting for **83 villages**, representing the highest district coverage. This is followed by **Chatra (72 villages)**, **Latehar (44 villages)**, and **Gumla (42 villages)**, indicating a strong focus on the Santhal Pargana and central plateau regions.

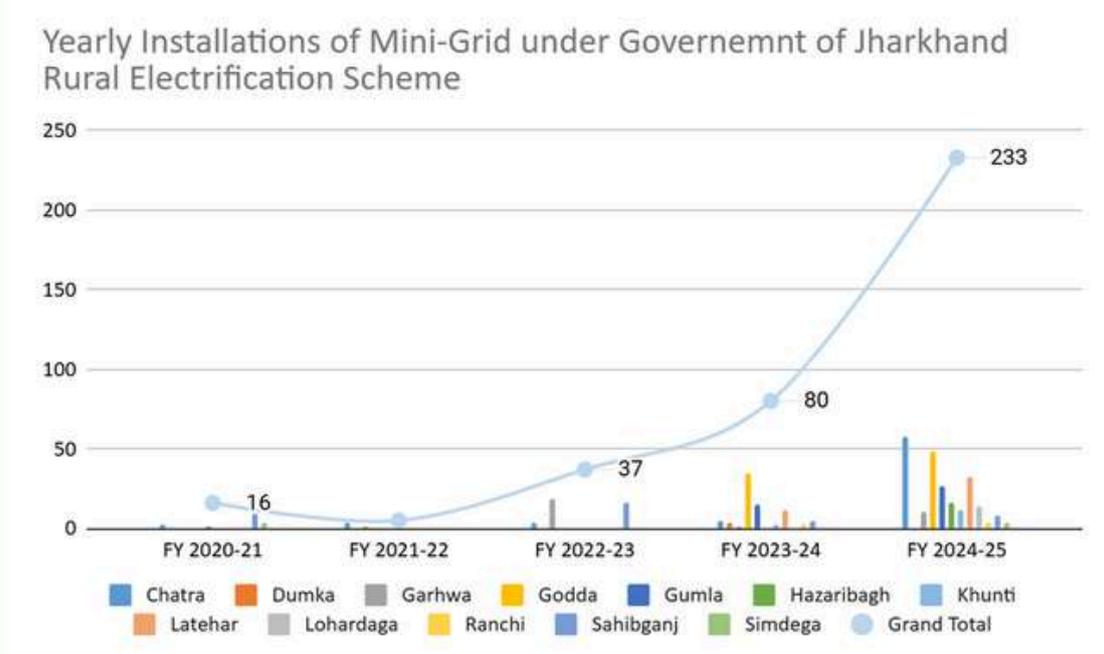
In terms of **household beneficiaries**, **Sahibganj** stands out with 3,171 households electrified – the highest among all districts – reflecting the state’s focus on dense rural habitations. Garhwa (1,781 households) and Godda (2,543 households) also show significant impact, followed closely by Chatra (2,800 households), suggesting wide household coverage across central and eastern Jharkhand.

When evaluated by **installed capacity**, **Godda** again ranks highest with 1,270 kWp, followed by Sahibganj (1,240.5 kWp) and Chatra (1,177 kWp), establishing these districts as the core hubs of Jharkhand’s solar energy infrastructure. Garhwa (884 kWp) and Gumla (920 kWp) further reinforce the state’s mid-tier performance zones.

Conversely, Dumka (85 kWp), Ranchi (90 kWp), and Simdega (154 kWp) remain the lowest in installed capacity and household reach, primarily due to geographical challenges, lower population density, limited requirement and smaller project footprints.



Under the Jharkhand Government Rural Electrification Scheme, the state has made significant progress in recent years. From Figure 18, it is evident that a major leap was recorded between 2023 and 2024, when JREDA accelerated the installation of solar mini-grids, marking a sharp rise in implementation. The momentum has continued into 2025, with ongoing installations further expanding rural electrification coverage. Within this expansion, Godda and Chatra emerged as the most prominent districts, reflecting focused efforts and substantial impact in these regions.



**Figure 18: Yearly Trend of Solar Mini-Grid Installation under Government of Jharkhand Rural Electrification Scheme**

The deployment of solar mini-grids under the Government of Jharkhand illustrates the state’s commitment to decentralized renewable energy for rural electrification. Among the districts, **Godda, Sahibganj, Chatra, Gumla, and Latehar emerge as key contributors**, together accounting for the majority of electrified villages, households, and installed capacity. Each district reflects implementation patterns shaped by geographic conditions, population distribution, and local development priorities.

Godda stands out as the frontrunner in installed capacity and village coverage. With 83 villages electrified, 2,543 households connected, and a total installed capacity of 1,270 kWp, it leads the state in capacity deployment. The districts of Sundarpahari and Boarijore feature prominently, indicating a strategic focus on blocks with limited grid penetration and dispersed rural settlements. Godda’s progress highlights the potential of solar mini-grids to provide stable energy access in areas where conventional grid extension is challenging.



**Sahibganj** records 38 villages electrified, 3,171 households connected, and 1,240.5 kWp of installed capacity, ranking first in household coverage statewide. Concentrated across Barhet, Pathna, Taljhari, and Udhwa blocks, the deployment emphasizes electrification in dense rural clusters, facilitating immediate socio-economic benefits for larger communities. Sahibganj's model demonstrates how targeted investment in solar infrastructure can rapidly increase household connectivity.

**Chatra** continues to be a strong performer with 72 villages, 2,800 households, and 1,177 kWp installed capacity. Spread across Lawalong, Simaria, Huntergunj, and Kunda blocks, the district exemplifies steady, geographically diverse implementation, balancing the dual objectives of capacity installation and household outreach. Chatra's approach reflects an emphasis on consistent, scalable expansion across multiple blocks rather than concentrated investments in a few areas.

**Gumla** reflects a balanced growth trajectory with 42 villages, 1,854 households, and 920 kWp of installed capacity. Implementation across Chainpur, Bishunpur, Dumri, and Palkot blocks illustrates how solar mini-grids can strengthen last-mile connectivity in hilly, forested terrains, where conventional grid infrastructure is less feasible. Gumla's progress highlights the role of decentralized energy solutions in enhancing access for geographically and socially marginalized populations.

**Latehar**, with 44 villages, 1,453 households, and 745 kWp installed capacity, demonstrates steady but crucial expansion in forest-covered and socio-economically fragile areas. Blocks such as Barwadih, Garu, and Mahuadanr are the focus of deployment, indicating efforts to integrate renewable energy access with livelihood improvement and local development objectives.

Collectively, these **five districts serve as the backbone of Jharkhand's rural electrification program through solar minigrids**. They showcase diverse approaches—from targeting dense rural clusters to addressing hard-to-reach areas—while contributing the bulk of installed capacity and household connections across the state. Their experience underscores the critical role of decentralized renewable energy in achieving energy access, supporting local development, and strengthening the state's overall energy infrastructure.







## E. Impact Assessment from DRE Solar Minigrids

Solar mini-grids have a profound impact on various aspects of a community, and their effects can be categorized into four fundamental categories: Environment, Social, Economic, and Governance. In terms of the environment, solar mini-grids reduce carbon emissions by replacing conventional fossil fuels with clean solar energy, contributing to a significant reduction in air pollution and greenhouse gas emissions. Socially, these mini-grids enhance the quality of life by providing reliable electricity, thus improving access to education, healthcare, and communication. On the economic front, solar mini-grids promote local employment and stimulate economic development, as well as reduce energy costs for households and businesses. These impact indicators collectively underscore the critical role of solar mini-grids in fostering sustainability, prosperity, and social well-being.

### 1. Electrification and Energy Access: Transforming Lives

The electrification of 304 villages in Jharkhand marks a pivotal stride towards transforming the lives of rural communities. The endeavor holds multifaceted implications, extending beyond mere access to electricity. The key variables determining the success and feasibility of such electrification initiatives revolve around technological reliability, community engagement, and sustainable energy solutions.

#### Key Variables:

- **Technological Reliability:** The success of electrification initiatives hinges on the reliability of the chosen technology, with solar minigrids and standalone systems emerging as sustainable solutions. Dependable technologies ensure consistent power supply, fostering trust among the communities.
- **Community Engagement:** Actively involving the community in the planning and implementation phases is critical. Understanding local needs, preferences, and challenges ensures that the electrification approach aligns with the unique characteristics of each village, enhancing acceptance and sustainability.
- **Sustainable Energy Solutions:** Embracing renewable energy sources, such as solar power, not only addresses energy access but also contributes to environmental sustainability. The use of clean energy minimizes carbon footprints, aligning with global efforts toward greener practices.



## Impacts and Relief:

- **Enhanced Quality of Life:** Access to electricity uplifts the overall quality of life in rural areas. Improved lighting extends productive hours, positively impacting daily activities, ranging from household chores to economic endeavors.
- **Health and Safety:** Reliable electricity mitigates health risks associated with traditional lighting sources like kerosene lamps. Well-lit homes contribute to a safer living environment, reducing the likelihood of accidents and health issues caused by indoor air pollution.
- **Educational Opportunities:** Adequate lighting enables extended study hours, creating opportunities for educational advancement. Students can now pursue academic goals beyond daylight hours, fostering a conducive learning environment.
- **Economic Empowerment:** The electrification initiative becomes a catalyst for economic empowerment. Entrepreneurs and small businesses benefit from increased working hours, higher productivity, and the ability to diversify economic activities, ultimately contributing to local economic development.

