Study on the Impact Assessment of Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA)

Submitted to
Rural Electrification Corporation Ltd

Submitted by
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To,
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Plot No. I – 4, Sector – 29,
Gurugram, Haryana – 122001

Date: 18/Jan/2025

Sub: Submission of Revised Draft Final Report (M5)

Dear REC,

This is the revised final draft report of the SAUBHAGYA impact assessment study by RTI-UCLA.

Should you have any queries, please feel free to reach out to Manan Thapar, Director – Energy & Utilities, RTI International, at +91-9818982701 or via email at mthapar@rti.org or Prof. Deepak Rajagopal, Associate Professor, UCLA at rdeepak@ioes.ucla.edu.

With warm regards,

UCLA

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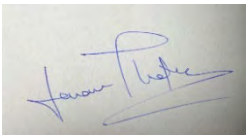

Manan Thapar,
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Acknowledgement

As we present this report on the impact of the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA) scheme, we extend our gratitude to the numerous individuals and organizations whose contributions have been instrumental in bringing this research to fruition. First, we acknowledge the vision and support of Ministry of Power, Government of India, for this study. We are also grateful to the various stakeholders within the Rural Electrification Corporation (REC) for their support. Their expertise and insights have played a significant role in improving our analysis and report. We also wish to acknowledge the Distribution Companies (DISCOMs) and state REC headquarters for their support. The provision of important data and insights by these entities has been valuable.

We extend our deep appreciation and thanks to Mr. Manan Thapar and his team at RTI International for their exemplary logistical support which was instrumental to completing this work given the extremely ambitious timeline. That we were able to effectively bridge the time difference between California and India and conduct innumerable meetings, and exchange email and have phone calls is largely due to the patience and understanding shown by Mr. Manan and his team at RTI. Without the RTI team's expertise and support this work could not have been completed within such a timeline.

Disclaimer

Please note that the responsibility for the findings and conclusions of this study along with any errors, and views and opinions herein are attributable solely to the individual authors of this work and not to the organizations each belong to.

TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

The Pradhan Mantri Sahaj Bijli Har Ghar Yojana – SAUBHAGYA scheme, launched by the Government of India in September 2017, aimed to ensure universal household electrification across the country. This program was designed to provide electricity connections to all households without electricity in rural areas, as well as to economically disadvantaged households in urban settings. The approach of the scheme involved three key strategies. First, it focused on establishing connectivity and providing electricity to all previously unelectrified homes. Secondly, it aimed to deploy Solar Photo Voltaic (SPV) standalone systems for homes in remote and inaccessible regions where extending the electrical grid was deemed impractical or not cost-effective. Lastly, the program sought to extend connectivity and electricity access to all remaining economically underprivileged households without electricity in urban areas.

By March 31, 2019, the scheme reported electrification of nearly all households, with the exception of 18,734 homes in areas of Chhattisgarh affected by political unrest. Further progress saw seven states—Assam, Chhattisgarh, Jharkhand, Karnataka, Manipur, Rajasthan, and Uttar Pradesh—identifying approximately 1.91 million households that, despite initial reluctance, later expressed interest in obtaining electricity connections. These households were subsequently included in the scheme, leading to these states achieving further household electrification by March 31, 2021. Since the launch of SAUBHAGYA, a total of 28.6 million households have been electrified. [1]

This report describes the findings of a study undertaken jointly by a team of experts from the University of California Los Angeles (UCLA), University of California San Diego (UCSD), and Research Triangle Institute (RTI) to study the impact of SAUBHAGYA on the beneficiary households. The objective of the study was to assess the impact of SAUBHAGYA on households that received access to electricity through this scheme. The aim was to understand the impact on select key indicators relevant to socio-economic well-being including access to electricity, expenditure on fuels and energy, household asset ownership (both electrical and non-electrical), health, education, time use, and income among others. A detailed survey was designed by UCLA and UCSD taking into account constraints and recommendations as laid out by REC, the implementation of which was led by RTI International. A total of 33,037 beneficiary households were surveyed. UCLA and UCSD then undertook a statistical analysis of the survey data.

Analysis of this data reveals that households that received a connection through SAUBHAGYA are experiencing patterns of consumption that are consistent with a marked improvement in the quality of life for the household. The data also shows a clear increase in ownership of electrical assets. This is especially true for basic electrical appliances such as tube lights, bulbs, cellphones, and fans, which in turn are associated with a variety of different forms of health, economic, and social benefits. A majority of SAUBHAGYA households with more than one room in their dwelling report having more than one room electrified and also experience low levels of power outages (less than 4 hours on average). Over 85% of the households rated the quality of electricity supply as good, very good or excellent.

With respect to health impacts, a majority of the households that reported a family member having health problems (specifically, eye and respiratory problems) before SAUBHAGYA also reported an improvement since electrification. However, caution is warranted in attributing such impacts entirely to SAUBHAGYA given other concurrent Government of India programs, such as PMUY (or

[1] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1907728

Ujjwala). Through PMUY poor households gained access to LPG, which replaces cooking fuels such as firewood, animal dung, and kerosene, substantially reducing indoor air pollution.

SAUBHAGYA households also report being able to both allocate a greater share of their time for enrichment activities (such as employment, leisure, and self-care) and allocate less time for chores and sustenance activities (such as domestic work and own production). The surveys also show that the time available for children for education and leisure has increased post-SAUBHAGYA.

SAUBHAGYA households also show an increase in consumption, measured by spending on different categories of goods and services. In addition to spending on electricity which of course increases, households increase spending on modern fuels, phones, groceries, education, household maintenance, and health. However, it is again important to remember that while it is plausible that SAUBHAGYA contributed indirectly to the increase in spending on some of these items (especially phone or fuels), we are not in position to make any causal connection without further information, such as the ability to track employment and economic activity as a direct result of electricity access.

In-depth interviews (IDI) and focus group discussions (FGD), which were conducted to complement the surveys, lend additional support to the conclusions above and also highlight additional dimensions of benefits that were not captured in the survey. For instance, respondents report that improved electricity access has brought about an enhanced sense of safety and security during evening and night times. Some specific examples include reduced risk of insect and snakebites, which is a common issue in rural regions. Electricity is also reported as providing relief from the discomfort and health concerns associated with mosquito-borne diseases.

This study has some methodological limitations primarily centered around the absence of a meaningful control group relative to which effects on SAUBHAGYA households can be compared. This makes it difficult to derive causal effects in a rigorous manner. Control groups are vital for establishing causality by providing a baseline for comparison against which program impacts can be measured. Given that the scheme extended electricity to the remaining un-electrified households and has reportedly achieved complete electrification, the lack of data on households without electricity presents a challenge in forming an adequate control group for the study. Some previous studies were able to establish a control group by exploiting an income cutoff that determined who did and did not receive a connection, but such a cutoff was not available in our case. Selection bias and endogeneity are potential major concerns since SAUBHAGYA households might be systematically different from households that received electricity earlier (for instance, due to their lower income or remoteness). Additionally, other policies that treated households might have benefited from (such as PMUY or UJJWALA) also confound the effect of SAUBHAGYA. While the study employs alternative analyses relying on variation in duration of treatment (early vs late recipients of connection) and a pseudo-control group (off-grid connections), these approaches have their limitations such as the inability to assume parallel trends before treatment.

Furthermore, the study also encountered limitations during data collection, particularly high non-response or incomplete responses for certain groups of variables such. Examples include occupational income, the absence of which hinders the examination of specific income streams affected by SAUBHAGYA. Limited data on pre-SAUBHAGYA income due to poor recall prevents a comprehensive assessment of income changes attributed to the program. High nonresponse rates also affect outcomes related to health, finance, and entrepreneurship, posing challenges in understanding

the indirect impacts of SAUBHAGYA on these aspects. Despite these challenges, efforts have been made to focus on electricity-based effects to attribute them more reliably to the SAUBHAGYA program through FGD and IDI, mitigating some of the limitations associated with parallel welfare programs impacting secondary outcomes like income.

The commitment of the Government of India in commissioning this independent study to assess the impact of SAUBHAGYA is noteworthy. But given the limitations we encountered, we strongly recommend involving experts on program evaluation well before implementation so that the roll out of the program could be executed in a manner such that robust estimation of causal effects becomes feasible.

1. PROJECT OBJECTIVE

The motivation underlying SAUBHAGYA was to improve socio-economic and health outcomes for rural households through electrification. The Rural Electrification Corporation (REC), which was the nodal agency for the implementation of the scheme during the project timeline, expressed interest in conducting a thorough assessment to gauge the scheme's socio-economic impact on its beneficiaries. This interest culminated in a collaborative study undertaken by the Research Triangle Institute (RTI) and the University of California, Los Angeles (UCLA) and University of California, San Diego (UCSD). UCLA and UCSD led the research methodology design, data analysis, and publication efforts, while RTI India focused on secondary and primary data collection through expansive on-ground surveys and local stakeholder coordination.

The objective of the study described here was simply to develop data-driven insights into the different dimensions of the impact of SAUBHAGYA at a household level. The primary approach was to conduct a detailed survey of beneficiaries. Given that SAUBHAGYA was aimed at achieving universal electrification, a challenge is the lack of a control group of non-electrified households against which beneficiaries could be compared. We return to this later.

Drawing inputs from the Socio Economic and Caste Census (SECC) 2011, Census 2011, National Family Health Survey and National Sample Survey Office (NSSO) databases, the assessment targeted a diverse beneficiary pool. This included Below Poverty Line (BPL) households that received free electricity connections, non-BPL households with paid connections, and recipients of off-grid solutions provided under the scheme. Such a comprehensive sampling strategy was pivotal for painting an accurate picture of the scheme's reach and effectiveness. The collaborative effort between UCLA, UCSD, and RTI India brought together a robust team of experts to lead this study. A detailed survey, designed by UCLA and UCSD and implemented by RTI India, was the primary tool for data collection. This survey, whose full questionnaire can be found in the Appendix 7.4, covered a broad range of socio-economic indicators, including access to electricity, expenditure on fuels and energy, household asset ownership (both electrical and non-electrical), health, education, time use, and income, among others. The survey aimed to capture the effects of the SAUBHAGYA scheme on households that had received electricity connections.

Through an impact assessment of the scheme, the study aimed to contribute new evidence on the role of electrification in the socio-economic upliftment of poor households. This study is also a testament to the potential for collaboration between academia and government agencies in conducting a rigorous, independent, and unbiased assessment of government programs and policies so that future policies could be designed to harness the full potential of public agencies in bringing about social and economic transformation in India.

1.1. STRUCTURE OF THE REPORT

The Introduction Section (Chapter 2) of the report offers an in-depth background on the subject, providing a historical overview of the Government of India's efforts in rural household electrification, with a focus on the key features of the SAUBHAGYA scheme. Chapter 3 presents the project objective, structure, and team structure. Chapter 4 details the methodology used for data gathering, encompassing surveys, FGD, case studies, and comprehensive data analysis of information provided by the electricity distribution companies regarding SAUBHAGYA. Chapter 5 presents the outcomes of the statistical analysis conducted on the survey data. Finally, Chapter 6 offers a linear analysis of the survey data collected. The final chapter presents the summary of the key findings, acknowledges the study's limitations, and suggests avenues for further research and a way forward for the sector.

While the comprehensive results are detailed in Chapter 5, the results suggest significant positive shifts in several key areas. Access to electricity, unsurprisingly, is associated with a positive change in several markers of socio-economic development. Electrified households reported a marked decrease in expenditure on traditional fuels and an increase in the ownership of both electrical and non-electrical assets, signaling an improvement in living standards. Furthermore, access to reliable electricity was associated with better health outcomes. Education and time use also saw positive changes, with electrification enabling longer study hours and freeing up time previously spent on fuel collection and other energy-related chores. Perhaps most importantly, the study noted improvements in income levels among electrified households, likely due to enhanced opportunities for home-based businesses and other economic activities facilitated by access to electricity. The findings from this study underscore the potential of rural electrification initiatives like the SAUBHAGYA scheme. By shining a light on the scheme's successes and areas for improvement, the research provides valuable insights for policymakers, stakeholders, and future electrification projects. This includes the provision of affordable electrical appliances, financial products tailored to the needs of rural households, and educational programs to maximize the productive use of electricity.

1.2. CONSORTIUM AND TEAM STRUCTURE

In order to answer the relevant study objectives, the tripartite has been formed to ensure proper coverage of key research elements. The tripartite functions in the manner shown below

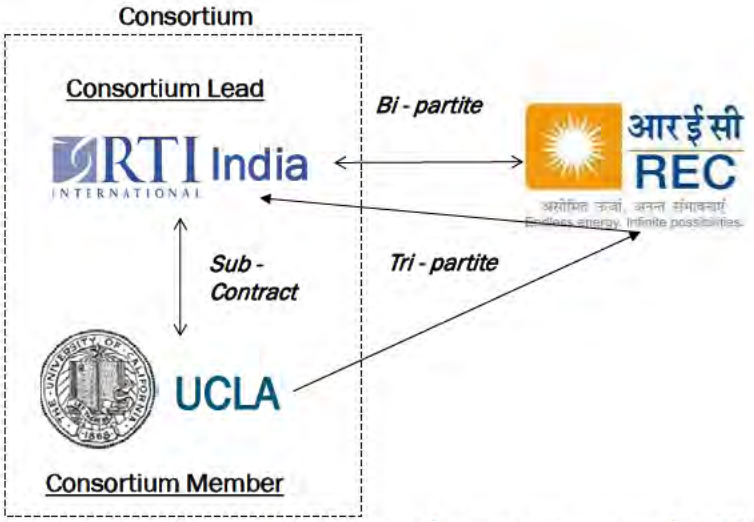


Figure 1: Final Structure of the research consortium proposed to REC

It is of utmost importance to clearly highlight the key capabilities and roles of all the organizations present in the tripartite. The Table showcases broad objectives fulfilled by consortium partners.

Table 1: Roles and Capabilities of project consortium

Organization	**UCLA**	**RTI International**	**REC**
Capabilities	Expertise in Economics	Expertise in Indian power sector, with focus on distribution	Strategic perspective of Indian power sector
Roles	• Research and survey design • Data Analysis • Assessment of socio-economic benefits delivered by the electrification achieved • Publication of final report	• Data Collection • Ensuring timely completion of field survey • Assessment of electrification achieved	• Strategic guidance to the Consortium • Facilitate data sharing from States

2. INTRODUCTION

The history of human civilization can be seen as comprising three major eras of exponentially increasing scale and sophistication in energy capture and utilization. The first era was one in which humans relied simply on fire and domesticated animals to supplement their own bodily energy derived from food consumption. This was followed by a second era in which humans invented devices such as water wheels to harness energy from naturally flowing water in rivers and streams, and from the wind through windmills. Following this, there emerged a third era beginning in the 18th century with the use of fossil fuels in modern engines, and which continues till date. Ever since, the first electricity stations were commissioned in 1882 in London and New York, every modernizing economy has been on a path of ever-increasing share of electricity in total national energy consumption and this trend is only accelerating today worldwide. According to Professor Vaclav Smil, a geographer and a historian of Energy, and one of the leading thinkers about global energy transitions – "An inexpensive and reliable supply of electricity transformed every aspect of everyday activities by bringing bright and affordable light to both interiors and streets, by powering a still-growing array of time-saving and leisure-enhancing gadgets, and by energizing urban and intercity trains… Electricity has been also the principal means of easing the burden of female household labor as a growing variety of machines and gadgets took over common chores."[2] Let alone the impact of electricity on industrial production altogether. To put things in perspective, a single 1000-Megawatt (MW) powerplant operating at 85% capacity factor generates on a daily basis the energy equivalent of what 10 Million (1 Crore) adult human beings expend in total to simply keep their body functioning at rest, which is also known as the Basal Metabolic Rate. It is an understatement that modern life is unimaginable without electricity. And yet, according to the International Energy Agency as of 2023 there were about 750 million people, or close to 10% of the global population, without access to electricity worldwide.[3] In this context, it is staggering that the world is already in the throes of a transition to a fourth energy era, an era in which fossil fuel use begins to decline for the sake of mitigating global climate change and environmental sustainability of human life on Earth. The moral implications of society attempting to transform its infrastructure for the sake of the long-term future even as large sections of its population lacks access to as fundamental an amenity as electric power supply in their household is therefore not hard to fathom. In this context, the importance of ambitious programs aimed at universal household electrification (such as SAUBHAGYA) achieving their targets and being successful cannot be overstated.