## 2. Health and Education Facilities:

The electrification of remote villages in Jharkhand has ushered in a transformative era for health and education facilities. Access to electricity has far-reaching implications for the well-being and educational development of these communities.



## Key Variables:

- **Lighting in Healthcare:** Well-lit facilities enhance medical services, enabling emergency care and surgeries, contributing to improved healthcare.
- **Extended Study Hours:** Electricity extends study hours, creating a conducive learning environment and positively affecting academic performance.
- **Technology Integration:** Electricity facilitates the integration of technology, enhancing healthcare and education with advanced tools.

## Success Metrics:

- **Community Engagement:** Actively involving communities in planning ensures that electrification aligns with healthcare and education needs.
- **Reliability:** A reliable supply is essential. Backup solutions like energy storage or generators prevent disruptions to critical services.
- **Training:** Capacity building for healthcare and education professionals ensures efficient use of electrical equipment.

## Community Impact:

- **Enhanced Healthcare:** Reliable electricity supports medical equipment, refrigeration, and emergency services, improving overall community health.
- **Educational Empowerment:** Extended study hours and technology access empower students and educators, fostering a brighter future.
- **Community Well-Being:** Improved facilities contribute to overall well-being, fostering economic growth and community development.

## 3. Income Generation and Economic Development:

The electrification of rural villages in Jharkhand, particularly through the implementation of solar minigrids, has ushered in a new era of economic development and income generation for local communities. This transformative change is marked by several key implications and considerations:



**Entrepreneurship Opportunities:**

- Local Businesses: With the availability of electricity, small businesses, like local grocery stores and enterprises, experience extended working hours. This enables entrepreneurs to cater to the needs of the community beyond traditional daylight hours, resulting in increased revenue.

**Productivity Enhancements:**

- Agricultural Activities: The electrification initiative benefits the agriculture sector by providing electricity for essential equipment such as threshers, oil pressing machines, and flour mills. This aids in enhancing productivity and streamlining agricultural processes, contributing to economic growth.

**Community Empowerment:**

- Livelihood Diversification: Access to electricity encourages diversification of livelihoods. Communities can explore new income-generating activities that leverage electrical appliances, fostering economic diversity and resilience.

**4. Environmental Benefits:**

The adoption of solar minigrids and standalone systems for rural electrification in Jharkhand not only addresses energy poverty but also brings forth substantial environmental benefits, aligning with sustainable and eco-friendly practices.

- **Implications:**

**Reduced Carbon Footprint:** Solar energy, being a clean and renewable source, contributes to a significant reduction in carbon emissions. Unlike conventional energy sources like diesel generators, solar power generation does not release harmful pollutants into the atmosphere, mitigating the impact on climate change.

**Mitigation of Environmental Degradation:** Dependence on traditional energy sources often leads to environmental degradation, such as deforestation for fuel. Solar electrification mitigates this by eliminating the need for extensive natural resource exploitation, preserving biodiversity and ecosystem integrity.

- **Key Variables Determining Success and Feasibility:**

**Solar Resource Potential:** The success of solar electrification projects is intricately tied to the region's solar resource potential. Jharkhand's geographic location, with ample sunlight, enhances the feasibility of solar-based initiatives.

**Technology Efficiency:** The efficiency of solar technologies, including the performance of minigrids and standalone systems, plays a crucial role. Advancements in solar technology contribute to increased energy yield, making projects more efficient and sustainable.

**Community Engagement:** The involvement and acceptance of local communities are pivotal. Awareness programs, training, and community participation ensure the success of projects, fostering a sense of ownership and responsibility.

- **Community Help and Relief:**

**Improved Air Quality:** Reduction in the use of traditional fuels like kerosene and diesel leads to improved air quality. The absence of indoor air pollution from kerosene lamps positively impacts the respiratory health of community members.

Enhanced Livelihood Opportunities: The provision of electricity through solar means fosters the growth of small-scale businesses. Entrepreneurs can utilize electrical appliances for income-generating activities, leading to improved economic conditions within the community.

Considering the above, the development and change in basic parameters for daily livelihood across the 10 districts was evaluated. Access to electricity, education, banking and finance services and overall economic upliftment were considered. Comparative analysis has been done between 2015-16 data and 2019-21 data to consider pre and post installation of solar grid scenarios. The Multidimensional Poverty Index has been charted across the two periods on the same scale to visualize how the 10 districts have developed. It is only natural that electricity being a fundamental necessity for other developments has been given weightage for relevant dataset calculations.

## E.1. Methodology

The methodology adopted to evaluate the impact of solar electrification in Jharkhand integrates a diverse array of variables and indicators derived from the Primary Data Set of the National Family Health Survey (NFHS) administered during the intervals of 2015-16(4th round) and 2019-21(5th round).

### Data Collection

The NFHS data has been downloaded from DHS website for the previously mentioned time periods.

### Data Analysis

The data has been extracted and the indicators and variables have been analysed in the spss formula. For analysis all data has been transformed into India specific weighted values. To calculate the indices, estimates have been computed using the data from the 4th & 5th rounds of the National Family Health Survey For other basic analyses excel has been used

### Indicators

To assess the Impact Various Indicators have been taken into account

### Household Electrification Status:

From household section Electricity variable was analysed.

### Education Levels:

It has been analysed using HV106 variable from the Household datasets section . This variable refers to the Highest level of education the household member attended. This is a standardized variable providing level of education in the following categories: No education, Primary, Secondary, and Higher. Any member below the lower age limit for the education questions is classified in the "No Education" category

### Access to banking facilities:

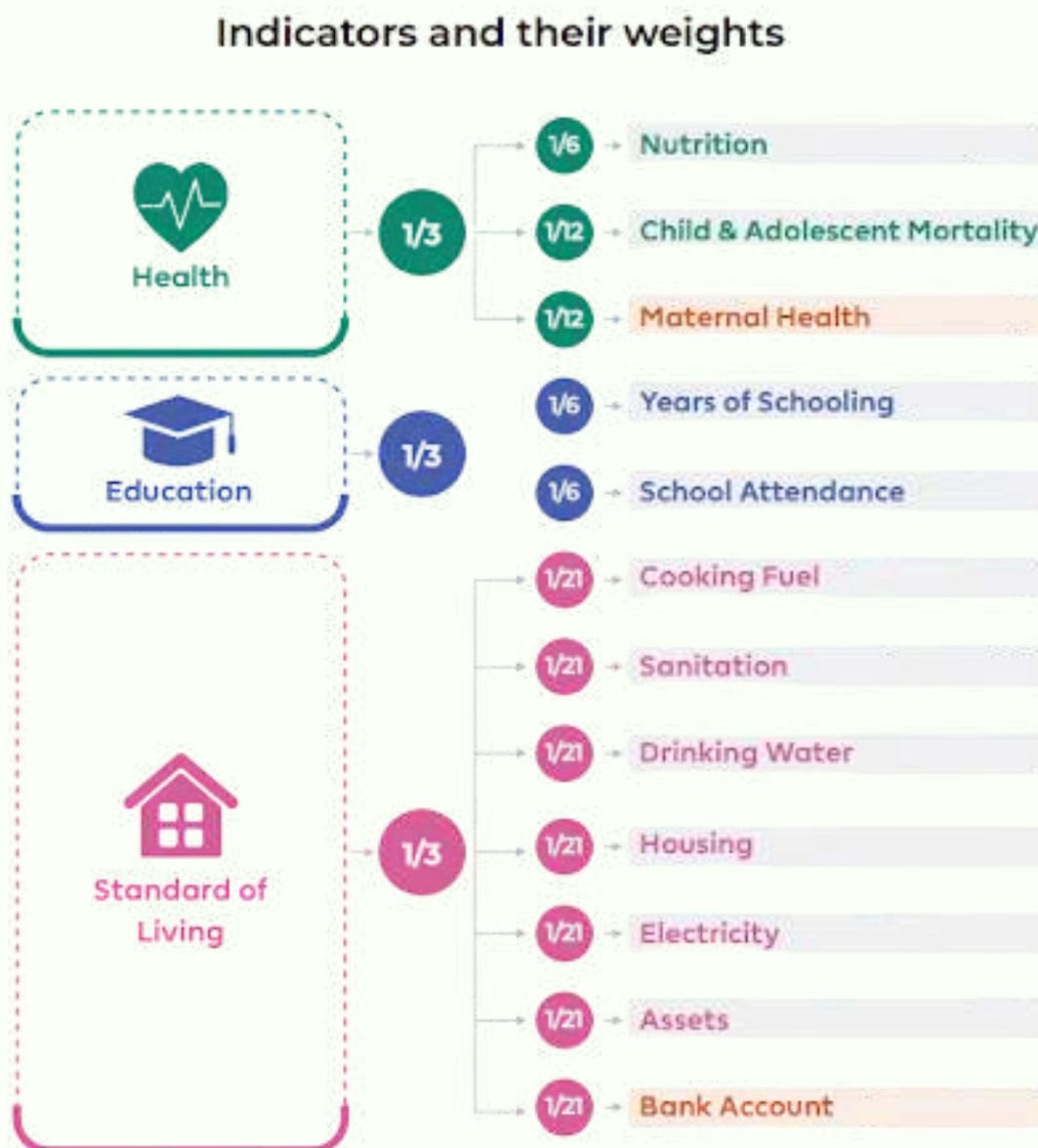
Variable HV247 in the household section of the NFHS dataset reveals whether any member of the household possesses a bank account. This metric is pivotal in understanding financial inclusion levels, disparities, and the factors influencing bank account ownership among surveyed households. It is very important because it provides data on households' access to banking, essential for accessing government subsidies and social benefit schemes, aligning with the government's focus on direct cash transfers to beneficiaries. Additionally, it is crucial to analyze in the present scenario when digital banking is rapidly expanding across the country, serving as a driving force in extending financial services to remote areas.

## Economic MPI

The global Multidimensional Poverty Index (MPI) is an international measure of acute multidimensional poverty covering over 100 developing countries. It complements traditional monetary poverty measures by capturing the acute deprivations in health, education, and living standards that a person faces simultaneously.

The Global Multidimensional Poverty Index (MPI), based on the Alkire-Foster (AF) methodology, captures overlapping deprivations in health, education, and living standards. It complements income poverty measurements because it measures and compares deprivations directly. The global MPI Report is jointly published by the Oxford Poverty and Human Development Initiative (OPHI) and the United Nations Development Programme (UNDP).

Like the global MPI, India's national MPI has three equally weighted dimensions – Health, Education, and Standard of living – which are represented by 12 indicators. These are depicted by the following graphic:



**Figure 19: Dimensions considered for MDPI calculations**

Sub Indices for National Level

The indices of the national MPI comprise:

**i) Headcount ratio (H):**

The Headcount ratio in MPI represents the proportion of multidimensionally poor individuals within the total population. It's calculated by dividing the number of multidimensionally poor persons by the entire population, offering a snapshot of poverty prevalence.

**ii) Intensity of poverty (A):**

The intensity of poverty in the Multidimensional Poverty Index (MPI) refers to the severity or depth of deprivation experienced by those identified as multidimensionally poor. It measures how far below the poverty line individuals or households are within the identified deprived dimensions. This metric provides insight into the extent of multiple deprivations experienced by the poor, offering a nuanced understanding beyond simple counts of the poor population.

MPI value is arrived at by multiplying the headcount ratio (H) and the intensity of poverty (A), reflecting both the share of people in poverty and the degree to which they are deprived.

$$\text{MPI} = \text{H} \times \text{A}$$



## E.2. Results:

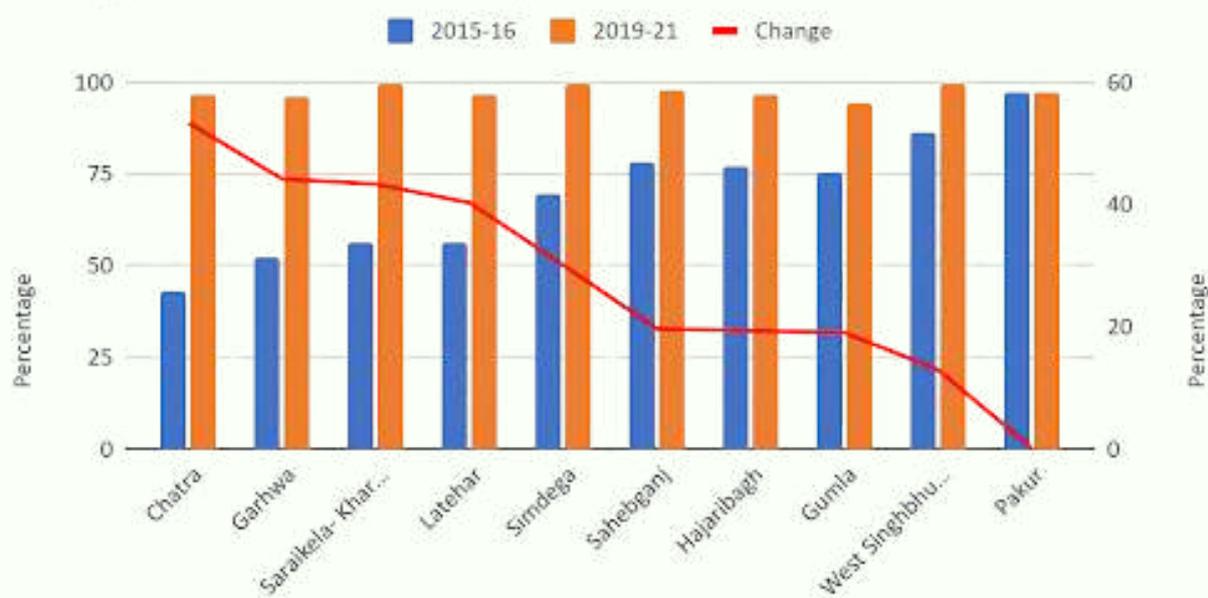
### 1. Access To Electricity:

**Figure 20** reflects a substantial improvement in access to electricity across districts in Jharkhand from 2015-16 to 2019-21. Notably, Chatra witnessed the most significant positive change, with a remarkable 53% increase, reaching 97%. Garhwa, Saraikela-Kharsawan, and Latehar also experienced substantial improvements, registering changes of 44%, 43%, and 40%, respectively.

Simdega, Sahebganj, Hajaribagh, Gumla, and West Singhbhum displayed commendable progress, achieving a range of improvements from 13% to 30%. Pakur, although maintaining a consistent 97% throughout, reflects an already high level of electrification in 2015-16.

The data clearly underscores the success of electrification initiatives, indicating the success of government policies and implementation strategies in enhancing the lives of the residents in these districts.

Change in Access to Electricity between 2016-2021



**Figure 20: Change in Access to Electricity across the 10 districts between 2016-2021**

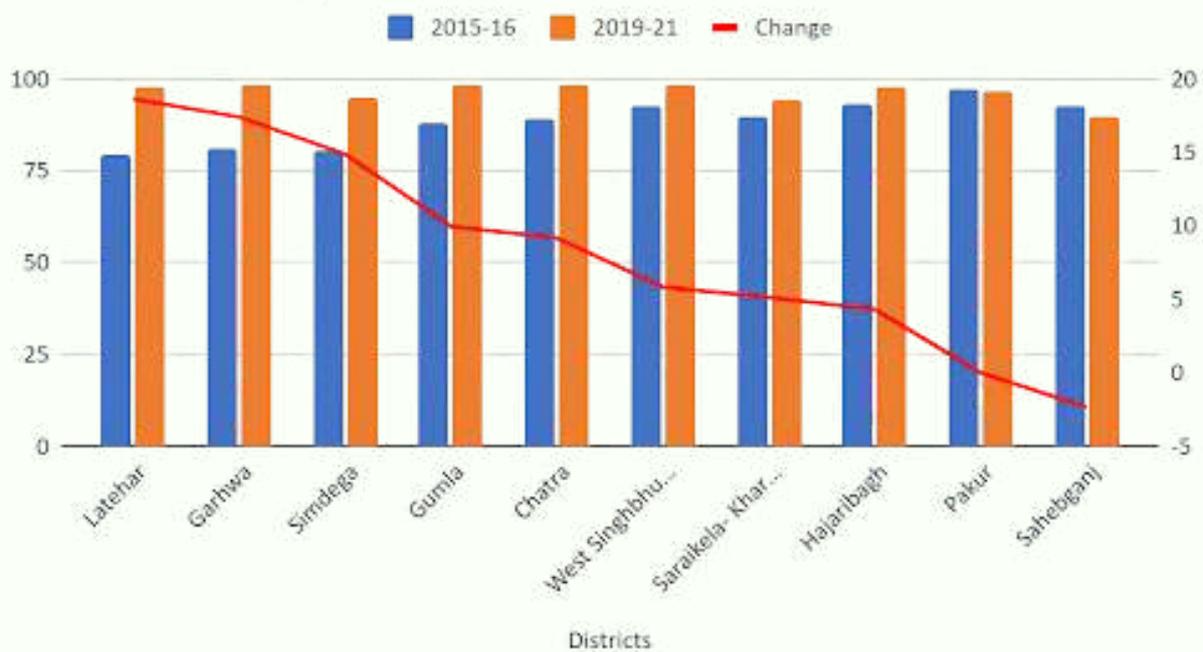


## 2. Access to Banking and Finance Services:

Figure 21 reveals a positive trend in access to banking facilities across various districts in Jharkhand between 2015-16 and 2019-21. Notably, Latehar experienced a substantial increase of 19%, while Garhwa and Simdega saw commendable growth of 17% and 15%, respectively. Gumla, Chatra, and Saraikela-Kharsawan exhibited moderate improvements, with positive changes of 10%, 9%, and 5%, respectively. West Singhbhum demonstrated a more modest increase of 6%, while Hazaribagh showed a 4% positive change. Pakur maintained the status quo with a 0% change, and Sahebganj experienced a slight decline of -2%. Despite variations, the overall upward trajectory in banking access underscores the positive impact of electrification initiatives.

Latehar emerges as a success story with a significant 19% positive change, emphasizing the tangible benefits of electrification. While districts like Garhwa and Simdega also demonstrate substantial growth, even districts with more modest changes, such as West Singhbhum and Hazaribagh, indicate positive strides. The data clearly underscores the success of electrification initiatives, enhancing the lives of the residents in these districts.