Access to reliable and affordable electricity is fundamental in enhancing the quality of life for individuals and communities. It enables critical development aspects like education to become more accessible and effective. For instance, the use of digital learning tools like mobile phones and computers in education are heavily dependent on electricity. Additionally, electrification helps in extending study hours after dark. This is particularly crucial in rural areas where daylight dictates the rhythm of daily life. The World Bank's report on "Electricity Access in Sub-Saharan Africa" underscores the significance of electrification in improving educational outcomes by providing reliable electricity to underserved regions.[4] `

[2] Smil, Vaclav. "World history and energy." Encyclopedia of energy 6 (2004): 549-561.
[3] Access to electricity improves slightly in 2023, but still far from the pace needed to meet SDG7, IEA, Sept 2023
[4] Blimpo, Moussa P. & Cosgrove-Davies, Malcolm. (2019). Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact. 10.1596/978-1-4648-1361-0.

Economically, electrification is a key driver of development. It often leads to direct and indirect economic benefits. The availability of electricity supports home-based businesses and cottage industries, enabling the use of machinery and electronic devices that increase productivity and income. As highlighted by the International Energy Agency (IEA) and World Bank in their "Tracking SDG 7: The Energy Progress Report," access to electricity is crucial for economic activities, offering opportunities for entrepreneurial ventures and diversifying household income sources. [5]

The health benefits of household electrification are potentially several-fold. It enables the refrigeration of food and medicines, reducing spoilage and improving nutrition and health outcomes. It reduces eye strain through improved lighting. Electric reduces the need for burning biomass such as wood and dung reducing exposure to air pollutants and respiratory illnesses. Research conducted by the World Health Organization (WHO)[6] underscores the health implications of transitioning to cleaner energy sources within households, highlighting reductions in ailments related to air quality.

Electrification can also enhance social inclusion and gender equality. Access to electricity facilitates social inclusion by reducing the urban-rural divide, enabling rural communities to access modern amenities and services. Gender equality benefits as electrification reduces the labor and time burden on women and girls, who are traditionally responsible for household chores and fetching fuel. This shift allows for greater opportunities for education and economic participation, as evidenced by research conducted on the impact of rural electrification in Rwanda by Grimm et al., which discusses the differential impacts on households and small businesses, emphasizing the role of electricity in economic development while also noting the unequal distribution of benefits.[7]

Beyond tangible economic and health benefits, electrification enhances the overall quality of life. It facilitates better lighting, access to information and entertainment when used to power televisions or simply mobile phones, which can also provide internet connectivity. These aspects of modern life, often taken for granted in urbanized and developed regions, represent significant improvements in the living standards of rural households in developing countries.

The effects of rural electrification, as studied by Burlig and Preonas (2022) in the context of India, reveal how electrification impacts economic activities, educational outcomes, and health indicators, providing a nuanced understanding of the benefits of electrification efforts.[8] Furthermore, the body of research, including studies by Aklin et al. (2016) on household satisfaction with electricity supply in rural India[9] and Paul Cook (2011) on the relationship between infrastructure development and economic development[10], underscores the critical role of electrification in enhancing productivity, improving health and education, and enabling technological adoption in rural areas. As such, electrification remains a priority in development planning and investment, ensuring that its benefits are equitably distributed across all segments of society. However, achieving universal electrification of poor and low-income households is challenging as recovering costs from users while maintaining

[5] IEA (2019), Tracking SDG7: The Energy Progress Report, 2019, IEA, Paris https://www.iea.org/reports/tracking-sdg7-the-energy-progress-report-2019
[6] WHO (2022), Energy and health, https://www.who.int/health-topics/energy-and-health#tab=tab_1
[7] Michael Grimm; Luciane Lenz; Jörg Peters and Maximiliane Sievert, (2016), Demand for Off-Grid Solar Electricity: Experimental Evidence from Rwanda, No 10427, IZA Discussion Papers, Institute of Labor Economics (IZA)
[8] Burlig, Fiona, and Louis Preonas. "Out of the darkness and into the light? development effects of rural electrification." Journal of Political Economy (2022) https://www.journals.uchicago.edu/doi/10.1086/730204
[9] Aklin, Michaël, et al. "Factors affecting household satisfaction with electricity supply in rural India." Nature Energy 1.11 (2016): 1-6.
[10] Cook, Paul. "Infrastructure, rural electrification and development." Energy for Sustainable Development 15.3 (2011): 304-313.

affordable electricity rates is challenging. This in turn leads to mutually reinforcing feedback of diminishing reliability leading to diminishing willingness to pay for electricity. India's pathway to rural electrification, beginning from the time of its independence in 1947 to achieving significant coverage up till now, reveals a complex narrative of ambitious goals, evolving strategies, and varied outcomes. While the country has made considerable strides in extending electricity access to 100% of willing households, the journey has been marked by challenges and shifts in focus that reflect the nuanced reality of implementing large-scale infrastructure projects in diverse and often difficult terrains.

In the early years, post-independence, the 1st Five Year Plan (1951-1956) targeted electrification with a primary focus on enhancing agricultural productivity and irrigation. The goal was modest, aiming to electrify every 200th village, resulting in 4,231 villages receiving electricity. This period established a foundational approach where electrification was linked directly to agriculture, a critical sector for the country's economy and food security. However, this approach, while practical, also meant that electrification was initially limited in scope, with a village considered electrified if electricity was used within its boundaries for any purpose, not necessarily reaching individual households or supporting broader community needs.

The subsequent plans gradually shifted focus. The 2nd Plan (1956-1961) expanded the definition of electrification to include it as a social amenity, recognizing the broader benefits of electricity beyond agriculture. This period saw a significant increase in electrified villages and towns, yet the criteria for what constituted an electrified village remained broad and, by today's standards, somewhat superficial. The establishment of the Rural Electrification Corporation (REC) in the 4th Plan marked a significant institutional response to the growing financial and logistical complexities of rural electrification. The REC's focus on reducing poverty and promoting productive activity, particularly against the backdrop of the Green Revolution, highlighted the economic returns of rural electrification. Nonetheless, the emphasis on electrifying villages with populations of at least 5,000 left smaller, more remote villages in a continued state of neglect, underscoring the unevenness of electrification efforts.

By the 5th Plan, the introduction of the Minimum Needs Programme aimed to elevate living standards and addressed states lagging behind the national electrification average. This period saw over 200,000 villages being electrified, a significant leap forward. Yet, the distribution of electricity remained skewed, with many households within electrified villages still without access, reflecting a gap between village-level electrification and household electrification.

The 6th and 7th Plans introduced targeted schemes to address energy poverty, recognizing the distributional challenges that earlier efforts had faced. Yet, the sheer scale of need versus the resources allocated meant that progress, while notable, was not uniform, leaving segments of the population in darkness. The 8th and 9th Plan faced funding challenges, slowing the pace of electrification despite the establishment of dedicated ministries and a revised, more inclusive definition of electrification. These challenges highlight the fiscal constraints and prioritization dilemmas facing a developing economy like India.

The 10th Plan and the Electricity Act of 2003, with a revised and stricter definition of electrification, represented a legislative commitment to rural electrification. It was the Electricity Act of 2003 which represented perhaps the most important policy and regulatory decision that accelerated rural

electrification. This act obligated the central and state to supply electricity to all rural areas, and importantly, adopted a more comprehensive definition of village electrification with an explicit emphasis on household electrification, unlike previous policies. Prior to this act, rural electrification was seen more as a by-product of the overall efforts towards increasing electricity access. However, the ambitious goals set forth required substantial investments and coordination between various levels of government and agencies, a task that proved to be daunting in practice.

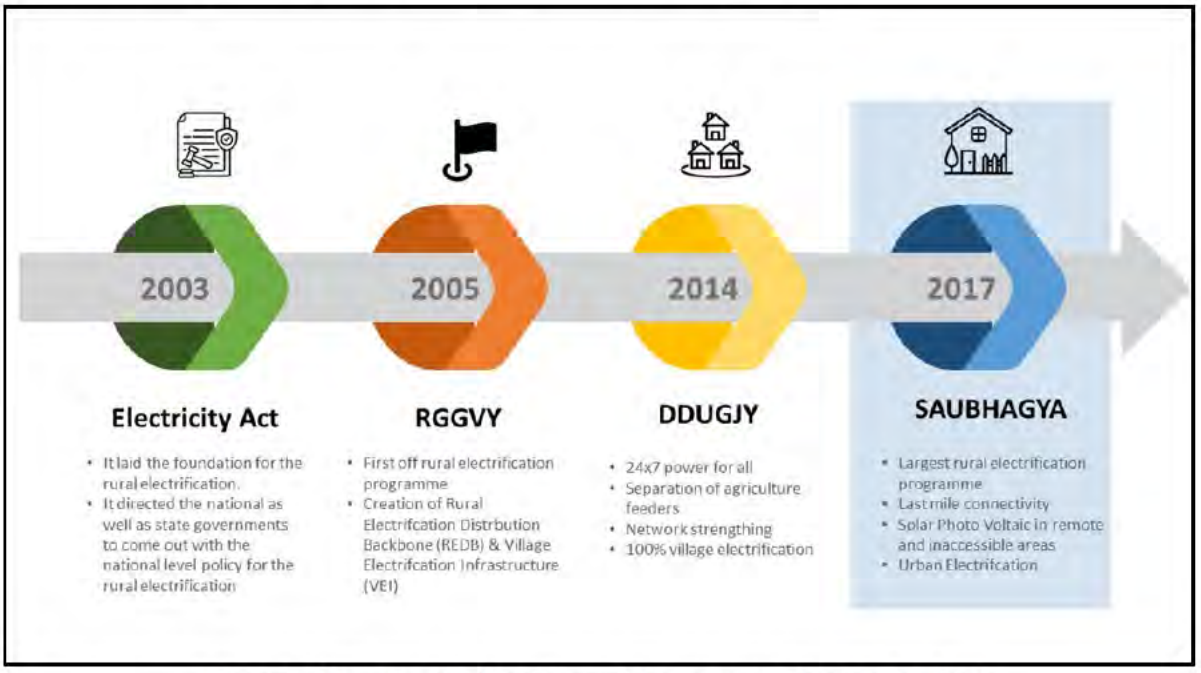


Figure 2: Major Rural Electrification Schemes since Electricity Act 2003

Figure 2 shows the major rural electrification schemes of the Government of India since the Electricity Act of 2003 which represented an important milestone in the transformation of the power sector in India. Post this Act, in April 2005,[11] the Government of India launched the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) with the aim of creating the much-needed rural electricity infrastructure and household electrification. The key features of the scheme involved the electrification of 125,000 un-electrified villages with the provision of Rural Electricity Distribution Backbone (REDB) by building 33/ 11KV (or 66/11 KV) sub-stations and the creation of Village Electrification Infrastructure (VEI) through electrification of both un-electrified villages as well as habitations. Under the scheme, the central government allocated a 90% capital subsidy, with the remaining 10% constituting a loan component financed through the Rural Electrification Corporation (REC). Specifically, for households falling under the Below Poverty Line (BPL) category, totaling around 23.4 million households, the central government extended a 100% capital subsidy for electricity connections. Most importantly, the scheme allowed the state government to reach out Central Public Sector Undertaking (CPSUs), National Thermal Power Corporation (NTPC), Power

[11] Since the Electricity Act of 2003 and prior to RGGVY in 2005, Government of India also launched the Village Energy Security Programme which aimed to provide holistic energy solution to villages, primarily using biomass and a plan to accelerate electrification of hundred thousand villages and 10 million households initiated by merging interest subsidy scheme AREP and Kutir Jyoti Programme which was running since 1988 and which central government providing funds to states for providing single point light to below poverty line families. For details see Palit and Bandhopadhyay (2017)

Grid Corporation of India (POWERGRID), National Hydroelectric Power Corporation (NHPC) & Damodar Valley Corporation (DVC) in leveraging their expertise and capabilities[12].

Following RGGVY, the Government of India launched Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) in December 2014, with a focus on separation of agriculture from non-agriculture feeders as well as metering of distribution transformers/feeders/consumers. The scheme subsumed RGGVY and the remaining 18,374 unelectrified villages were electrified, thereby achieving the milestone of electrifying all the villages by 28th April, 2018[13]. DDUGJY followed a funding pattern of 85:15 between central and special category states[14] and for the other states[15], the pattern was 60:40. Apart from that, to expedite the implementation of the scheme, there were additional grants from the Government of India for the achievement of prescribed milestones. In between, the Government of India implemented other distribution reforms. Unnat Jyoti by Affordable LEDs for All (UJALA)[16] was launched on January 5, 2015, with the objective of promoting the efficient use of energy at the residential level & dissemination of awareness of using energy-efficient appliances. Through continuous efforts from the Government of India, there was pressure on electricity distribution companies (DISCOM) to deliver electricity to all the consumers who were getting ready to connect to the grid. Therefore, to tackle these issues and to strengthen the DISCOMs, the Government of India came up with the Ujwal Discom Assurance Yojana (UDAY)[17]. The key objective of the scheme was to enforce financial discipline on DISCOMs, reduce the cost of power & improve the operational efficiency of the DISCOMs. Even after the consecutive electrification drives, the growth of household electrification was sluggish. To address this the central government launched Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA). This scheme aimed to provide electricity connections to all willing households in rural and urban areas, further accelerating the electrification drive in India. SAUBHAGYA was designed to ensure last-mile connectivity, covering even the most remote and marginalized communities, and has played a pivotal role in advancing the goal of universal electrification in the country. The sub-section below delves deeper into the SAUBHAGYA scheme.

2.1. KEY FEATURES OF SAUBHAGYA

On 25th September 2017, the Government of India launched the Pradhan Mantri Sahaj Bijli Har Ghar Yojana, commonly known as "SAUBHAGYA". The aim was to provide electricity connections to all willing households across rural and urban India by 31st March 2019. The scheme was predominantly funded by the Government of India. The scheme had a total budget allocation of INR 16,320 Crores, with INR 12,320 Crores designated as Gross Budgetary Support (GBS). Specifically, rural households were allocated INR 14,025 Crores with GBS at INR 10,587 Crores, and urban households were allocated INR 2,295 Crores with GBS of INR 1,732 Crores. Beneficiaries for free electricity connections were identified using the Socio Economic and Caste Census (SECC) 2011 data, with provisions to include households not listed in the SECC data for a nominal fee of INR 500, recoverable in 10 installments through electricity bills. The scheme designed to achieve multiple

[12] https://www.ddugjy.gov.in/assets/uploads/1549536893mfu7n.pdf
[13] https://pib.gov.in/PressReleasePage.aspx?PRID=1907722
[14] All northeastern states including Sikkim, J&K, Himachal Pradesh and Uttarakhand
[15] All other states leaving special category states
[16] 368.6 million LEDS, 7.22 million tubelights & 2.4 million fans were provided as a part of the scheme; https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/jan/doc202316150401.pdf
[17] https://powermin.gov.in/pdf/Uday_Ujjawal_Scheme_for_Operational_and_financial_Turnaround_of_power_distribution_companies.pdf

outcomes: a reduction in kerosene usage for lighting; enhancements in education and health services; better connectivity via radio, television, and mobiles; stimulation of economic activities and job creation; and overall improvement in the quality of life, particularly for women. To streamline and expedite implementation, the scheme leveraged modern technology, including a mobile app for household surveys. This technology facilitated on-the-spot registration of applications for electricity connections, complete with applicant photographs and identity proofs. Rural Gram Panchayats and public institutions played a role in collecting applications, distributing bills, and revenue collection, in collaboration with Panchayat Raj Institutions and Urban Local Bodies. The Rural Electrification Corporation Limited (REC) was designated as the nodal agency for the scheme's operationalization nationwide.