Access to Banking Services 2016-2021



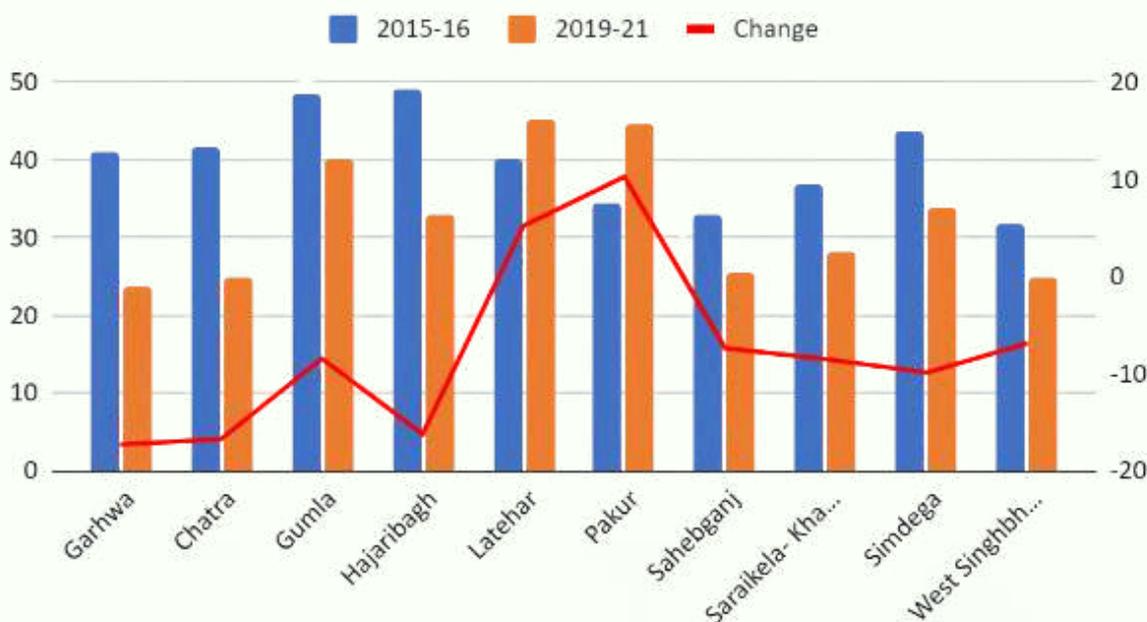
**Figure 21: Change in Access to Banking Services across the 10 districts between 2016-2021**

### 3. Access to Education:

**Figure 22** provides a nuanced view of the impact of electrification on access to education facilities across various districts in Jharkhand between 2015-16 and 2019-21. Garhwa and Chatra stand out with a substantial positive change of -17% each, showcasing a notable improvement in reducing the percentage of individuals with no education. Hajaribagh also exhibits a commendable -16% change, indicating a significant shift towards improved education access. Gumla and Saraikela-Kharsawan depict a positive change of -8% and -9%, respectively, contributing to enhanced educational opportunities.

In contrast, districts like Latehar and Pakur experienced a slight increase in the percentage of individuals with no education, with changes of 5% and 10%, respectively. Sahebganj, Simdega, and West Singhbhum demonstrated more modest changes of -7%, -10%, and -7%, respectively. Despite variations, the overall trend suggests a positive impact of electrification initiatives on reducing the percentage of individuals with no education.

Education Attainment (% Total Population): No Education



**Figure 22: Education attainment: No Education across the 10 districts between 2016-2021**



Figure 23 reflects a significant positive transformation in access to primary education across various districts in Jharkhand between 2015-16 and 2019-21, showcasing the positive impact of electrification initiatives. Garhwa stands out with an impressive increase of 24%, while Chatra, Gumla, and Pakur follow closely with noteworthy improvements of 21%, 20%, and 20%, respectively. Hajaribagh, Latehar, Sahebganj, Simdega, and Saraikela-Kharsawan demonstrate commendable growth ranging from 17% to 19%. West Singhbhum exhibits a respectable 17% increase. These substantial positive changes underscore the crucial role of electrification in fostering access to primary education, reflecting government initiatives and strategies.

The varied yet uniformly positive changes in districts like Garhwa, Chatra, and Gumla emphasize the multifaceted benefits of electrification on education access.

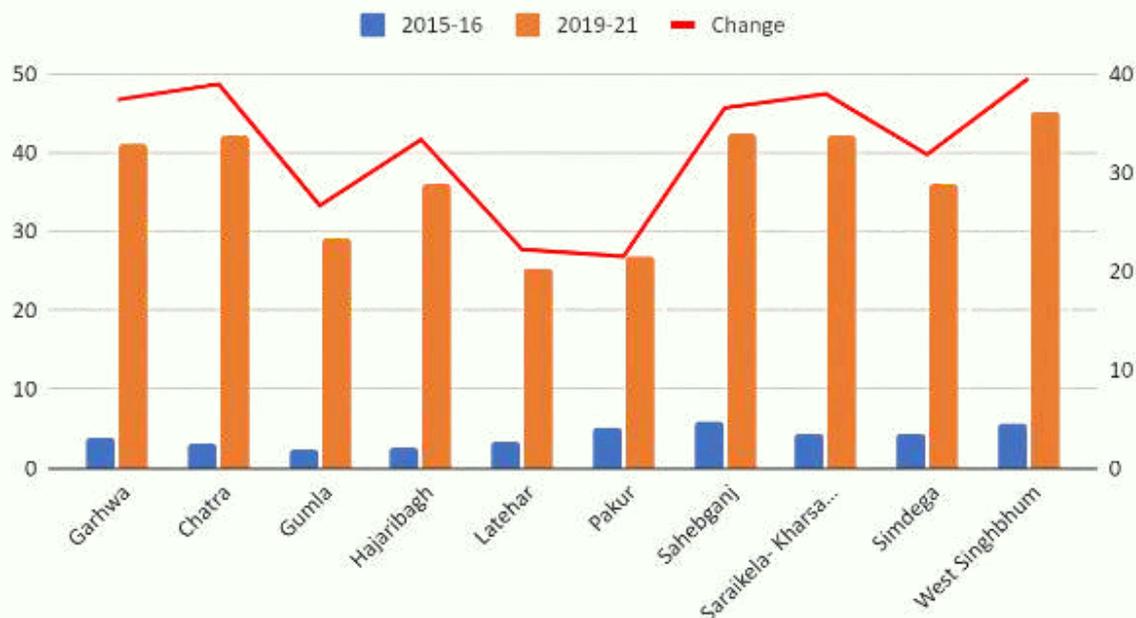
### Education Attainment (%Total Population): Primary Education



**Figure 23: Education attainment : Primary Education across the 10 districts between 2016-2021**

**Figure 24** reflects a remarkable positive transformation in access to secondary education facilities across various districts in Jharkhand between 2015-16 and 2019-21 due to electrification initiatives. Notably, Chatra experienced an outstanding growth of 39%, followed closely by Sahebganj and West Singhbhum, both witnessing substantial improvements of 37% and 40%, respectively. Saraikela-Kharsawan and Garhwa also demonstrated commendable progress, with a positive change of 38% and 37%, showcasing the beneficial impact of electrification on educational opportunities. Gumla, Simdega, and Hazaribagh exhibited moderate growth, with positive changes of 27%, 32%, and 33%, respectively. Even districts with more modest changes, such as Latehar and Pakur, indicated significant positive strides, with 22% and 21% improvements, respectively. The overall surge in secondary education access highlights the pivotal role of electrification in fostering educational development.

### Education Attainment (% Total Population): Secondary Education



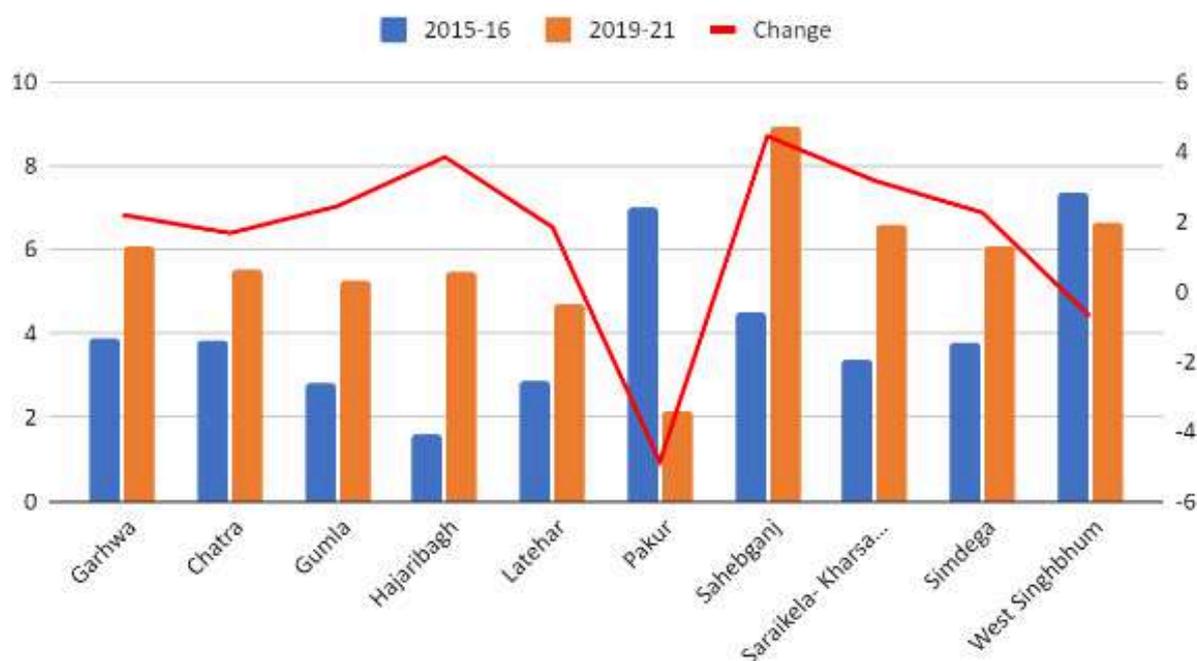
**Figure 24: Education attainment: Secondary Education across the 10 districts between 2016–2021**

**Figure 25** reflects significant strides in access to higher education facilities across various districts in Jharkhand between 2015–16 and 2019–21. Notably, Hazaribagh emerges as a success story, exhibiting an impressive increase from 2% to 5%, indicating a positive change of 3%. Sahebganj experienced substantial growth, with access to higher education facilities escalating from 4% to 9%, marking a notable positive change of 5%. Similarly, Saraikeela-Kharsawan demonstrated commendable progress, with a positive change of 4%, reaching from 3% to 7%.

While certain districts maintained a steady trajectory, such as Garhwa, Chatra, Gumla, Latehar, and Simdega, each showing a consistent increase of 2%, there were deviations in other areas. Pakur witnessed a decline, experiencing a negative change of -5%, as access to higher education facilities dropped from 7% to 2%. In contrast, West Singhbhum saw a slight reduction from 7% to 6%, resulting in a marginal negative change of -1%. The nuanced data portrays the multifaceted impact of electrification initiatives on educational accessibility, emphasizing the intricate relationship between electricity and educational development.



## Education Attainment (%Total Population): Higher Education



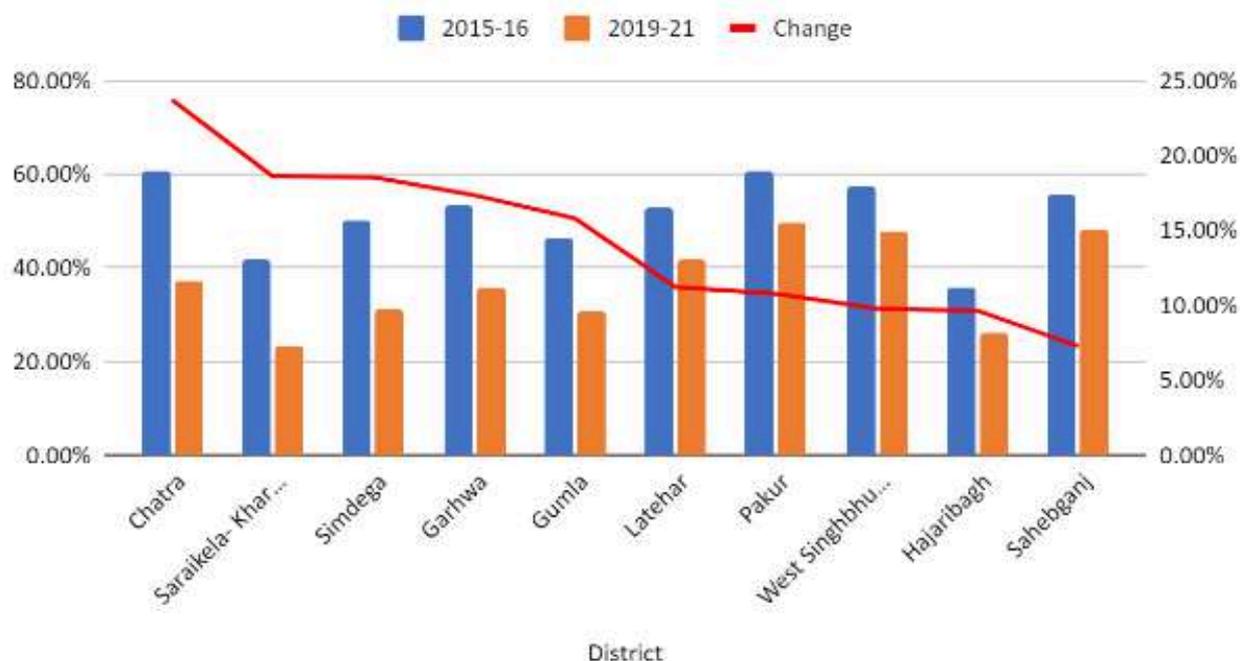
**Figure 25: Education attainment: Higher Education across the 10 districts between 2016–2021**

The comprehensive assessment unveils the positive transformations in the education sector due to electrification initiatives. The nuanced data underscores the direct correlation between electrification initiatives and enhanced access to education. These positive changes signify the success of government policies and implementation strategies, affirming the transformative impact on residents' lives in these districts. The data unequivocally supports the notion that electrification serves as a catalyst for educational development, contributing to a brighter and more empowered future for the communities involved.

#### 4. Economic growth; Poverty and alleviation of living standards:

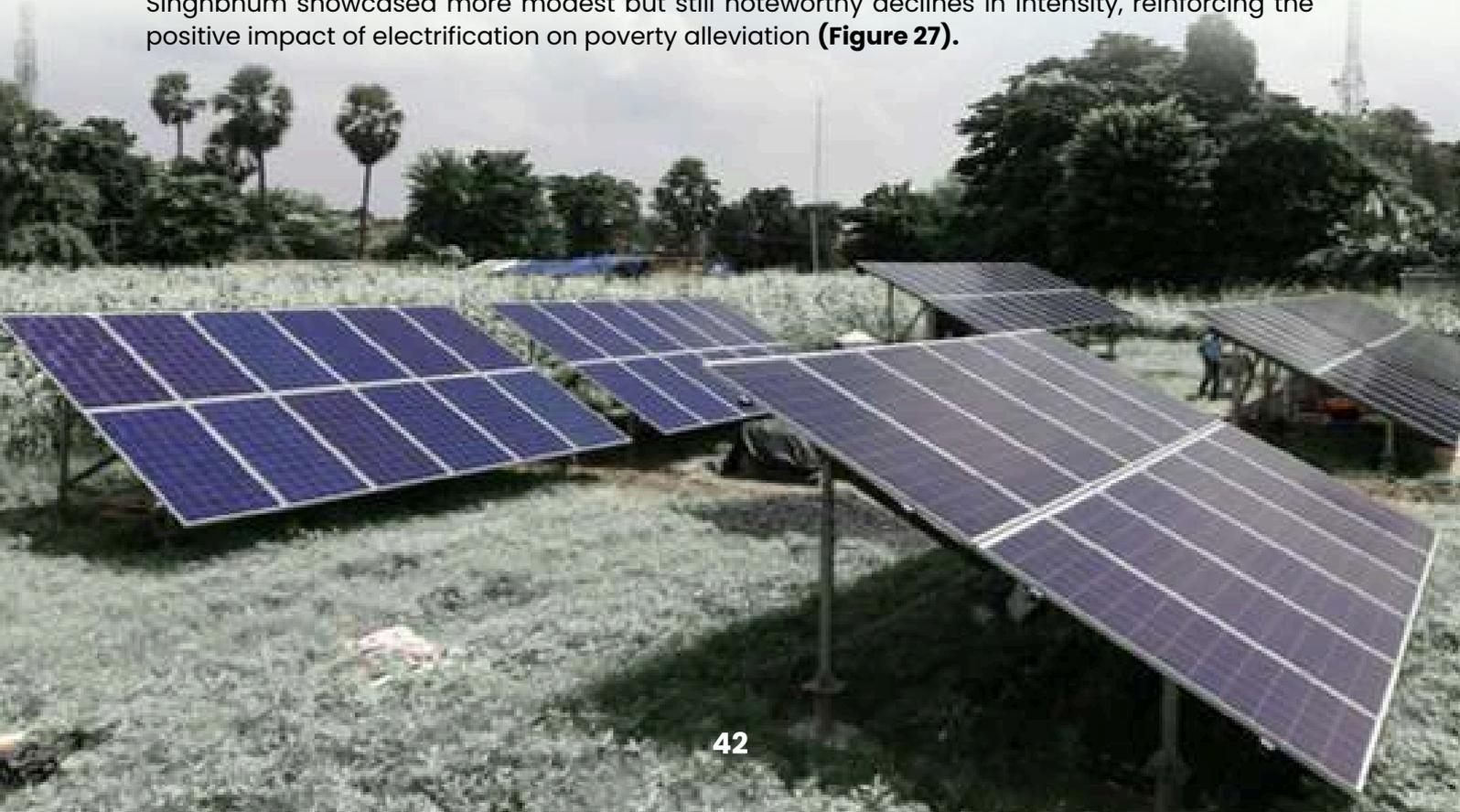
**Headcount Ratio (H):** The headcount ratio data reveals a significant reduction in poverty levels across various districts in Jharkhand, highlighting the positive impact of electrification initiatives between 2015–16 and 2019–21. Chatra stands out with an impressive decline of 23.74%, followed closely by Saraikela-Kharsawan, Simdega, and Garhwa, showcasing substantial improvements of 18.63%, 18.57%, and 17.37%, respectively. Gumla, Latehar, and Pakur exhibit commendable progress, witnessing reductions in headcount ratios by 15.83%, 11.23%, and 10.79%, respectively. West Singhbhum, Hajaribagh, and Sahebganj demonstrate positive changes of 9.79%, 9.65%, and 7.27%, respectively. The data underscores a consistent pattern of poverty alleviation, indicating the positive correlation between electrification initiatives and improved socio-economic conditions. **(Figure 26).**