The scheme faced several challenges. These included ensuring the scheme's accessibility to the most remote and underserved households, the logistical and infrastructural hurdles in electrifying vast rural areas, and the scheme's reliance on accurate data for beneficiary identification. Additionally, the repayment model for non-SECC households raised questions about affordability and the potential burden on economically weaker beneficiaries. The success of SAUBHAGYA ultimately hinged on its execution, the ability to overcome these challenges, and its impact on the targeted populations. Some of the major features of the scheme which ensured universal electrification are:

- **Criteria selection of the households:** The beneficiary households were identified using the Socio-Economic and Caste Census (SECC) 2011 in order to ensure economically poor households could benefit the most from the scheme. There were three levels of criteria selection:

    1. **Automatic Inclusion of certain socio-economic household categories**: These are socio-economically disadvantaged individuals and households who were automatically eligible under the scheme to ensure equitable access to electricity. These were:
        a. Households without shelter
        b. Destitute, living on alms
        c. Manual scavenger families
        d. Primitive tribal groups
        e. Legally released bonded labourers
    2. **Moving beyond BPL**: The scheme provided subsidies for electrification not only to BPL families but also to all other households that met at least one deprivation criterion as per SECC 2011. This was a significant step as it broadened the scope by incorporating parameters such as female-headed households, households with disabled members, households with no literate adult above 25 years, and other relevant factors.
    3. **Electrification of non - BPL categories**: As the scheme envisions universal electrification, all those who were not covered under the SECC 2011 selection criteria were also provided with electricity connections. For such households, a nominal amount of Rs 500 per household was finalized. To ensure that this amount does not burden these households, the Distribution Company (DISCOM) or the Power Department was set to recover the sum in ten (10) installments of Rs 50 each, to be collected along with the electricity bills.

- **Coverage of all the topographies:** To ensure universal household electrification, the scheme included provisions for off-grid connections in remote and inaccessible areas. This accommodation was made due to the challenges of extending the traditional power grid to remote

regions. Remote areas, such as rural communities or areas with challenging terrain, often experience an energy gap because of their distance from the local distribution grid.

- **Components of the scheme:** The service connection under the scheme included several key components to ensure comprehensive electrification. This encompassed the provision of necessary service line cabling to connect households to the electricity network. Additionally, households were equipped with energy meters, with the option for either pre-paid or smart meters to facilitate efficient energy usage and billing. Single-point wiring was provided to ensure safe and standardized electrical installations within the homes. Moreover, to support energy efficiency and meet technical specifications and construction standards, LED lamps, and accessories were supplied to the households. Recognizing the unique challenges of electrifying remote areas, special provisions were made to provide off-grid solar solutions. These solutions included panels with a capacity of 200 to 300 Wp, accompanied by a battery bank for energy storage, and essential electrical appliances such as up to 5 LED lights, 1 DC fan, and 1 DC power plug. To ensure the sustainability of these solutions, repair, and maintenance (R&M) services were covered for a period of 5 years, addressing any potential issues and ensuring the long-term functionality of the systems.

In terms of the financial structure, SAUBHAGYA adopted a funding model that emphasized different funding strategies for different types of states.

Table 2: Financial Support under the SAUBHAGYA Scheme (Source: SAUBHAGYA Guidelines)

Agency	**Nature of support**	**Quantum of support**	
		Special Category States*	**Other than the Special Category States**
Government of India	Grant	85%	60%
Utility/State Contribution	Own Fund	5%	10%
Loan (FIs/Banks)	Loan	10%	30%
Additional Grant from the GOI on the achievement of prescribed milestones	Grant	50% of the total loan component (10%) that would be 5%	50% of the total loan component (30%) that would be 15%
Maximum Grant by the GOI (including additional grant)	Grant	90%	75%

*All Northeastern States, Sikkim, J&K, Himachal Pradesh, Uttarakhand

This approach aimed to encourage DISCOMs to actively participate in the electrification drive. The efficient allocation of resources was instrumental in achieving electrification goals more economically. While offering grants and incentives offered encouragement to compliance, there were also corrective measures in place to enforce accountability and progress toward the electrification objectives.

2.2. TOTAL HOUSEHOLDS ELECTRIFIED UNDER SAUBHAGYA

Following the initiation of the SAUBHAGYA scheme, as per the Ministry of Power, all states reported achieving 100% electrification of all willing un-electrified households identified prior to 31st March 2019. According to state reports, since the launch of SAUBHAGYA up to 31st March 2021, a total of 28.2 million households have been provided with electricity connections. Additionally, under

the DDUGJY scheme, 443 thousand more households have been electrified. Consequently, by 31st March 2022, the total number of households electrified since the commencement of SAUBHAGYA, including tribal households, reached 28.6 million. The scheme has since been concluded. [18]

Table 3: State-wise electrification of households since launch of SAUBHAGYA Scheme including Additional Households achievement under DDUGJY (Source: PIB, Dec 2023)

Sl. No.	Name of the States	No of Households electrified from 11.10.2017 to 31.03.2019 as per SAUBHAGYA Portal	Additional Sanction allowed under SAUBHAGYA		Further Additional Households sanctioned under DDUGJY		Grand Total(A+B)
			No of Households reported electrified from 01.04.2019 to 31.03.2021	Total HHs electrified as on 31.03.2021 (A)	Households Sanctioned during 2021-22	Households electrified (as on 31.03.2022) (B)	
1	Andhra Pradesh*	181,930	0	181,930			181,930
2	Arunachal Pradesh	47,089	0	47,089	7859	0	47,089
3	Assam	1,745,149	2,00,000	1,945,149	480,249	381,507	2,326,656
4	Bihar	3,259,041	0	3,259,041			3,259,041
5	Chhattisgarh	749,397	40,394	789,791	21,981	2577	792,368
6	Gujarat*	41,317	0	41,317			41,317
7	Haryana	54,681	0	54,681			54,681
8	Himachal Pradesh	12,891	0	12,891			12,891
9	Jammu & Kashmir	377,045	0	377,045			377,045
10	Jharkhand	1,530,708	200,000	1,730,708			1,730,708
11	Karnataka	356,974	26,824	383,798			383,798
12	Ladakh	10,456	0	10,456			10,456
13	Madhya Pradesh	1,984,264	0	1,984,264	99,722	0	1,984,264
14	Maharashtra	1,517,922	0	1,517,922			1,517,922
15	Manipur	102,748	5,367	108,115	21,135	0	108,115
16	Meghalaya	199,839	0	199,839	420	401	200,240
17	Mizoram	27,970	0	27,970			27,970
18	Nagaland	132,507	0	132,507	7009	7009	139,516
19	Odisha	2,452,444	0	2,452,444			2,452,444
20	Puducherry*	912	0	912			912

[18] *PIB, Dec 2023*

Sl. No.	Name of the States	No of Households electrified from 11.10.2017 to 31.03.2019 as per SAUBHAGYA Portal	Additional Sanction allowed under SAUBHAGYA		Further Additional Households sanctioned under DDUGJY		Grand Total(A+B)
			No of Households reported electrified from 01.04.2019 to 31.03.2021	Total HHs electrified as on 31.03.2021 (A)	Households Sanctioned during 2021-22	Households electrified (as on 31.03.2022) (B)	
21	Punjab	3,477	0	3,477			3,477
22	Rajasthan	1,862,736	212,786	2,075,522	210,843	52,206	2,127,728
23	Sikkim	14,900	0	14,900			14,900
24	Tamil Nadu*	2,170	0	2,170			2,170
25	Telangana	515,084	0	515,084			515,084
26	Tripura	139,090	0	139,090			139,090
27	Uttar Pradesh	7,980,568	1,200,003	9,180,571	334,652	0	9,180,571
28	Uttarakhand	248,751	0	248,751			248,751
29	West Bengal	732,290	0	732,290			732,290
Total		**26,284,350**	**1,885,374**	**28,169,724**	**1,183,870**	**443,700**	**28,613,424**
* Not funded under SAUBHAGYA							

Up until the SAUBHAGYA scheme, the definition of electrification remained limited to the village level. An electrified village is characterized by (i) the establishment of essential infrastructure, including distribution transformers and lines within the inhabited areas, (ii) the electrification of public facilities such as schools, panchayat offices, health centers, dispensaries, and community centers, and (iii) the electrification of at least 10% of the households within the village. According to this criterion, a village attains the status of being electrified when a minimum of 10% of its households have access to electricity, in addition to having the necessary infrastructure and electrification of specified public places.[19] The Standing Committee on Energy (2013) highlighted a concern with this definition, noting that it permits a village to be classified as electrified even if up to 90% of its households remain without an electricity connection. The Committee further critiqued the infrastructure provided under the scheme as insufficient, unreliable, and not sustainable. It advocated for a thorough evaluation of the actual electrification needs of villages, emphasizing that state electricity distribution companies (discoms) should commit to supplying electricity to all unconnected households within these villages[20]. The SAUBHAGYA scheme sought to ensure universal household (last mile connectivity) electrification, that is, in both rural and urban areas.

[19] "Office memorandum: Deendayal Upadhyaya Gram Jyoti Yojana", Ministry of Power, December 3, 2014, http://powermin.nic.in/rural_electrification/pdf/Deendayal_Upadhyaya_Gram_Jyoti_Yojana.pdf

[20] 41st Report: Implementation of Rajiv Gandhi Grameen Vidyutikaran Yojana", Standing Committee on Energy, December 13, 2013, http://164.100.47.134/lsscommittee/Energy/15_Energy_41.pdf.

2.3. SALIENT FEATURES OF THE SAUBHAGYA SCHEME

The identification of un-electrified households was a significant challenge at the outset of the SAUBHAGYA scheme. To address this, the implementation team utilized the Department of Posts, leveraging its extensive network to conduct a detailed survey. The creation of 'Sankhya,' a dedicated web portal and mobile app, facilitated real-time analysis and strategy development.[21] The implementation of SAUBHAGYA was made possible through coordination between state and central governments. 56 DISCOMs across India were instrumental in providing electricity connections to all the eligible households under the scheme. Efforts to raise awareness and facilitate registration included organizing SAUBHAGYA camps at the village level and deploying 'SAUBHAGYA Raths' in various states. A 24x7 Control Room was set up to address beneficiaries' queries and complaints, enhancing the scheme's responsiveness. In regions where traditional electrification methods were impractical, stand-alone solar PV systems were installed. With 28.2 million households electrified, the focus shifts towards providing a reliable and quality power supply 24x7 to all households.

Salient aspects of Strategy formulation and Implementation

- The initiation of the SAUBHAGYA scheme for Universal Household Electrification in India involved strategic planning through national workshops and review meetings, bringing together stakeholders from various sectors to outline and refine the approaches for achieving the set objectives within the designated timeline.
- Technological advancements played a key role in the scheme's execution, with the development of a dedicated mobile app and web portal (SAUBHAGYA.gov.in) facilitating real-time monitoring and transparency in tracking the progress of household electrification nationwide.
- Beneficiaries for the physical survey were chosen from the SECC 2011 database, with the challenge being the on-ground identification of these individuals within a strict timeline.
- Overcoming geographical challenges, dedicated teams delivered materials for electrification across India, including remote and extremism-affected regions, with innovative logistics like helicopters and railway support, facilitated by the concerted efforts of CPSUs such as RECPDCL, NTPC, PGCIL, and NEEPCO.
- Financial backing of INR 727.02 million from schemes like DDUGJY and SAUBHAGYA, alongside infrastructure development funds, was crucial in supporting the nationwide drive for Universal Household Electrification.
- A combination of comprehensive surveys, the Gram Swaraj Abhiyan, SAUBHAGYA camps, and 'SAUBHAGYA Raths', along with a 24x7 control room, played key roles in identifying and electrifying un-electrified households.

2.3.1. Methods Employed for Beneficiary Identification

- **Gram Swaraj Abhiyan**: Under the campaign of "Sabka Sath Sabka Gaon Sabka Vikas," the Government of India launched the Gram Swaraj Abhiyan from April 14 to May 5, 2018. The primary objective of the campaign was to reach out to households of the poor and create awareness

[21] https://recindia.nic.in/uploads/files/SAUBHAGYA-Coffee-Table-Book--low-resoltion-Final.pdf

about various government schemes, including SAUBHAGYA. The Abhiyan covered 484 districts and 21,058 villages, providing the much-needed stimulus to spread awareness about the SAUBHAGYA scheme (Figure 3).

Figure 3: Glimpses of Gram Swaraj Abhiyan

- **SAUBHAGYA Rath Yatra:** The Rath Yatra was a campaign launched by the Ministry of Power, Government of India, to create awareness about the SAUBHAGYA scheme and its benefits among the masses. The campaign involved a specially designed vehicle called the SAUBHAGYA Rath, which traveled across various parts of the country to spread awareness about the scheme and its objectives. The campaign's objective was to reach the remotest parts of the country and educate people about the importance of electricity and the benefits of the SAUBHAGYA scheme (Figure 4).

Figure 4: SAUBHAGYA Raths

- **SAUBHAGYA Camps:** To simplify the process of getting electricity connections, all the discoms set up SAUBHAGYA camps at the village level. The aim was to connect with beneficiaries, facilitate on-the-spot registration, and ensure that no one is left without access to electricity. These camps encouraged active local participation and raised crucial awareness at the village level. In addition, electric rickshaws were used for disseminating awareness about the

camps, and reaching out to more people in the community. This approach effectively engaged the community in the electrification initiative.

- **Leveraging the IT solutions**: To maintain transparency in releasing connections, the power departments of discoms/states adopted various innovative solutions. This was necessary considering many unelectrified households had to be connected to the grid in a short span of time. Therefore, there was a need to expedite the process of identifying beneficiaries, registration, and finally releasing the required electricity connection. Mobile apps such as "Gram Jyoti Doot" and "Urja Vistaar" were devised for the fast-track release of electricity connections. To enable real-time tracking and monitoring, a SAUBHAGYA portal was also launched (Figure 5). The portal provided the much-needed status and enabled the discoms to track electrification progress.

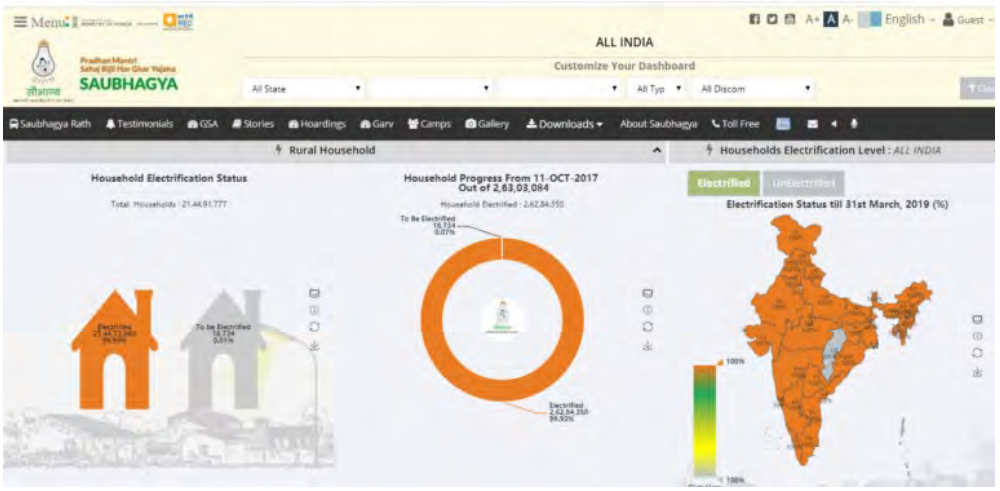


Figure 5: Use of IT Solutions like the SAUBHAGYA Portal

3. APPROACH AND METHODOLOGY

3.1. OVERALL APPROACH

The assessment of the socio-economic impact of the SAUBHAGYA Scheme represents a comprehensive endeavor aimed at evaluating the outcomes of the scheme on its beneficiaries across diverse regions within India. The assessment study encompasses an extensive array of parameters, with the overarching goal of discerning the multifaceted ways in which the scheme has engendered socio-economic transformations among its beneficiaries.

For the primary data collection, the sample survey size in different Indian districts is based on the power calculation calibration conducted in consultation with UCLA. The districts are selected on the basis of areas which have >10% electrification done under the SAUBHAGYA scheme. This is done to ensure the statistical relevance of the data collected from the field for impact assessment. However, there are states where all the districts had <10% electrification done under the SAUBHAGYA scheme since they were majorly electrified prior to the scheme (Himachal Pradesh, Kerala, and Punjab) and hence have been included as a special case to ensure 100% state coverage.

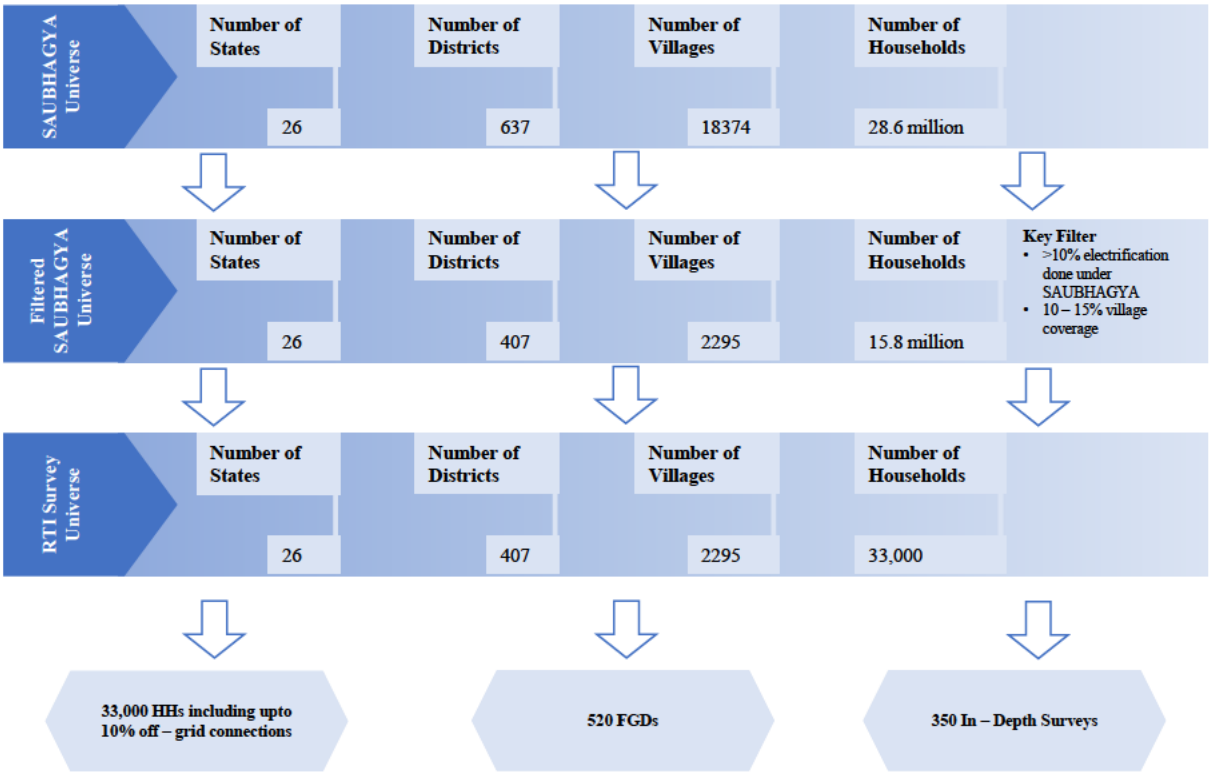


Figure 6: Infographic highlighting data collection plan (Source: RTI and UCLA)

Central to the study's methodology are on-ground surveys, totaling 33,000+ in number (95% grid-connected and 5% off-grid connections). These surveys are meticulously designed to capture first-hand accounts, experiences, and perceptible changes as articulated directly by the beneficiaries. Furthermore, the assessment incorporates a qualitative dimension through 520 FGD and 350 IDI (Figure 6).

3.2. METHODOLOGY FOR SURVEY AND DATA COLLECTION

The assessment underscores a paramount focus on data collection, with a particular emphasis on acquiring comprehensive beneficiary information to effectively facilitate the outreach of surveys. Figure 7 is a schematic representation of the methodology and work plan. The approach to quality control has been adopted, incorporating a spectrum of techniques during the main survey phase. Notably, both the survey questionnaire and the methodology employed for data collection have been approved by UCLA and REC. This validation occurred during the inception phase and has been executed in practice during the substantive main survey phase.

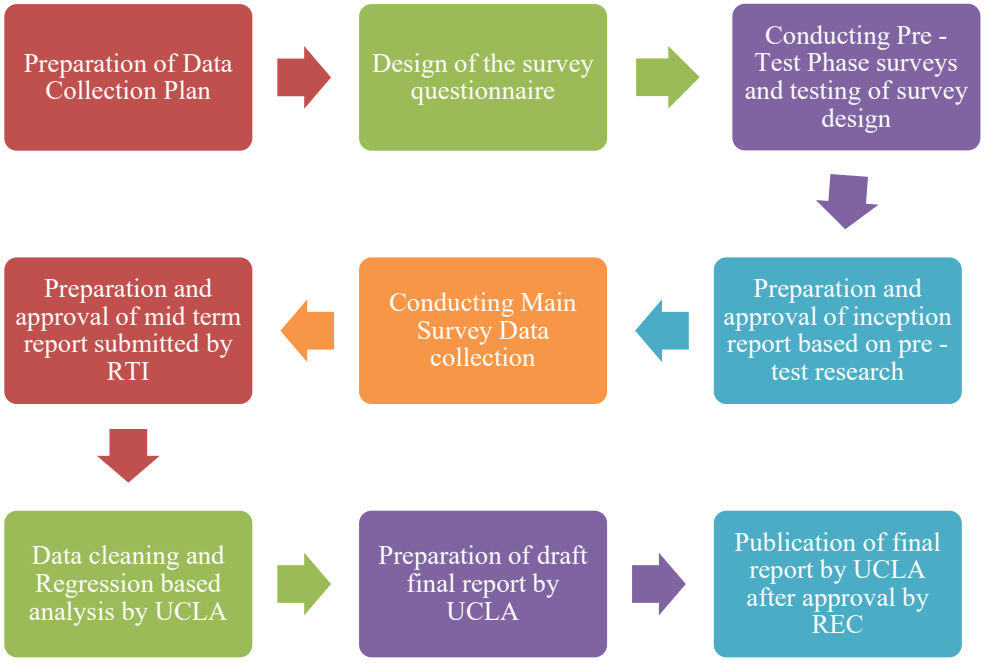


Figure 7: Methodology in a snapshot

The main survey research focused on a large volume of data through survey design tested and approved by UCLA and REC during the pre-test phase. The data is collected from the following sources:

- Secondary Data: This information is collected from government sources like the Ministry of Power's website, REC's website, datasets present on the websites of relevant state and central government organizations like PFC, established research reports from reputed organizations like The World Bank, IRENA, IEA, etc.
- Primary Data collection: This is segregated into primary data collection from beneficiaries through individual surveys, FGDs, and IDIs as well as data collection from DISCOMs as well as state REC offices.

Post the approval of inception report, a variety of techniques and tools for on ground main survey data collection have been implemented.

Household Survey Questionnaire: An effective approach and design for the survey instrument plays a crucial role in ensuring accurate data collection. Although it is well recognized that electricity has a transformative impact on socio-economic conditions, capturing these changes is both vital and challenging. The approved methodology, questionnaire, and process in M3 has been followed to

conduct the main survey data collection in the 26 SAUBHAGYA states. The sample survey size for primary data collection across various Indian districts is determined through power calculation calibration, carried out in collaboration with the University of California, Los Angeles (UCLA). The selection of districts is strategically focused on areas where more than 10% of electrification has been achieved under the SAUBHAGYA scheme. This approach is adopted to guarantee that the data gathered from field surveys holds statistical significance, ensuring its validity for conducting a thorough impact assessment. To ensure both the quality and punctuality of the survey, the entire data collection process was digitized. The survey information has been collected on the basis of discussion with the SAUBHAGYA beneficiaries and uploaded instantly on a mobile app. This enabled real-time monitoring of the responses with the capability to provide prompt feedback if any issues were present with the responses.

Focus Group Discussions (FGDs): Since the response rate for certain parameters can dwindle in surveys of this scale, FGDs become an effective tool to ensure inclusivity to capture a comprehensive qualitative understanding of the topic. FGDs assisted in gathering diverse perspectives and enabled effective communication during the data collection process wherever the response rates were low for particular parameters required by UCLA for conducting the impact analysis.

In Depth Interviews (IDI): In-depth interviews of SAUBHAGYA beneficiaries, key stakeholders like DISCOM officials who were instrumental in SAUBHAGYA implementation as well as policy and technology experts captured nuanced changes brought about by the scheme. The objective is to comprehensively examine and explore the complexities, dynamics, and unique characteristics of the scheme through in-depth information.

3.3. ANALYSIS METHODOLOGY

3.3.1. Qualitative analysis

Recognizing the potential limitations of survey methodologies, especially concerning response rates for specific parameters in studies of considerable scale, FGDs, and IDIs were employed as a strategic measure to ensure inclusivity and depth in the qualitative understanding of the SAUBHAGYA scheme's impact.

The qualitative analysis through FGDs and IDIs brought forth a layered understanding of the SAUBHAGYA scheme's impact, enriching the study with detailed narratives and personal experiences. This approach ensured that the research captured both the breadth and depth of the scheme's effects, providing a balanced view that integrates quantitative findings with qualitative insights. Together, FGDs and IDIs formed a comprehensive methodological framework for assessing the socio-economic transformations engendered by the SAUBHAGYA scheme, contributing to a nuanced evaluation of its success and areas for future enhancement.

FGDs facilitated the collection of a diverse array of perspectives, allowing for a rich, multi-dimensional exploration of the electrification initiative's effects on beneficiaries. These discussions were structured to create an open, communicative environment where participants felt comfortable sharing their experiences, perceptions, and suggestions regarding the scheme. This setting was particularly advantageous for delving into areas where survey data might have shown low response rates, enabling the research team to gather nuanced insights that might otherwise have been overlooked. The implementation of FGDs was designed to capture a comprehensive qualitative

understanding of the SAUBHAGYA scheme, encompassing the lived experiences of the beneficiaries, their satisfaction levels, challenges encountered, and the perceived socio-economic transformations following electrification. By engaging directly with communities, FGDs provided a platform for voices that are often marginalized or underrepresented in large-scale quantitative analyses, thereby enriching the study with qualitative data. Table 4 lists the number of FGDs and IDIs in each state.

Table 4: Statewise FGDs and IDIs conducted

State	Focus Group discussion (FGD)	In-depth interviews (IDI)
Arunachal Pradesh	3	3
Assam	25	25
Bihar	70	22
Chhattisgarh	5	8
Haryana	12	15
Himachal Pradesh	20	6
J&K	4	10
Jharkhand	8	20
Karnataka	4	15
Kerala	4	5
Ladakh	1	3
Madhya Pradesh	55	20
Maharashtra	21	20
Manipur	0	0
Meghalaya	9	10
Mizoram	2	7
Nagaland	4	0
Odisha	5	28
Punjab	4	4
Rajasthan	127	20
Sikkim	2	4
Telangana	10	8
Tripura	3	5
Uttar Pradesh	103	81
Uttarakhand	10	4
West Bengal	9	7
Total	520	350

Complementing the group-focused approach of FGDs, IDIs were conducted to gain detailed, personal insights into the SAUBHAGYA scheme's impact. These interviews targeted a range of participants, including beneficiaries of the SAUBHAGYA scheme, DISCOM officials who played a pivotal role in its implementation, and experts in policy and technology. The objective of IDIs was to unearth the nuanced changes and effects brought about by the electrification scheme, offering a granular perspective on its outcomes. IDIs also allowed for a deep dive into the complexities and dynamics of the SAUBHAGYA scheme, exploring the unique experiences and observations of individuals closely associated with or affected by the program. This method provided a structured yet flexible framework for probing into specific areas of interest, such as the efficiency of implementation processes, the adequacy of the infrastructure deployed, and the sustainability of the benefits realized.

Through careful questioning and active listening, researchers conducting IDIs were able to explore the subtleties of the scheme's impact on household economies, social structures, and individual lives. These conversations not only highlighted the successes and areas for improvement of the SAUBHAGYA initiative but also offered critical insights into the policy formulation and technology adoption processes underlying rural electrification efforts.

3.3.2. Statistical approach

3.3.2.1. Sampling - Geographical coverage & respondent profile

The survey sampled 33,037 households and covered 26 states. All these households were covered under the SAUBHAGYA scheme. RTI India worked closely with REC to obtain lists of districts and beneficiaries which were used to draw a sample. The majority of households (31,795 or 96.25%) received a grid connection, while some received a solar connection or off-grid connection (1,242 or 3.75%). As seen in Table 5, the majority of households were located in Bihar, Madhya Pradesh, and Uttar Pradesh (17,893 or 54.2%) although 26 states throughout the country are represented. The survey was conducted by RTI India who then provided the data to the UCLA/UCSD team to carry out the regression-based analysis.

Table 5: Total Household Surveys conducted on the ground

S No	States	Number of Surveys Conducted
1	Arunachal Pradesh	500
2	Assam	2312
3	Bihar	4888
4	Chhattisgarh	1100
5	Haryana	84
6	Himachal Pradesh	103
7	Jammu & Kashmir	288
8	Jharkhand	1000
9	Karnataka	700
10	Kerala	500
11	Ladakh	50
12	Madhya Pradesh	4384
13	Maharashtra	306
14	Manipur	500
15	Meghalaya	800
16	Mizoram	750
17	Nagaland	500
18	Odisha	1000
19	Punjab	284
20	Rajasthan	1387
21	Sikkim	900
22	Telangana	500
23	Tirpura	496
24	Uttar Pradesh	8621
25	Uttarakhand	471
26	West Bengal	613
Grand Total		**33037**

The survey included several demographic questions in order to better understand the characteristics of the survey respondents. Demographic information collected includes household type, number of adults and children in the household, religion, and social group, which are summarized in the figures shown below (Figure 8). These are important aspects that are covered to ensure diversity in the responses as well as maintain the richness of the research study.