### Headcount Ratio 2016-2021

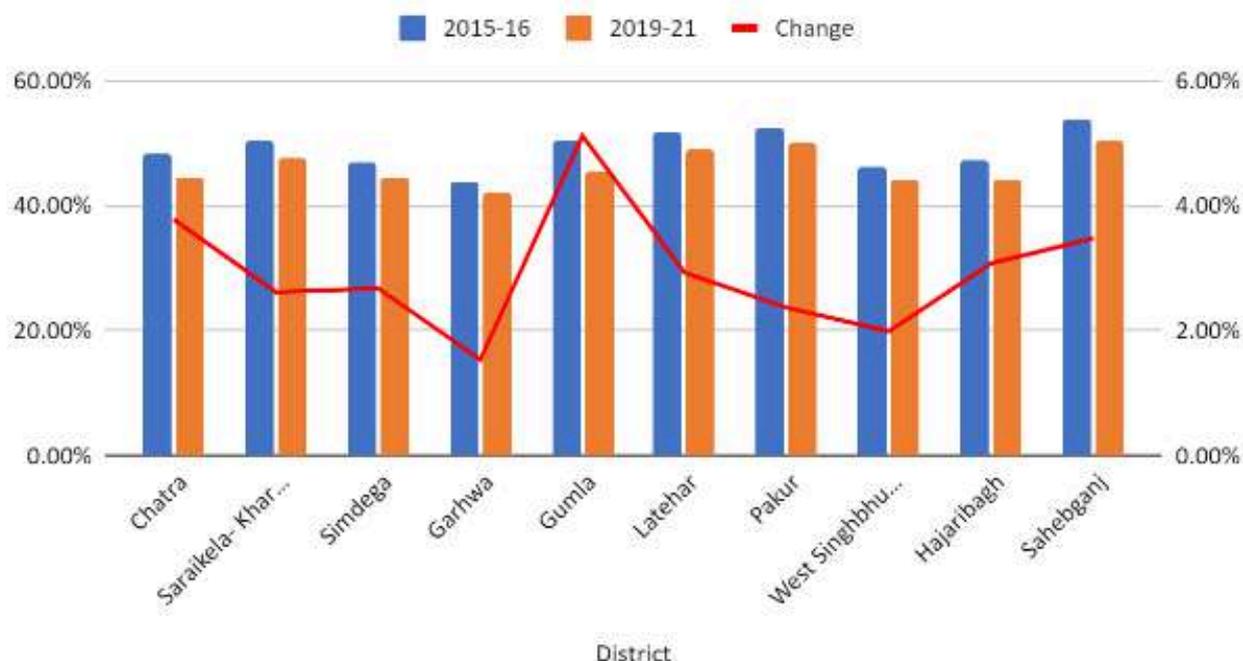


**Figure 26: Headcount ratio as a measure of % People affected by Poverty across the 10 districts between 2016–2021**

**Intensity (A):** The analysis of intensity data reveals a consistent and substantial reduction in poverty levels across various districts in Jharkhand between 2015–16 and 2019–21, directly associated with electrification initiatives. Gumla stands out with the most significant improvement, showing a substantial 5.12% decrease in poverty intensity, followed closely by Chatra and Sahebganj, both experiencing notable reductions of 3.78% and 3.48%, respectively. Saraikela–Kharasawan, Latehar, and Hajaribagh also demonstrated meaningful decreases, with reductions of 2.62%, 2.93%, and 3.08%, respectively. Simdega, Garhwa, Pakur, and West Singhbhum showcased more modest but still noteworthy declines in intensity, reinforcing the positive impact of electrification on poverty alleviation (**Figure 27**).



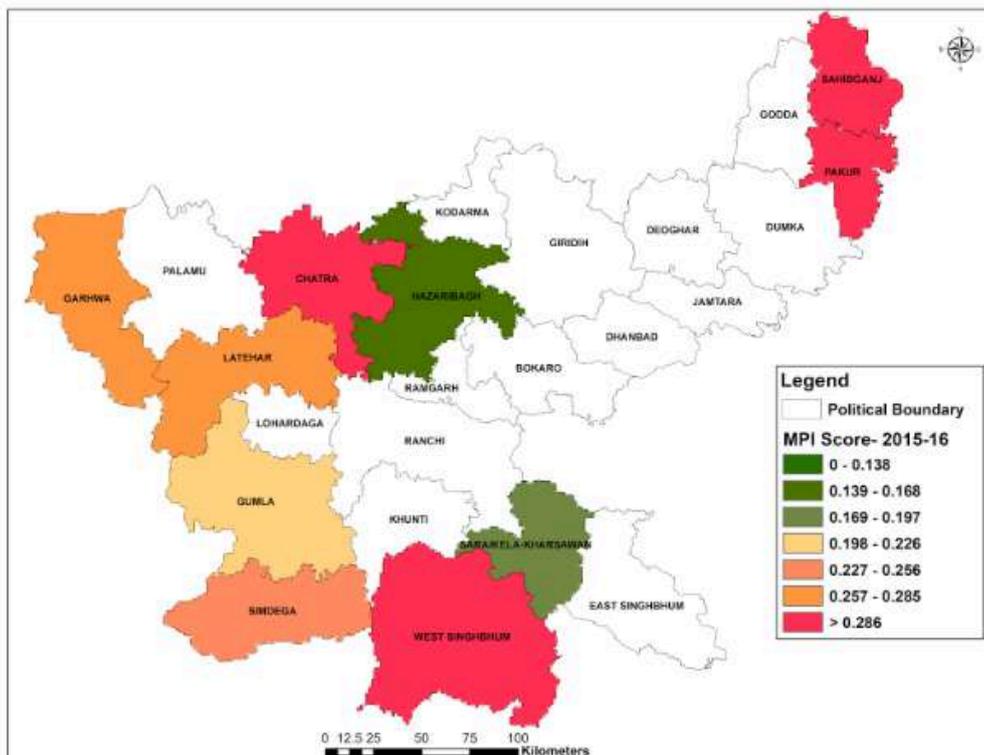
### Intensity 2016-2021



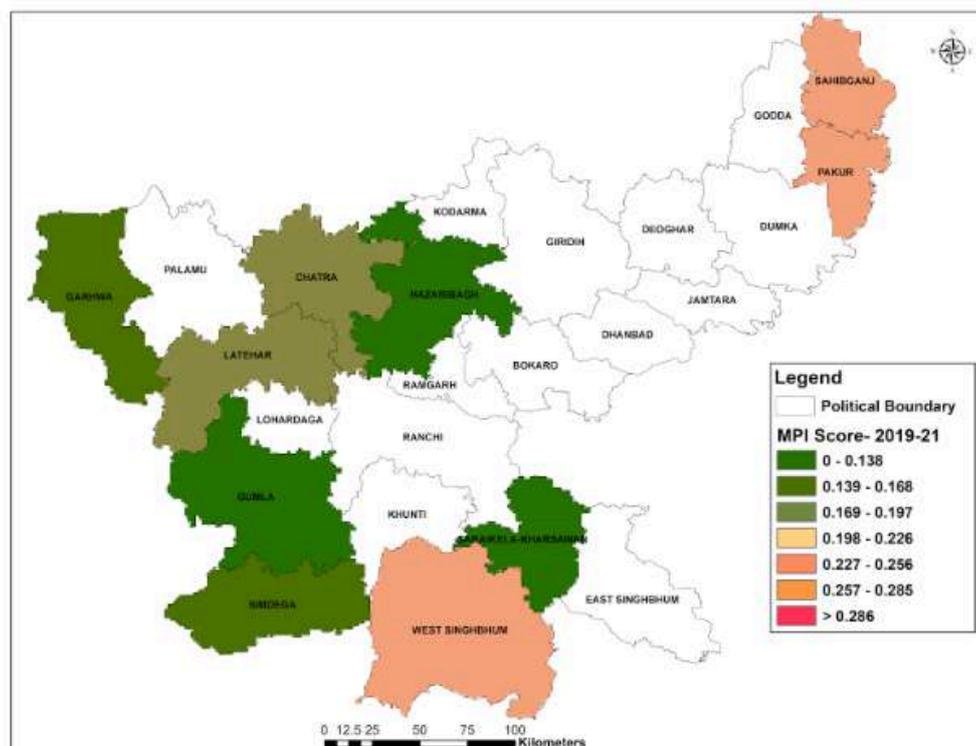
**Figure 27: Intensity of Poverty across the 10 districts between 2016-2021**

- MPI:** The Multi-Dimensional Poverty Index (MPI) from **Figure 28(A,B)** presents a compelling narrative of positive change in the overall well-being of districts in Jharkhand between 2015-16 and 2019-21, attributed to electrification initiatives. The substantial reduction in MPI values across districts signifies a notable improvement in residents' access to healthcare, education, and household assets. Chatra experienced a significant positive change of 0.097, followed by Saraikela-Kharsawan, Sahebganj, and West Singhbhum, displaying noteworthy improvements of 0.129, 0.069, and 0.091, respectively. Simdega, Latehar, and Hajaribagh also demonstrated positive changes of 0.083, 0.071, and 0.097, contributing to a more favorable socio-economic landscape. The data underscores a considerable reduction in multidimensional poverty, pointing towards the success of electrification initiatives in fostering holistic development.





**Figure 28(A): Multi-Dimensional Poverty Index of 10 Districts in assessment year 2015-16**



**Figure 28(B): Multi-Dimensional Poverty Index of 10 Districts in assessment year 2019-21**

## Environmental Impact:

- **Reduction in GHG by Lighting:**

Estimating an average of 5 hours use for a kerosene lantern and 2 lanterns per household, the minimum kerosene consumption is 3 Litre/month per lantern i.e for a cumulative 19470 households across 10 districts, electrified using minigrids, the cumulative fossil fuel consumption per year comes to nearly 8411 KLitre of Kerosene per year. That is equivalent to 52,569 barrels of kerosene.