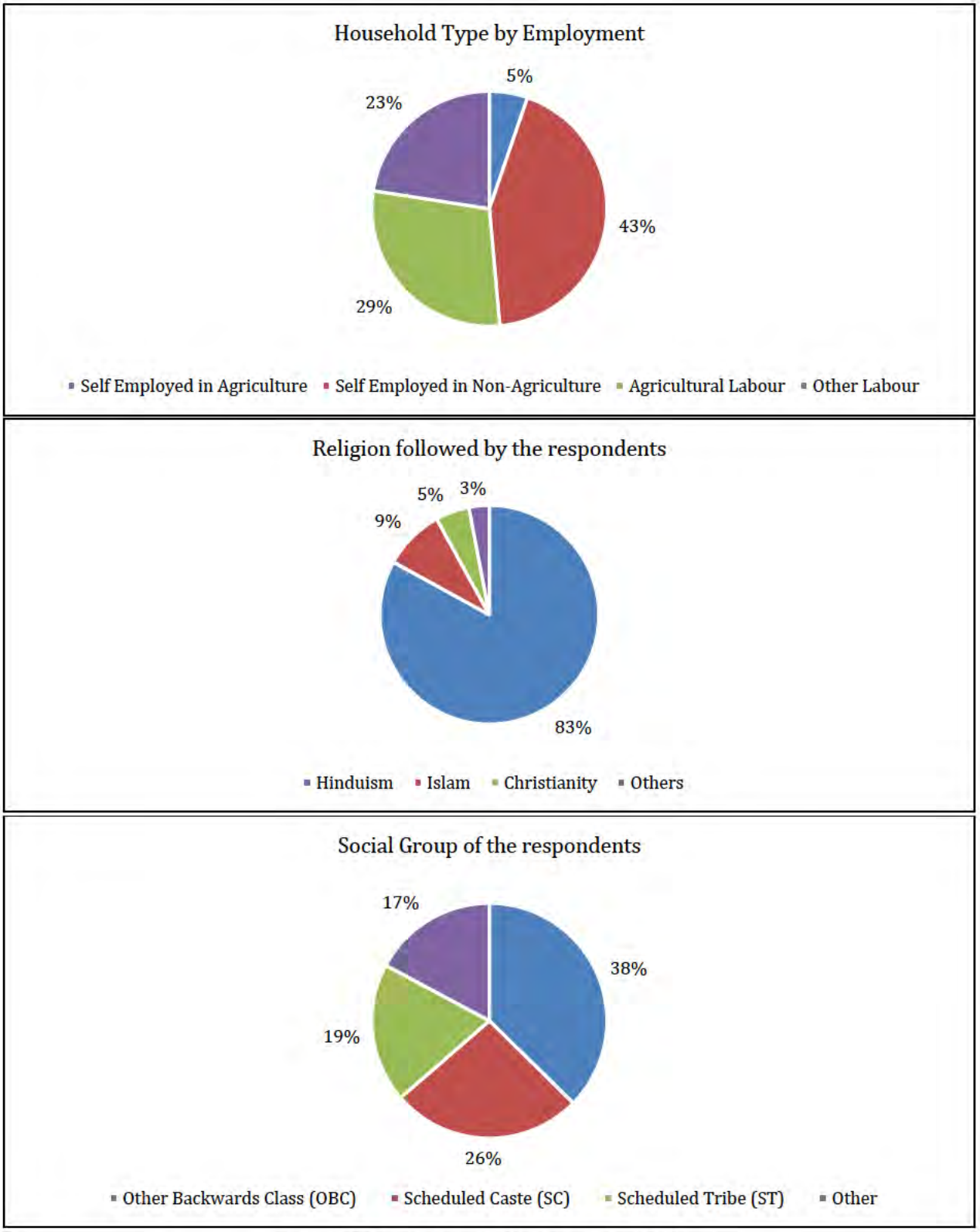


Figure 8: Socio-Demographic Descriptive Statistics

3.3.2.2. Sample Selection

In this study, we used power calculations to understand how well the research can identify real changes or effects. Power calculations help to identify if the study can detect important changes, for instance, increases in income. We used information on how much people spend from a national survey (the 11th schedule of the NSS) for the calculations. The study included a minimum of 30,000 households from 407 districts. With this size, we found that the study can notice a small increase in people's average income by 2.5%, which means we can detect if the average income goes up to INR 1014 from a smaller amount. However, when we investigate specific groups within the study, the ability to detect changes becomes a bit limited. Despite this, we can still observe an increase in income by about INR 50-60 for these groups. Based on the research of Burlig and Preonas (2022) [22], we determined that the average income in the study is INR 988, with a variation (standard deviation) of INR 371. This means while the average income is INR 988, many people earn more or less than this, within a range defined by the standard deviation.

3.4. LIMITATIONS OF THE RESEARCH DESIGN AND ITS MITIGATIONS

In evaluating the impact of the SAUBHAGYA scheme based on this research, it's essential to appreciate the study's innovative approaches while acknowledging certain methodological challenges and limitations that were navigated with careful consideration.

One key challenge stems from the study's ex-post nature, initiated after the scheme's conclusion, which presented difficulties in establishing a traditional control group lacking electricity access. This absence of a direct control group necessitates a nuanced interpretation of the findings, as control groups play a crucial role in causal analysis by offering a baseline for comparison. Despite this, the study innovatively employed alternative analytical methods to circumvent these constraints and provide insightful observations on the SAUBHAGYA scheme's effects.

To address the lack of a strict control group, the research team implemented two distinct analytical strategies. Firstly, the study leveraged a temporal comparison, examining recall values from 2017 (pre-SAUBHAGYA) and 2023 (post-SAUBHAGYA), using time as a variable to discern changes. This approach, although challenged by potential recall biases, offered a creative way to assess the scheme's impact over time. Secondly, the study introduced a group comparison analysis, contrasting the outcomes between households connected to the grid under SAUBHAGYA and those with off-grid (solar) connections. This method provided a comparative perspective, albeit with the acknowledgment that the off-grid group also received benefits through SAUBHAGYA, making it a pseudo-control group.

This methodology allowed for a focused examination of electricity-based outcomes, minimizing the potential confounding effects of other welfare programs. By concentrating on changes directly attributable to electrification, such as improvements in household lighting and energy access, the study aimed to isolate the specific contributions of the SAUBHAGYA scheme. This approach helped in elucidating the direct benefits of electrification, notwithstanding the broader socio-economic shifts occurring concurrently in India.

[22] See earlier footnote for full citation

The second challenge faced in this study pertains to the complexities of data collection, which inherently influenced the scope of the outcome analysis. Despite encountering areas with high nonresponse rates or incomplete data—particularly in variables related to occupational income, health, financial status, and entrepreneurship—the research team embraced alternative approaches to ensure a comprehensive understanding of the SAUBHAGYA scheme's impact.

The study encountered limitations regarding the collection of data on occupational income, leading to a gap in understanding the specific impact of SAUBHAGYA. Furthermore, the data available pertains only to annual or monthly income following the implementation of SAUBHAGYA, with no comparative figures from before the scheme's introduction. As a result, it is challenging to conclusively attribute changes in income levels directly to the electrification provided by SAUBHAGYA. Income data is crucial for analyzing the relationship between electricity access and economic activities, and subsequently, how these dynamics influence wealth accumulation, including the ownership of non-electric assets. Moreover, the high levels of nonresponse in areas critical to understanding the full spectrum of electrification benefits did not deter the research endeavor. Hence, FGDs and IDIs were strategically utilized to bridge the gap, offering rich qualitative data that painted a holistic picture of the scheme's multifaceted impacts. These qualitative methodologies provided nuanced insights into the health, income, financial, and entrepreneurial dynamics post-electrification, complementing the quantitative data collected.

Acknowledging the methodological challenges, the study proceeded with a cautiously optimistic approach, aiming to shed light on the transformative potential of the SAUBHAGYA scheme on the lives of its beneficiaries. The intent was not merely to compile data but to weave together a narrative that reflects the lived experiences of individuals and communities touched by this initiative. While the study's conclusions are drawn with an understanding of the inherent assumptions, they contribute meaningfully to the discourse on electrification's role in socio-economic development. Readers are encouraged to engage with the findings, keeping in mind the noted caveats, as a step towards comprehending the broad and nuanced impacts of such a significant governmental program.

4. DETAILED REGRESSION ANALYSIS OF THE ELECTRIFICATION IMPACT

This section provides summary statistics that delineate the experiences of beneficiaries with their electricity connections. These statistics are presented as raw averages and do not account for variables such as household type, religion, social group, ownership status of the dwelling, and district differences. The data encapsulates various dimensions of electrification impact, for instance, including the distribution of connections per year, the quality of electricity service experienced by beneficiaries, self-reported changes in income, health improvements, and instances of in-migration into households.

The analysis encompasses a total of 33,037 households that were connected under the SAUBHAGYA scheme. A significant portion of these connections were established in 2018 as shown in Figure 9.

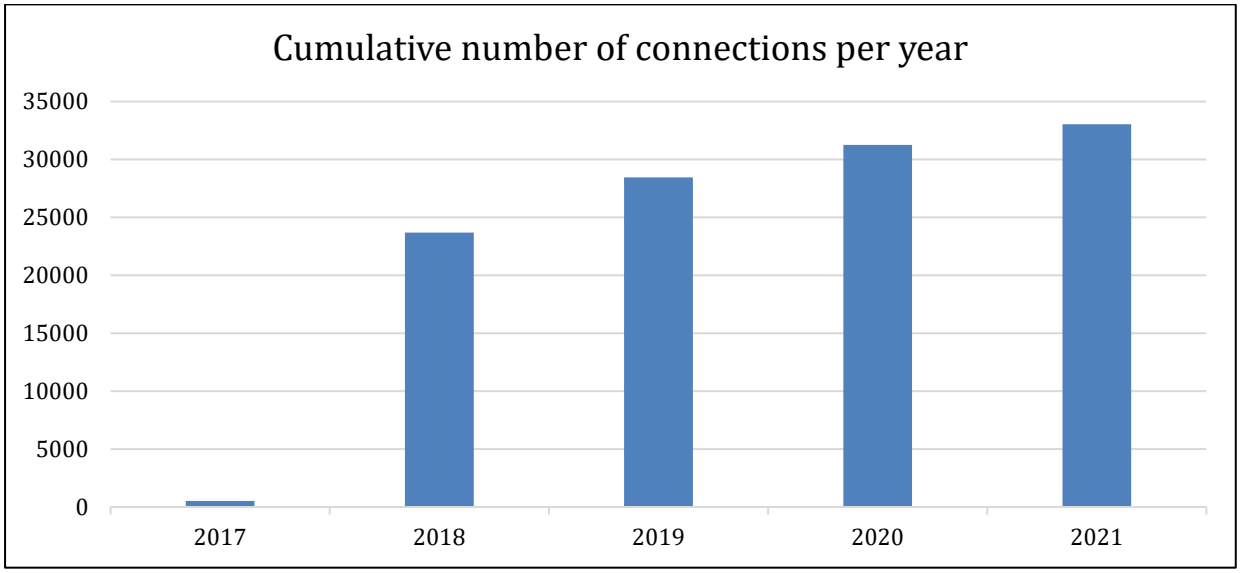


Figure 9: Cumulative SAUBHAGYA Connections (2017-2021); The graph illustrates the steady growth in total connections over the years. (Source: Ground Surveys)

It was observed that a substantial majority of these SAUBHAGYA beneficiaries, approximately 93% (30,724 households), have electricity in at least one room in their dwelling. Furthermore, among these 30,724 households, 59% (18,127 households) reported having electricity in more than one room.

4.1. REGRESSION RESULTS

We performed regression analysis to determine the percent change in outcomes from pre-SAUBHAGYA (2017) to the Present (2023). The results are accounting for household type, religion, social group, rent vs owning their dwelling, and district through fixed effects. This implies that any effect that these characteristics may have on changing asset ownership independent of the SAUBHAGYA program is controlled for, allowing us to comment on any detected trend as likely attributable to SAUBHAGYA. Standard errors are clustered at the district level since program implementation planning occurred at this level of administration.

$$Outcome_{it} = \beta_0 \quad + \beta_1 Post_{it} + \alpha_i + u_{it}$$

Here, $Outcome_{it}$ is the dependent variable for individual (or household) i at time t, β_0 is the constant, β_1 represents the dummy variable indicating the post-period, α_i represents the set of fixed effects

(which include household type, religion, social group, rent vs owning their dwelling, and district), and u_{it} is the error term.

4.1.1. Ownership of Electrical Assets

This section focuses on electrical asset ownership and non-electrical assets. We break down the electrical assets into basic assets that cover primary electrical appliances that influence the day-to-day functions of households. Other electrical assets also affect quality of life but may be considered secondary and are likely more expensive. Figure 10 shows the percent change in basic electrical asset ownership from 2017 to 2023 (adjusted for fixed effects). Figure 11 shows the percent change in ownership for other types of electrical assets from 2017 to 2023 (adjusted for fixed effects) while Figure 12 shows changes in non-electrical asset ownership. It is important to note that these graphs show the percentage change for owning an asset and not the percent change in the number of assets. For example, the number of households owning at least one bulb increased by 23% from 2017 to 2023. It does not matter how many bulbs were owned (beyond the first bulb owned). Overall, the ownership of electrical assets increased over the study period. This is especially true for basic electrical appliances like fans, TVs, bulbs, CFLs, and cell phones. In the other electrical assets, we see big improvements in Tube light ownership, but effects on others (like electrical stoves, electric sewing machines, iron presses, heaters, mixers, and motor pumps) remain small. On average, one electrical appliance was owned pre-SAUBHAGYA. In contrast, four electrical appliances were owned post-SAUBHAGYA, on average. Examining the percent change in ownership of basic electrical assets from 2017 to 2023, this figure highlights notable increases across all assets, with fans experiencing the most substantial growth. The evolving ownership landscape reflects positive trends in the adoption of essential electrical assets over the specified period.