Assuming a conservative 2.5kg CO<sub>2</sub> emission per litre of kerosene, 19470 households would be contributing nearly 21KTonne of CO<sub>2</sub> every year.

Thus by ensuring electrification for just lighting purpose only, GHG emission of nearly 21KT is prevented. Additionally indoor air pollutants, i.e CO, NO<sub>2</sub> and SO<sub>2</sub> emissions and exposure is completely abolished which directly benefits health of the family members.

- **Reduction in GHG by Shifting to DRE:**

For a cumulative 5.4 MW Solar PV minigrad across 10 districts, the daily electricity production is nearly 21,600 KWh. From a conservative perspective in Indian context, approx 0.92kg CO<sub>2</sub> is released per KWh of thermal power and if the above capacity was met using thermal grid, the GHG emissions per year for a continuous 5.4MW capacity production would have been nearly 7.15KTonne CO<sub>2</sub> eqv. Thus by shifting to Solar DRE, this nearly 7.15KT of GHG emission is completely prevented while meeting rural electrification demands.

- **Less stress on Water and Forest resources:**

On an average, thermal power plants are expected to consume nearly 3.5–4 m<sup>3</sup> of Water per MW production capacity. This would relate to nearly 20 m<sup>3</sup> water for a cumulative 5.4MW production. By shifting to DRE, the stress on water bodies in an already water stressed state such as Jharkhand is greatly averted. Jharkhand is also home to several complex and stressed ecosystems having a diverse vegetation and wildlife distributed throughout nearly 12 national parks and wildlife sanctuaries. The land footprint, deforestation potential and habitat destruction would have been rampant and massive to setup infrastructure for power transmission through conventional grid compromising the flora and fauna of the state. Additionally, for a state massively relying on coal and mineral resources and mines, any form of mitigation and divergence from mining for more coal and resources to meet the rural power demands is a truly eco-friendly initiative in itself.

## Studies from Field:

SwitchOn Foundation conducted a series of surveys in solar mini-grid electrified villages of Sahibgunj, Chatra and Simdega with 207 beneficiaries from 7 villages in July 2022 (Table 4) and the same was published by JREDA in December 2022 (Prasad & Chatterjee, 2022) The beneficiary profile of the study included households in the intervention villages where electrification had been through solar mini-grids for at least the last 6 months.

The objectives of the study on the impact of rural electrification through solar mini-grids in Jharkhand were as follows:

1. To understand the overall socio-economic change in the quality of life for selected rural households after the installation of solar mini-grid plants.
2. To unfold the economic impact of solar mini-grids for the selected households.
3. To gauge the current challenges of using solar mini-grid plants.

The study followed a mixed research methodology. It conducted semi-structured household surveys and quantitative analysis to understand the usage pattern of electricity generated through the solar mini-grids. Qualitative research tools such as Key Informant Interviews, Case Studies, and Focus Group Discussions were employed to understand the qualitative change in the lives of the beneficiaries.

A Proportionate Random Sampling Method was used to select the sample for the study. The sample size was 207, and it was determined in proportion to the beneficiary households in the three districts. Efforts were made to select villages with the maximum and minimum number of beneficiary households to represent a holistic impact scenario of the solar mini-grids. The sample size considered a 95% confidence interval.

**Table 4: Surveyed Villages Electrified using Solar Minigrids across 3 districts of Jharkhand**

District	Village Surveyed	Respondent Count
Sahibgunj	Dulmi	62
	Chapel Pahar	25
	Karanghatti	22
Chatra	Kaslalu	65
Simdega	Tarap Tola	12
	Khapra Tola	10
	Kadam Tola	11

## Impact of Solar Mini Grids at Household Level;

### 1a. Solar Mini Grids as primary source of electricity

The research revealed that 55.07% of respondents preferred solar mini-grids as their primary power source, with other options including solar-based home systems (30.43%), rechargeable solar systems (8.70%), and diesel generators (0.97%).

### 1b. Increased usage of electrical equipment

After the solar mini-grid installation, 81.65% of respondents experienced a rise in electrical appliance usage. Notable increases included lights (38.34%), fans (32.38%), and television (8.55%). Qualitative interviews highlighted significant mobile phone charging convenience, eliminating the need for weekly travel.

### 1c. Increased usage of of electrical appliances in the evening

A substantial 92.40% of households used electrical appliances in the evening, impacting education and reducing women's chore time.

## F. Stories of Change:

### A. Social impact on women's health

**Marangmai Marandi** from Dulmi Village of Sahibganj was happy with the supply of electricity in her household. Access to reliable and clean energy resources had been a life-changing experience for her. She used to cook under a diesel-lit light, which was harmful to her health due to continuous exposure to harmful chemicals. But then, with electricity, she could easily prepare food without affecting her health. The installation of a solar mini-grid also had a huge impact on her health, as she no longer had to sleep under a diesel or kerosene lamp, which emitted harmful fumes. Additionally, electricity had enabled longer working hours and increased efficiency in work, and the children of the household could study after daylight hours.

### B. Increase in usage of electrical appliances for small businesses

There was a considerable increase in the usage of electrical appliances powered by solar mini-grids for small businesses. Significant growth was observed in the use of lights (42%) and fans (33%). Although there was a minuscule increase in the use of computers and photocopier machines, there might have been significant potential for livelihood generation through enterprises using solar mini-grids in the past.

### C. Woman Entrepreneur using Solar Mini Grid as a source of power supply

In a conversation with a woman entrepreneur, **Bitea Marandi**, 36, from Dumli, with five family members, it was revealed that she owned a small grocery store. When the mini-grid was installed, it was discovered that the store's opening hours had been extended by 7 to 8 hours compared to past circumstances. She no longer had to decide whether to open the store in the evening. Since she didn't have any appliances at that time, she only utilized the electricity for lighting in the store. She primarily used one light bulb, and her monthly revenue from the business was Rs. 4,500. She sold little food products like chips and snacks as well as some potatoes, ginger, garlic, and spices.

## Impact at community Levels

### 1a. Social Mini Grid as a driver of social upliftment and community engagement

The qualitative interviews conducted in Dulmi Village of Sahibganj district indicated that Solar Mini Grids had been a driving force for social cohesion and upliftment. There were 240 households in the village, and every single household was connected to the solar mini-grid, which had a total capacity of 73 Kw. The process of village identification and installation encouraged Community Engagement and Ownership. The process was participatory in nature and involved identifying villages without power supply and forming a Committee (Samiti) by conducting an Aam Sabha. Aam Sabha was composed of villagers and was responsible for making project decisions. Only after attaining consensus in the sabha was the decision made to move forward with the installation.

### 1b. Village Energy Committees A collective responsibility model for maintenance

The service provider is responsible for maintaining the solar mini-grid, offering free service for the first five years. After the warranty period, a fee will be charged for servicing. A village energy committee oversees grid functioning, while remote monitoring tracks usage patterns, though it may be hindered by network issues. In Dulmi village, a dedicated committee ensures timely maintenance, including cleaning modules and reporting significant issues. Residents are trained in basic problem-solving. The committee also manages a fund, created from nominal amounts, to sustain the solar grid beyond the warranty, with theft insurance in place.

## Understanding the Business Case of Service Providers- Insights from an interview with M/s Vaishnavi Engineering

In Chapel Pahar and Karanghatti of Sahibganj, Vaishnavi Engineering executed the installation of Solar Mini Grids, discussed through an interview with Mr. Sandeep Patil, a key informant representing the service provider perspective. The service model followed Build, Operate, and Transfer, with assets belonging to JREDA and a 5-year operational agreement. Plant capacities were determined based on household load estimations, accommodating lights, mobile charging, fans, and TV, with a battery backup for 2-3 days. A 20% buffer was added for agricultural equipment and other purposes.

For power connections, the service provider handled transmission and distribution lines, constituting 40% of plant costs. The 5-year agreement involved staged payments: 60% initially, 30% post-commissioning, and 10% retained for servicing, with a 2% annual release after solar mini-grid verification. Material specifications and certifications were scrutinized by JREDA staff before purchase, ensuring compliance. Geotagged photo reports submitted every three months facilitated inspections, guaranteeing proper usage and maintenance adherence.



## Case Study: Powering Safety and Comfort: Solar Electrification in Side Village

In the village of Side, the scenario was equally transformative. Before solar power, residents relied on lanterns for lighting, which made the village vulnerable to wild animal attacks, particularly from elephants and snakes. The absence of lighting increased the risk of dangerous encounters at night. However, since the installation of the solar mini-grid, there has been a significant reduction in wild animal attacks, providing a safer environment for residents. The 100 households that benefit from the grid now enjoy small electric fans, which have improved their comfort during hot summer months. With solar electricity, the quality of life for over 400 people has improved, reducing their dependency on traditional fuels and enhancing overall security.

"Before the solar plant, we used lanterns, and wild animals, including elephants and snakes, were a constant threat. Now, with the new lights and fans, we feel much safer and more comfortable," shares **Prayag Yadav**, an elderly resident of Side Village.

Overall, the solar mini-grid project has successfully empowered both Jhanjhari Tola and Side villages, demonstrating the positive impact of renewable energy solutions on rural electrification and quality of life.



## Case Story: Empowering Education through Solar Power: A story of Chaplasi Village

Chaplasi village faced the challenge of limited access to reliable electricity, hindering educational opportunities for its residents. However, with the implementation of a solar power grid, spearheaded by local authorities and supported by government initiatives, the village experienced a transformative journey, particularly impacting its middle school children and encouraging the re-enrollment of female students.