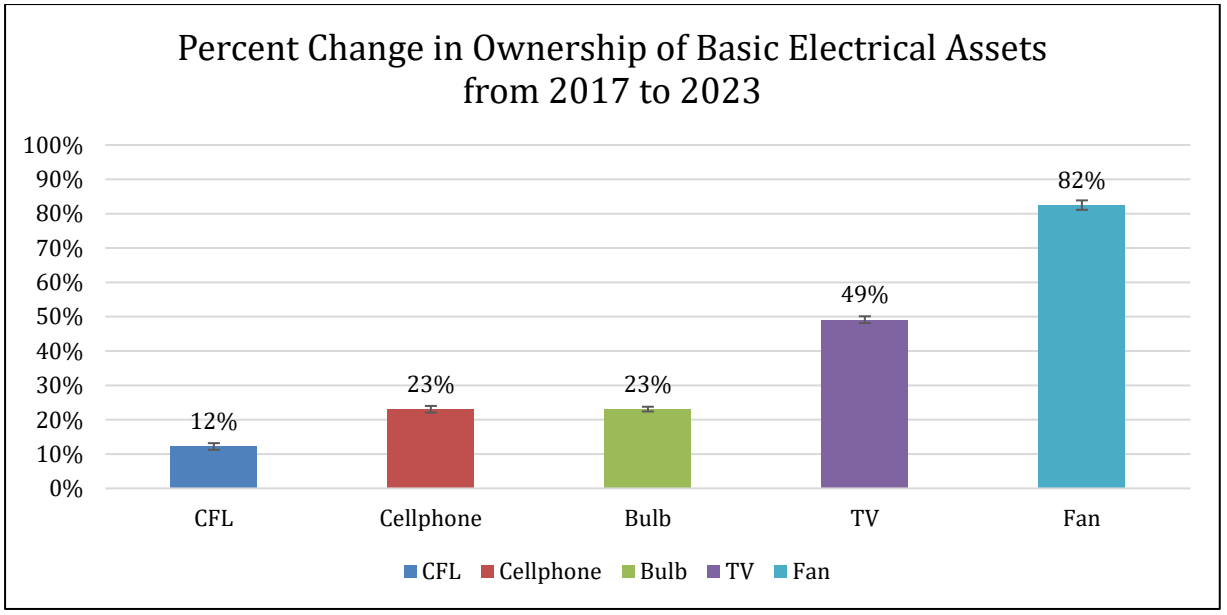


Figure 10: Shifts in Ownership of Basic Electrical Assets

Illustrating the percent change in ownership of various electrical assets from 2017 to 2023, Figure 10 depicts significant increases in all categories. Tube lights exhibit the most substantial growth among the assets, emphasizing a noteworthy shift in the ownership dynamics, reflecting a rising trend in the adoption of these essential electrical items.

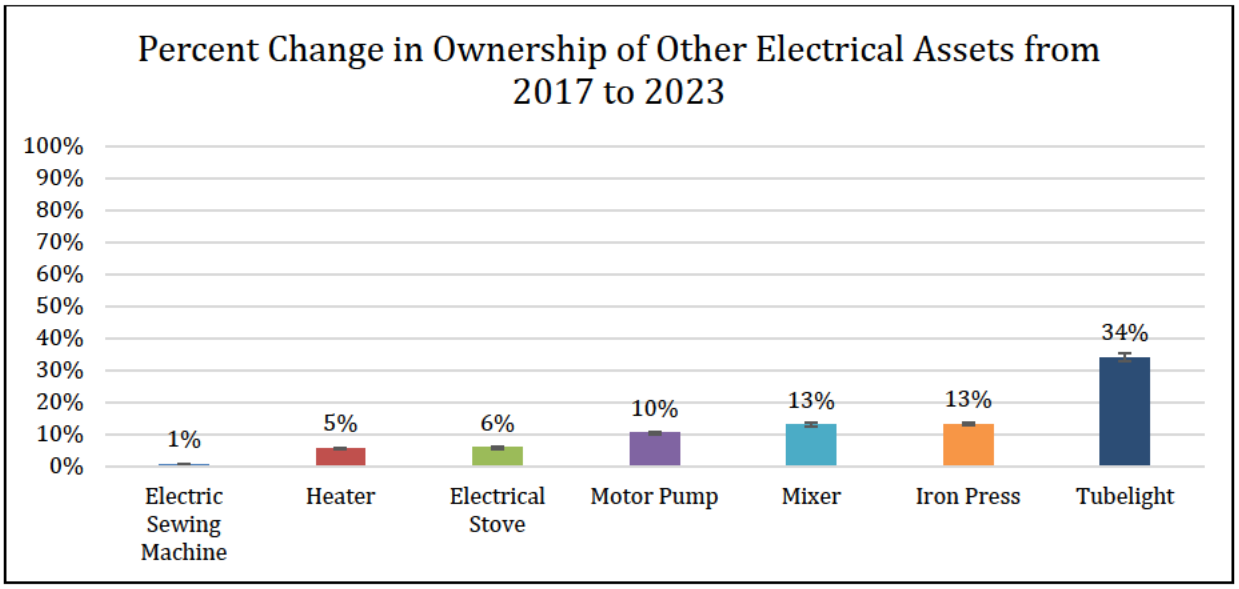


Figure 11: Changes in Other Electrical Asset Ownership

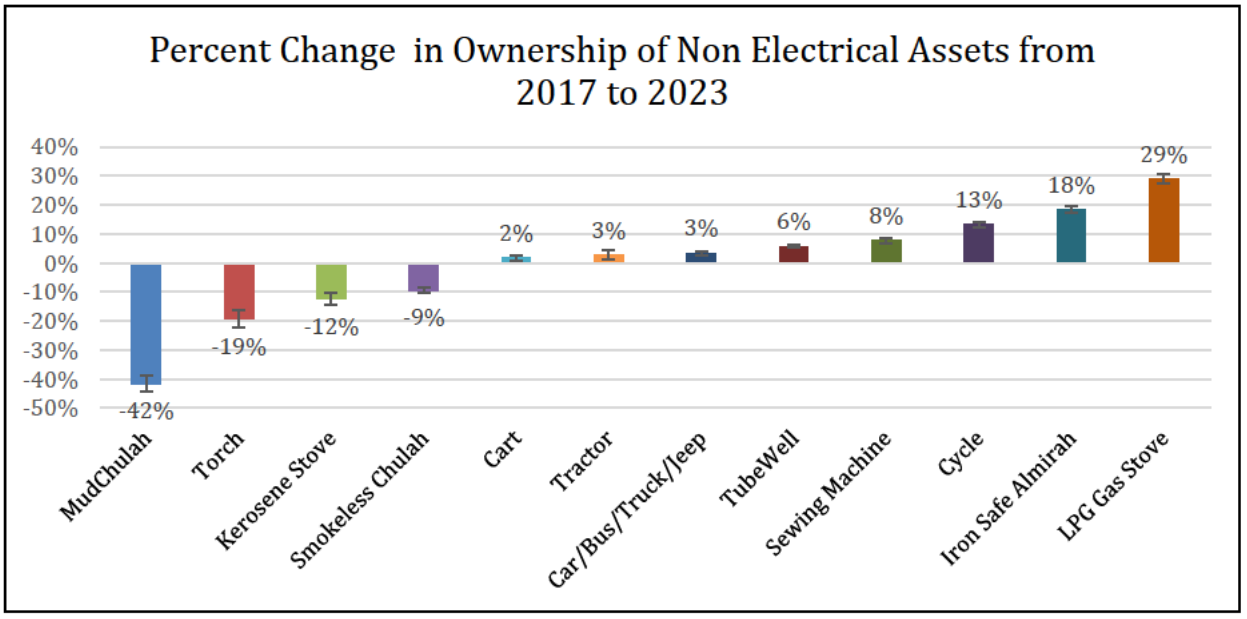


Figure 12: Changes in Non-Electrical Asset Ownership

4.1.2. Fuel Expenditure

This section explores how changes in modern vs traditional fuels are driven by SAUBHAGYA. Modern fuels for lighting include solar, electric bulbs/LED bulbs, and chargeable LEDs while modern fuels for cooking include biogas, LPG, and electric stoves. Traditional fuels for lighting include kerosene, candles, and torches while traditional fuel for cooking includes coal, animal dung, and fuel wood. Overall, there is greater expenditure on modern fuels after a SAUBHAGYA connection than before (and conversely, less expenditure on traditional fuels). Expenditure on traditional fuels decreased in part due to a decreased use of kerosene as people switched to electric lighting. For lighting, we see the largest change on electric bulbs. For cooking, we see the largest change on LPG. However, it is important to note that the expansion of LPG is likely confounded by a concurrent policy that expanded LPG use, and likely not due to SAUBHAGYA. Since we don't see any effects on the take-up of electrical stoves, it is difficult to attribute changes in LPG uses to electrical connections and may be driven by a parallel policy on expanding LPG usage instead of traditional cooking stoves.

Figure 13 presents the percent change in expenditure on modern versus traditional fuels from 2017 to 2023. Notably, there was a significant ~40% decrease in traditional fuel expenditure, accompanied by a ~20% increase in modern fuel expenditure. The data underscores a discernible transition towards greater reliance on modern fuels over the specified period.

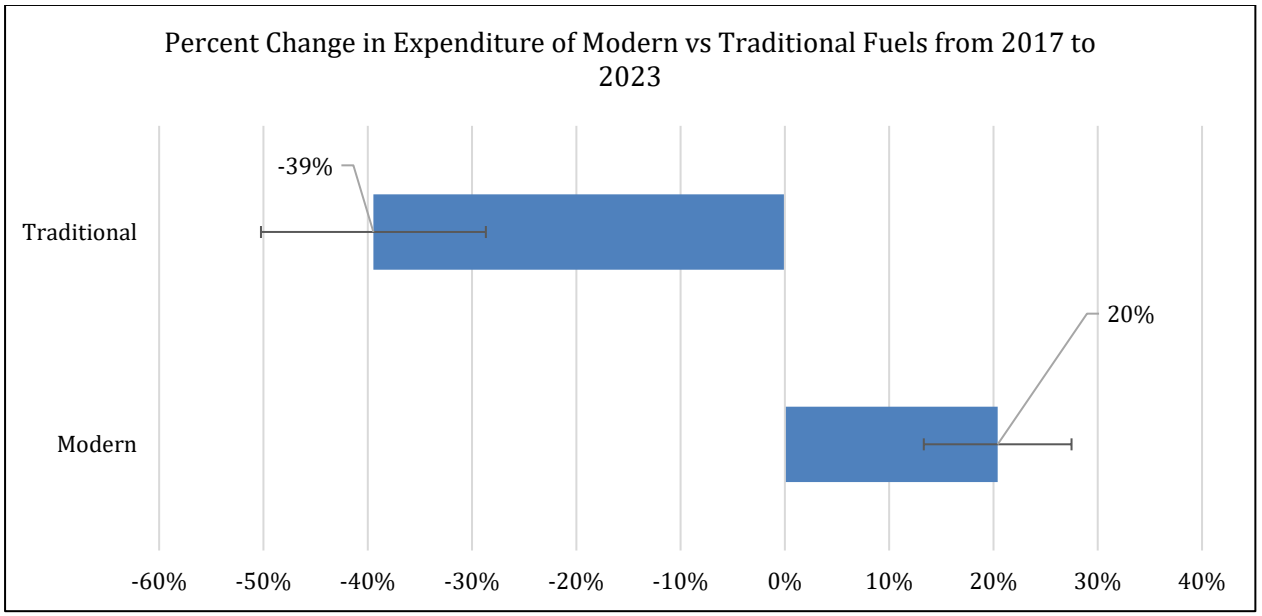


Figure 13: Shift in Fuel Expenditure Trends

Examining the percent change in expenditure on lighting fuels from 2017 to 2023. Figure 14 shows shifts in spending on fuels for lighting. The most notable changes were observed for bulbs, emphasizing a significant transformation in energy consumption patterns towards modern energy and away from traditional lighting sources over the specified period.

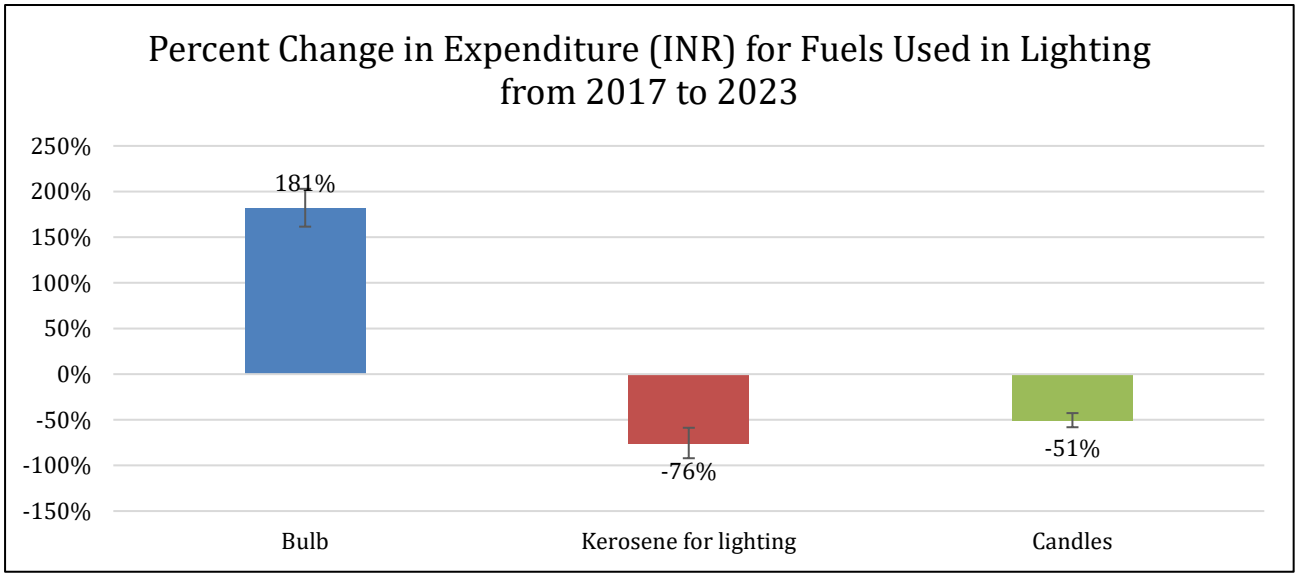


Figure 14: Dynamics of Expenditure on Fuels for Lighting

Examining the percent change in expenditure on all fuels from 2017 to 2023, Figure 15 highlights significant shifts in consumption patterns. Again, bulbs, kerosene for lighting, and candles experienced the most substantial changes, reflecting transformative trends in energy preferences and utilization over the specified period.

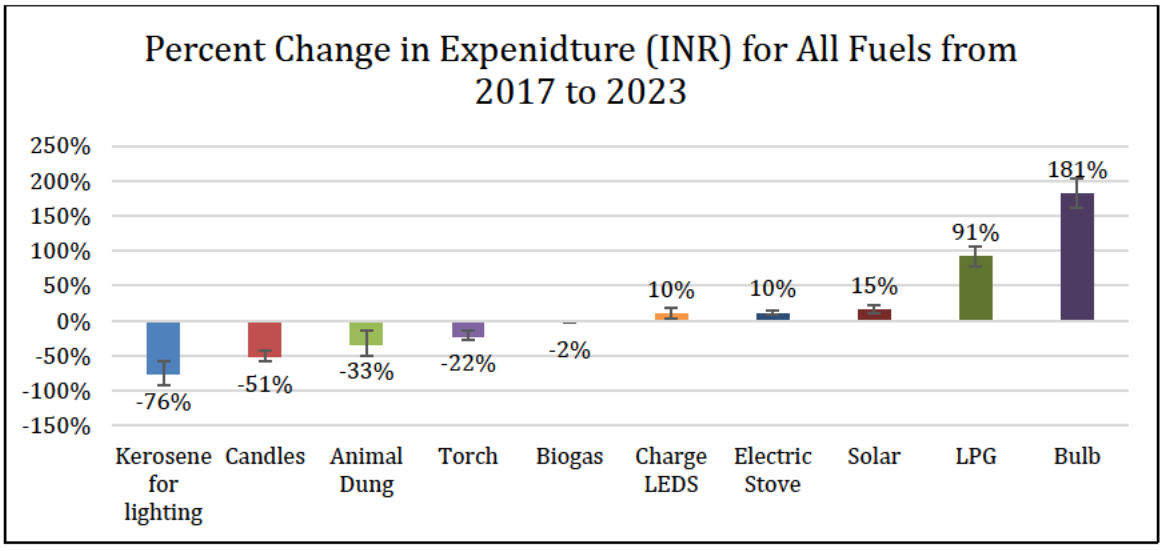
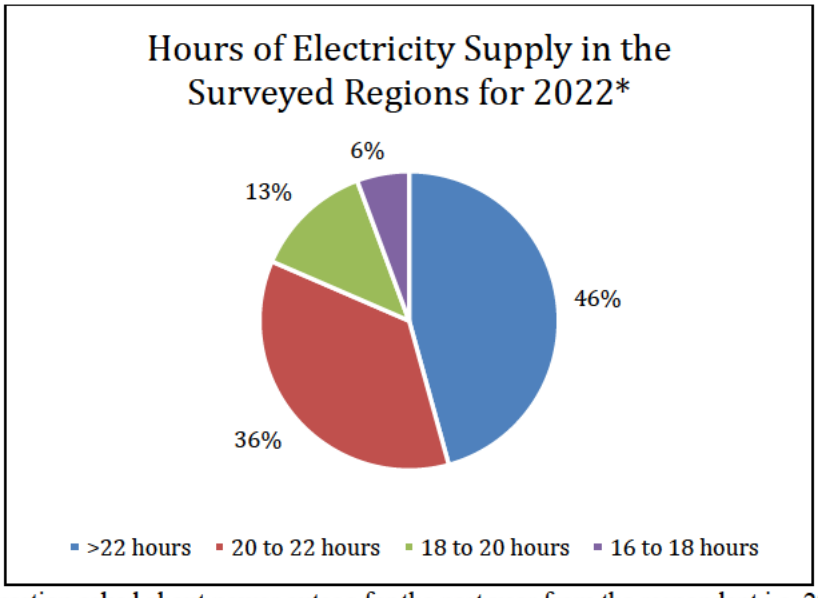


Figure 15: Evolution of Fuel Expenditure for All Fuels

4.1.3. Observations on Power Quality

Figure 16 depicts the electricity supply in the summer, which is not dissimilar to the winter supply with summer experiencing slightly greater outages. The majority of respondents observed few power outages (between 0-4 hours) and either no voltage issues or slight fluctuations. This compares well with estimates reported in the Ministry of Power's 2023 Year-end review which finds that the average availability of power has increased to 21.7 hours per day in rural areas and 23.3 in urban areas.[23] The average supply of power reported by SAUBHAGYA households is not (statistically) significantly different from MOP estimates of power supply.



(*Question asked about power outage for the past year from the respondent i.e. 2022)

Figure 16: Seasonal Outages

[23] https://pib.gov.in/PressReleasePage.aspx?PRID=2041634

When asked "What kind of voltage issues did you experience in the last year", the majority reported no voltage issues (58%) or slight fluctuations (37%). Very few reported brownouts (3%), blackouts (2%), or appliances fusing out (<1%).

Figure 17 depicts responses to the question "How would you rate the overall quality of supply and services by DISCOM?". >80% of the respondents expressed a positive sentiment, with "good" being the prevailing choice, reflecting a favorable perception of the overall service quality.

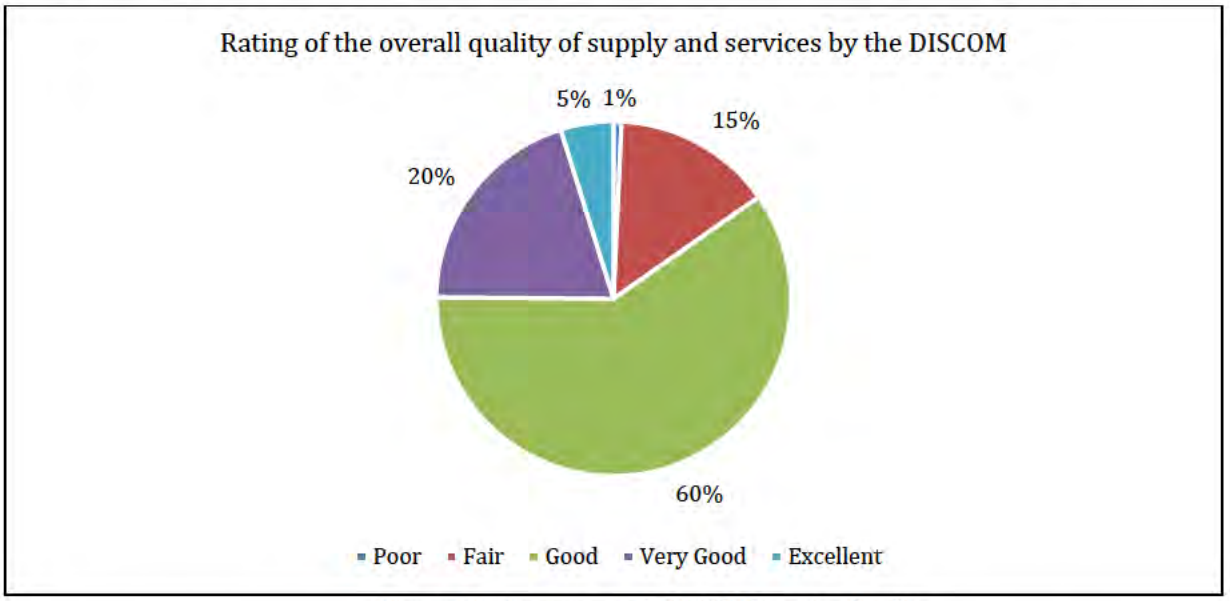


Figure 17: Assessment of DISCOM Service Quality

Figure 18 presents responses to the question 'How would you rate the availability of uninterrupted power supply by your DISCOM?' A predominant consensus (84%) emerges that the availability is good or better, with a majority of respondents rating the service as 'Very Good,' indicating a high level of satisfaction with the continuous power supply provided by the DISCOM.

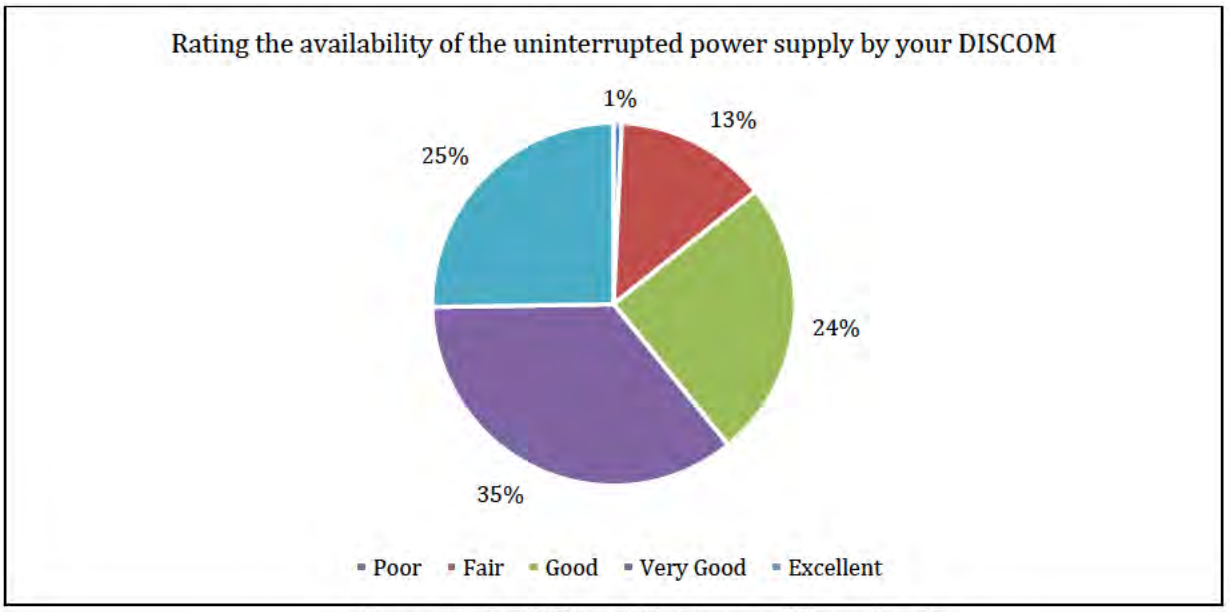


Figure 18: Availability of Uninterrupted Power Supply

4.1.4. Impact on key aspects like Income & Health

In the context of the SAUBHAGYA scheme's impact on household health outcomes, it is noteworthy that among respondents who reported a health issue prior to obtaining a SAUBHAGYA electricity connection, a significant majority (61%) observed an improvement in the health condition post-electrification. This observation suggests a potential correlation between electrification and enhanced health outcomes within these households. Electricity can improve both respiratory health and eye strain through specific mechanisms. First, electricity reduces kerosene usage for lighting, which can produce high levels of indoor air pollutants, including carbon monoxide, nitrogen dioxide, carbon dioxide, and sulfur dioxide, all of which can negatively impact respiratory health[24]. Second, electricity provides higher lumens than candles or kerosene lamps, thereby reducing eye strain[25]. However, it is crucial to consider concurrent environmental and health policy interventions, notably the shift towards liquefied petroleum gas (LPG) for cooking. The transition from traditional biomass stoves, which contribute to indoor air pollution through particulate emissions, to cleaner LPG cooking solutions could also be a contributing factor to the reported health improvements. Thus, while the SAUBHAGYA scheme may have direct and indirect benefits on household health, the observed health improvements might also be influenced by parallel reductions in indoor air pollution due to increased adoption of LPG cooking methods which was supported by policies such as PMUY or Ujjwala. Figure 19 represents responses to the question 'Have you or your family members had any health problems in the last 5 years/ Pre SAUBHAGYA. About 42% report having health problems. Figure 20 represents responses to the question 'Has your or your family member's health problem improved since electrification/SAUBHAGYA connection, given an existing condition pre-SAUBHAGYA?' The majority of respondents provided an affirmative response, indicating a positive impact on health conditions following electrification.

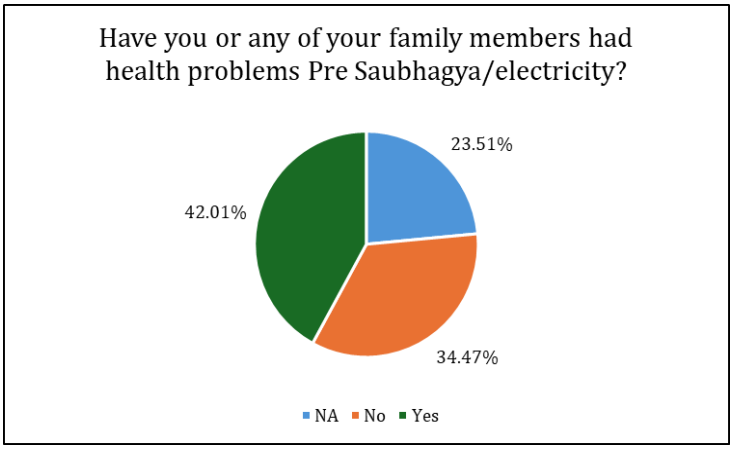


Figure 19: Types of Health Problems Pre SAUBHAGYA Connection

[24] Barron, M., & Torero, M. (2017). Household electrification and indoor air pollution. Journal of Environmental Economics and Management, 86, 81-92.; Capuno, J. J., Tan Jr, C. A. R., & Javier, X. (2018). Cooking and coughing: Estimating the effects of clean fuel for cooking on the respiratory health of children in the Philippines. Global public health, 13(1), 20-34.

[25] Gustavsson, M. (2007). Educational benefits from solar technology—Access to solar electric services and changes in children's study routines, experiences from eastern province Zambia. Energy Policy, 35(2), 1292-1299.

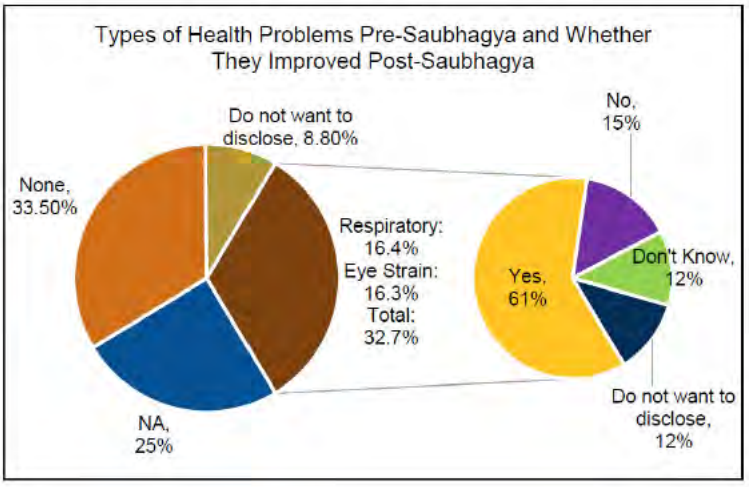


Figure 20: Health Improvement Post SAUBHAGYA Connection

Figure 21 illustrates responses to the question "Has your income in the income-generating activity gone up since SAUBHAGYA?" While the majority answered "No", nearly 30% answered "Yes". The increase in income in their respective business/ profession like agriculture or labor activities cannot be directly attributed to the availability of "household" electricity.

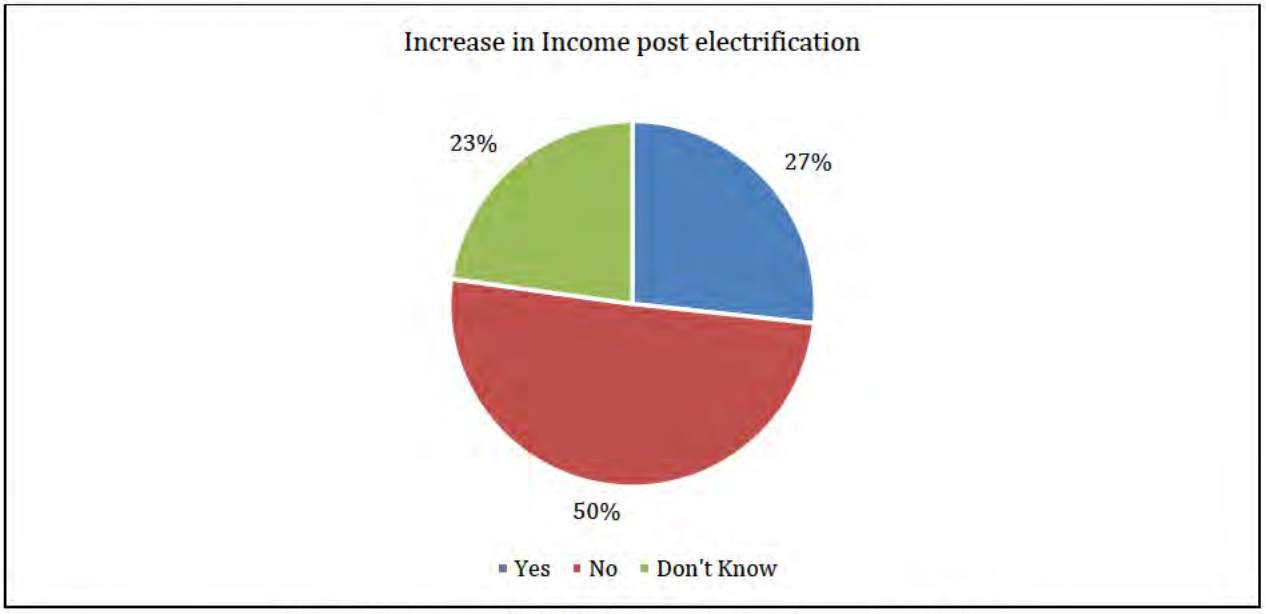


Figure 21: Impact of SAUBHAGYA on Income Generating Activities

The observed increase in migration into households after receiving the connection (denoted as time point 0 in Figure 22) while an important finding that needs further scrutiny. Data pertaining to this phenomenon was gathered through inquiries directed at households regarding the presence of members above the age of 5 prior to September 2017. It's important to acknowledge that the method used for collecting data deviated from the initial plan, which was to gather detailed information on every individual living in the household. Instead, the approach taken provided a one-year snapshot, likely capturing the most recent addition to the household rather than offering a detailed account of all newcomers. This approach might lead to an underestimation of the migration into households that occurred before the SAUBHAGYA scheme was implemented, potentially affecting the accuracy of the observed increase in migration. This situation highlights the need for improved data collection methods to accurately reflect migration patterns and their relationship with electrification efforts.