Prior to the installation of the solar power grid, Chaplasi grappled with frequent power outages and unreliable electricity supply. The absence of consistent energy access not only hindered everyday life but also posed significant barriers to education, affecting the attendance and academic performance of students, especially those attending the local middle school.

Recognizing the need for sustainable solutions to address energy poverty and enhance educational opportunities, the community leaders collaborated with government agencies and renewable energy providers to install a solar power grid. The project aimed to provide uninterrupted electricity to households, businesses, and crucial community institutions, including the local middle school.

The introduction of reliable electricity through the solar power grid significantly improved attendance rates among middle school children. With access to well-lit classrooms, students no longer had to contend with studying in dimly lit conditions or navigating through blackout-induced disruptions, leading to a notable decrease in absenteeism.

One of the most impactful outcomes of the solar power grid implementation was the resurgence of interest among female students in pursuing education. Historically, cultural norms and household responsibilities often discouraged girls from attending school, perpetuating gender disparities in education. However, with the assurance of reliable electricity, parents and community members felt more confident in sending their daughters to school, recognizing the importance of education in empowering girls and fostering gender equality.

The adoption of solar power in the village not only addressed energy challenges but also catalyzed positive transformations in the realm of education. By providing a sustainable and reliable source of electricity, the solar power grid empowered middle school children to attend school regularly, reduced dropout rates, and facilitated the re-enrollment of female students, thus paving the way for a brighter and more inclusive educational future for the entire community.



## Case Story: Bringing Light to the lives of Khalari Village

Located in the Simariya Block of Chatra district, lies the small village of Khalari. For years, its residents lived without basic electricity connection. This led the residents of the village to adopt various means like relying on diesel, kerosene, and wood for lighting and cooking. This not only posed environmental concerns but also hindered the daily lives of the villagers. The villagers had to travel long distances to access the essential services like police station, post office, hospital, making their life challenging.

However, two years ago, a solar mini grid was installed in Khalari Village, revolutionizing the lives of its residents. The mini grid brought 24 hours of electricity, ending the villagers' reliance on diesel and kerosene. The impact was immediate and profound. The villagers no longer had to travel to other villages to get the basic things done. Night time was a huge relief. As a result, more children enrolled in school, and the overall educational prospects of the village have improved. The mini grid also transformed social functions, providing good lighting for weddings and other celebrations.

Govind Bhokta, Head of the village, Khalari said, "With 24 hours of electricity, our village now thrives with renewed opportunities. We no longer depend on the kerosene lamps for lighting but proudly use the power of the sun."

## Case Story: Enabling Women Entrepreneurship with Solar-mini grids in Hajaribag

In the village of Gardin, situated in the Ichak Block of Hajaribag District, agriculture served as the primary source of income for many families. However, due to various factors such as unpredictable weather conditions and fluctuating market prices, the income generated from agriculture alone often proved insufficient to meet the needs of the community. Recognizing this challenge, a group of enterprising women came together with the idea of diversifying their income streams.

Understanding the potential of value addition in agricultural produce, the women established a rice milling unit. It was made possible by the recent installation of a solar mini grid in the village, ensuring a reliable source of electricity to power the milling operations. Facilitated by SwitchON's intervention, which included facilitating loans for the installation of a solar mini grid and providing training sessions in collaboration with JREDA, the unit gained momentum.

With the rice milling unit in operation, the women were able to process locally harvested rice efficiently, transforming it into higher-value products such as polished rice, rice flakes, puffed rice and rice flour. It became a focal point for economic activity in the village, creating employment opportunities, particularly women. From operating the milling machinery to packaging and marketing the final products, community members were actively involved in various aspects of the business, contributing to its success.

This provided a sustainable source of income for the women involved but also had a positive effect on the entire village economy. The increased economic activity stimulated by the venture helped boost local purchasing power, leading to improved living standards for the community as a whole.

## Challenges associated with Minigrid/Standalone systems in the Region:



**Figure 29:**  
**Jharkhand map showing distribution of grids, vegetation, terrain and major arterial roads.**

Establishing solar mini-grids for rural electrification in Jharkhand is a task facing diverse challenges. Factors like geographic complexities, socio-cultural diversity, economic constraints, and infrastructural limitations present hurdles, requiring tailored approaches for effective implementation and sustainable energy access in rural communities. These have been widely categorised as:



## 1. Geographic Challenges:

### Hilly Terrains:

In districts with hilly terrains like Gumla and Khunti, the installation of solar mini-grids faces logistical challenges due to difficult topography.

### Remote Locations:

Villages situated in remote areas, especially in districts like Simdega and Latehar, pose challenges in terms of accessibility, affecting the transportation of equipment and maintenance.

## 2. Social Challenges:

### Cultural Diversity:

Districts such as Saraikela-Kharsawan and West Singhbhum, characterized by cultural diversity, present challenges in community engagement and acceptance of solar technologies.

### Community Resistance:

Some districts experience resistance or scepticism towards adopting new technologies, necessitating awareness programs and community involvement in the decision-making process.

## 3. Economic Challenges:

### Financial Constraints:

In economically weaker districts like Chatra, financial constraints impact the implementation of solar mini-grids, affecting both initial setup costs and long-term operational sustainability.

### Limited Income Opportunities:

Districts with limited income-generating activities, such as Gumla and Pakur, face challenges in creating a viable revenue model for sustaining mini-grid operations.

## 4. Infrastructure Challenges:

### Inadequate Road Connectivity:

Almost all the concerned districts, grapple with inadequate road connectivity, particularly along heavily forested regions, hampering the transportation of materials and hindering regular maintenance of solar installations.

### Water Scarcity:

Water scarcity, prevalent in districts like Hazaribagh, poses a challenge for solar panel cleaning, impacting their efficiency and overall performance and maintenance.

## 5. Environmental Challenges:

### Climate Variability:

Districts experiencing climate variability, face challenges related to intermittency in solar energy production, requiring efficient energy storage solutions that in turn compromise life and operation efficiency of systems.

## H. Conclusion:

The rural electrification initiatives led by JREDA in the 12 districts of Jharkhand have brought about a transformative impact on communities. The installation of solar mini-grids has resulted in increased energy access, fostering better living conditions, creating job opportunities, enhancing educational prospects, and improving health outcomes. Additionally, the deployment of solar mini-grids has contributed to a reduction in carbon emissions, empowering communities through local engagement and enhancing overall energy resilience. Agriculture practices have seen improvement, leading to a positive impact on the quality of life for the residents.

However, it's crucial to recognize that the success and impact of solar mini-grids can vary based on various factors, such as local environment, community involvement, governmental policies, and deployment approaches. Regular monitoring and evaluation are imperative to assess the long-term effectiveness and functioning of these projects.

Solar mini-grids have emerged as a pivotal tool in uplifting rural and underserved communities by providing access to clean and reliable energy. The impact assessment report underscores their potential to improve living conditions, increase climate resilience, and open new livelihood opportunities. These solar-powered systems have not only illuminated homes but also contributed significantly to supporting various livelihood activities.

While showcasing the positive impacts, the report also acknowledges potential setbacks and limitations. Challenges may include technical issues affecting efficiency, financial constraints, and community-specific barriers. Identifying these challenges is essential for proposing recommendations to enhance the resilience and effectiveness of future solar mini-grid projects in Jharkhand. The report underscores the success of electrification initiatives, indicating the success of government policies and implementation strategies in enhancing the lives of the residents in these districts.



### iii. References:

IEA, (2021). Jawaharlal Nehru National Solar Mission (Phase I, II and III). <https://www.iea.org/policies/4916-jawaharlal-nehru-national-solar-mission-phase-i-ii-and-iii?>

Arya, A., Nikum, K., Wagh, A., Mehroliya, S., & Mundra, P. (2022). Policies and prospects to promote microgrids for rural electrification in present indian scenario: a comprehensive review. *Planning of Hybrid Renewable Energy Systems, Electric Vehicles and Microgrid: Modeling, Control and Optimization*, 957–989. [https://link.springer.com/chapter/10.1007/978-981-19-0979-5\\_36](https://link.springer.com/chapter/10.1007/978-981-19-0979-5_36)

The Voice of the Industry. (2022b). Transforming India into a Global Solar DRE Manufacturing Hub: A Study into Market Requirements and Readiness (By Simpa Networks). [https://gogla.org/wp-content/uploads/2024/11/transforming\\_india\\_into\\_a\\_global\\_solar\\_dre\\_manufacturing\\_hub-compressed.pdf](https://gogla.org/wp-content/uploads/2024/11/transforming_india_into_a_global_solar_dre_manufacturing_hub-compressed.pdf)

Ministry of Panchayat Raj. (2009). A note on the backward regions grant fund programme. *National Institute of Rural Development, November 2018*.

Average household size - Area Database - Table - Global Data Lab. (n.d.). <https://globaldatalab.org/areadata/table/hhsize/IND/?levels=2+3+4&years=2022>

Prasad, M., & Chatterjee, S. (2022). Impact of rural electrification by Solar Mini Grids: A study of 3 districts in Jharkhand. Jharkhand Renewable Energy Development Agency (JREDA).

Kapoor, Tarun (1 July 2015). "Scaling up of Grid Connected Solar Power Projects" . Ministry of New and Renewable Energy. Archived from the original on 26 February 2017.

"District Census Handbook: West Singhbhum" . censusindia.gov.in. Registrar General and Census Commissioner of India. 2011.





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