Figure 22 depicts the phenomenon of migration into households since receiving an electrical connection. The data reveals that the majority of migrations occurred around the 5-year mark.

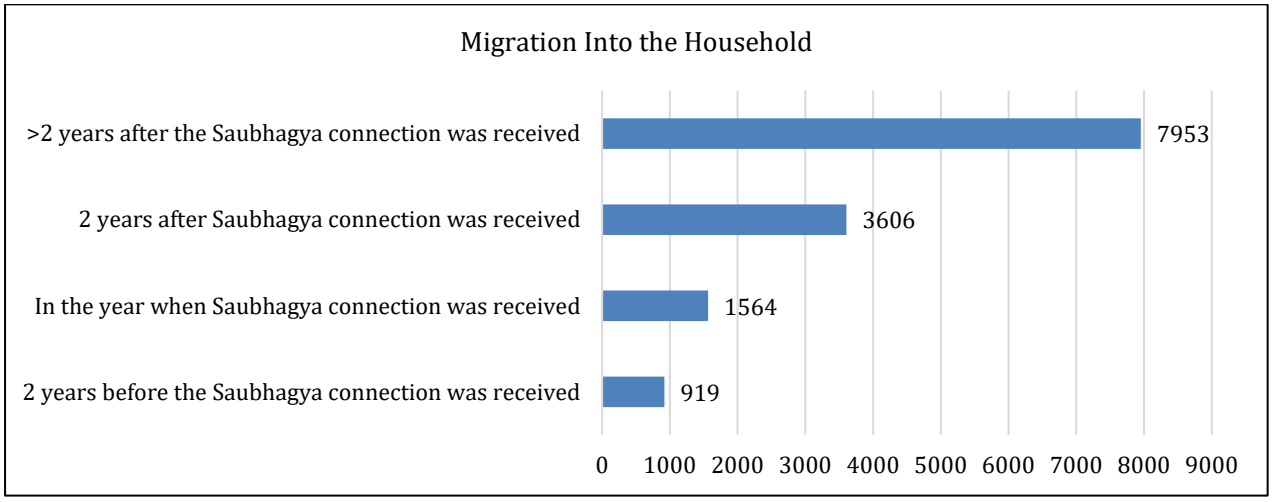


Figure 22: Influx of New Household Members Post-Electrification

4.1.5. Time usage

This section explores how children's, women's, and men's time usage changed from 2017 to 2023. We have divided time usage into 6 categories: Employment, Own Production, Domestic Work Leisure, Self-Care, and Education. Employment entails wage-generating work and includes agriculture related work, wage labor, working in a shop or business, and working a government job. Own production is the production of goods for own final use and includes taking care of animals and fuel wood/fodder collection. Domestic work is chores done around or for the home and includes cooking/eating/serving food, childcare, overseeing children playing (for men and women), going to the market, and cleaning utensils/filling water. Leisure includes entertainment related activities, reading during the day, children playing (for children) and talking with neighbors/family members. Self-care includes sleeping/relaxing and using the bath/toilet. Finally, education includes attending school and reading at night (for children).

Overall, there is more time spent on enrichment activities (such as employment, leisure, and self-care) and less time spent on sustainment activities (such as domestic work and own production). For example, both men and women spent more time on wage-generating activities, with women spending almost 1.8 hours more and men spending almost 1 hour more on employment activities. For leisure, all were able to spend at least an hour more, with children almost 2 hours more. For self-care, women spent just over half an hour more, men spent 1 hour more, and children spent over 12 minutes more. For children's education specifically, children spent over half an hour more reading at night. There is less time spent in the production of goods for own final use and domestic work. Women and men both spent around 20-40 minutes less on own production. Women spent almost 2 hours less, men spent almost 1 hour less, and children spent almost 12 minutes less on domestic work.

Figure 23 portrays the change in time usage (both as hours and as a percentage) on employment activities from 2017 to 2023. Notably, both women and men witnessed an increase of over an hour or more in the time allocated to employment-related activities, highlighting evolving patterns in work engagement over the specified period.

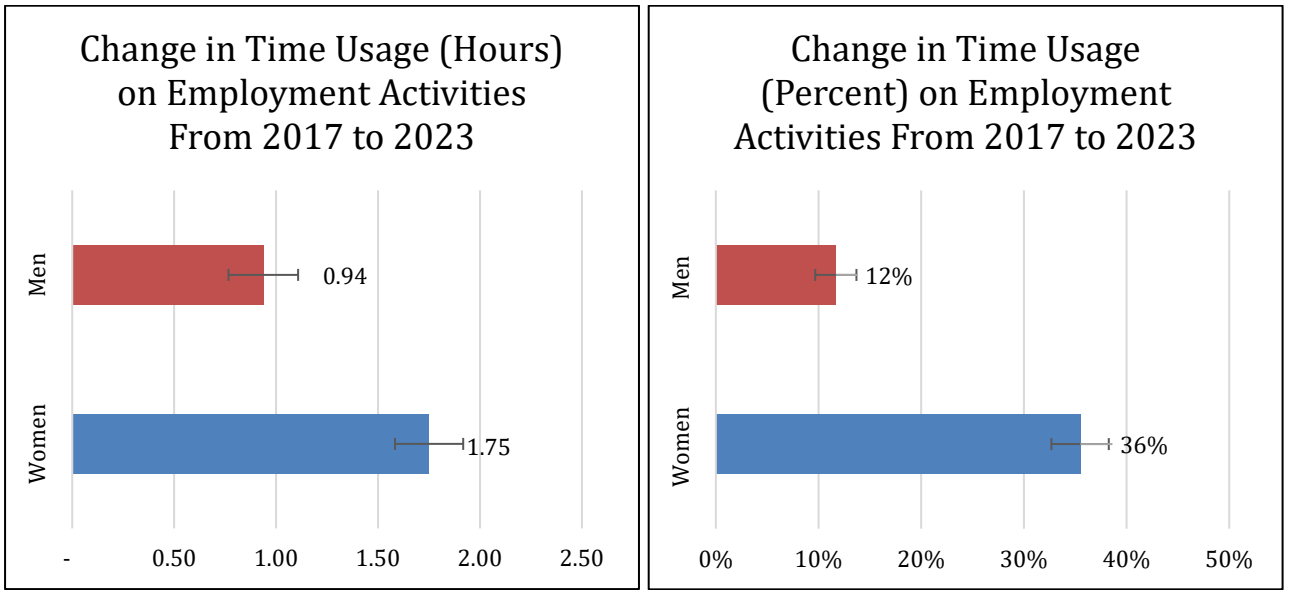


Figure 23: Shifts in Time Allocation for Employment

Figure 24 below illustrates the change in time usage (both as hours and as a percentage) on the production of goods for own final use from 2017 to 2023. Both women and men witnessed a notable decrease in the time allocated to this activity, indicating shifting patterns in production practices over the specified period.

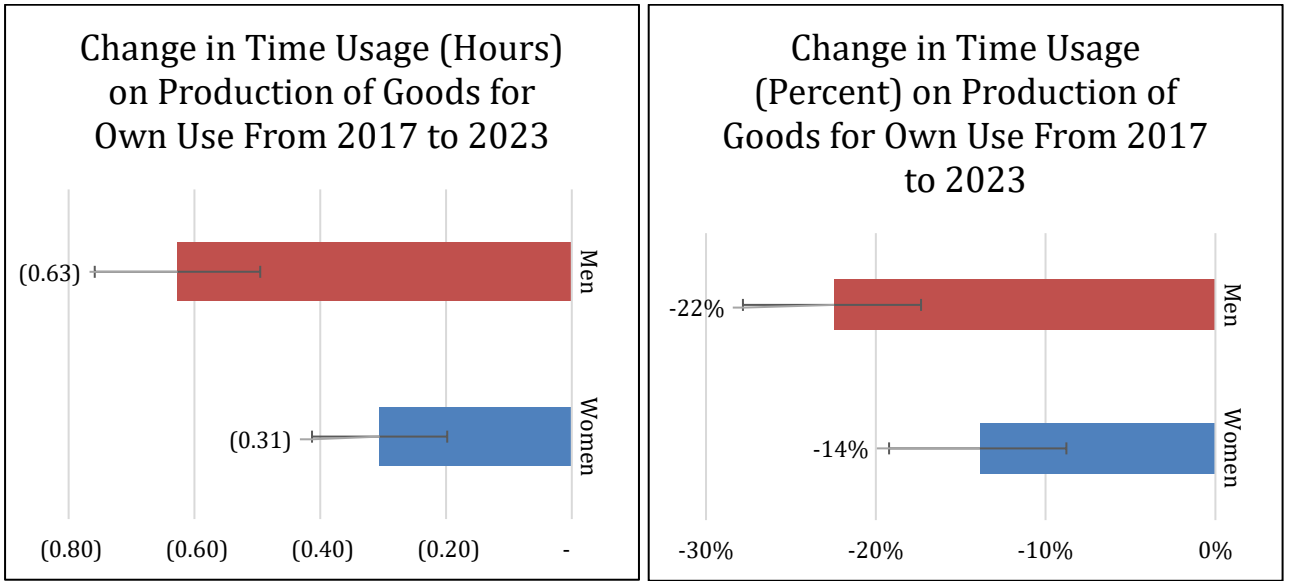


Figure 24: Temporal Dynamics in Own Production

Figure 25 illustrates the change in time usage (both as hours and as a percentage) on domestic activities from 2017 to 2023. Interestingly, the most notable decrease in dedicated hours is observed among women, while the most notable decrease as a percentage is observed among children. Men also observed a decline.

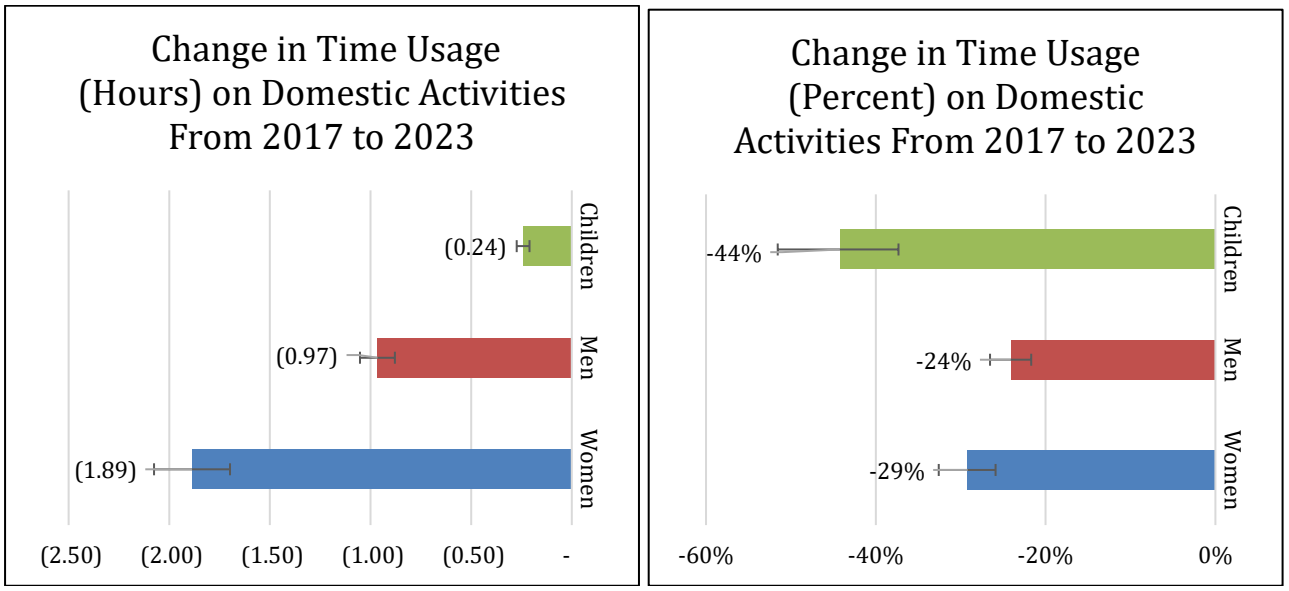


Figure 25: Time Allocation Shifts in Domestic Activities

Illustrating the change in time usage (both as hours and as a percentage) on leisure activities from 2017 to 2023, Figure 26 demonstrates a universal increase across women, men, and children, surpassing an hour. The data suggests a notable upward trend in the allocation of time to leisure pursuits over the specified period.

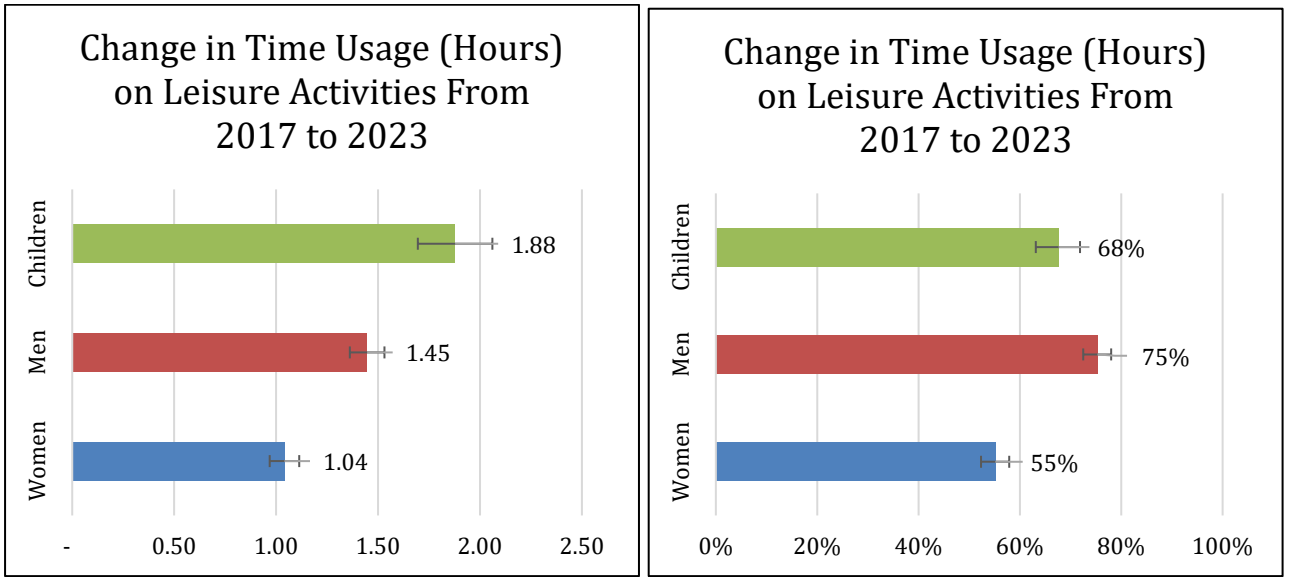


Figure 26: Leisure Time Dynamics

Figure 27 illustrates the change in time usage (both as hours and as a percentage) on self-care activities from 2017 to 2023. Notably, there is a universal increase in time allocated to self-care, with men exhibiting the most pronounced growth.

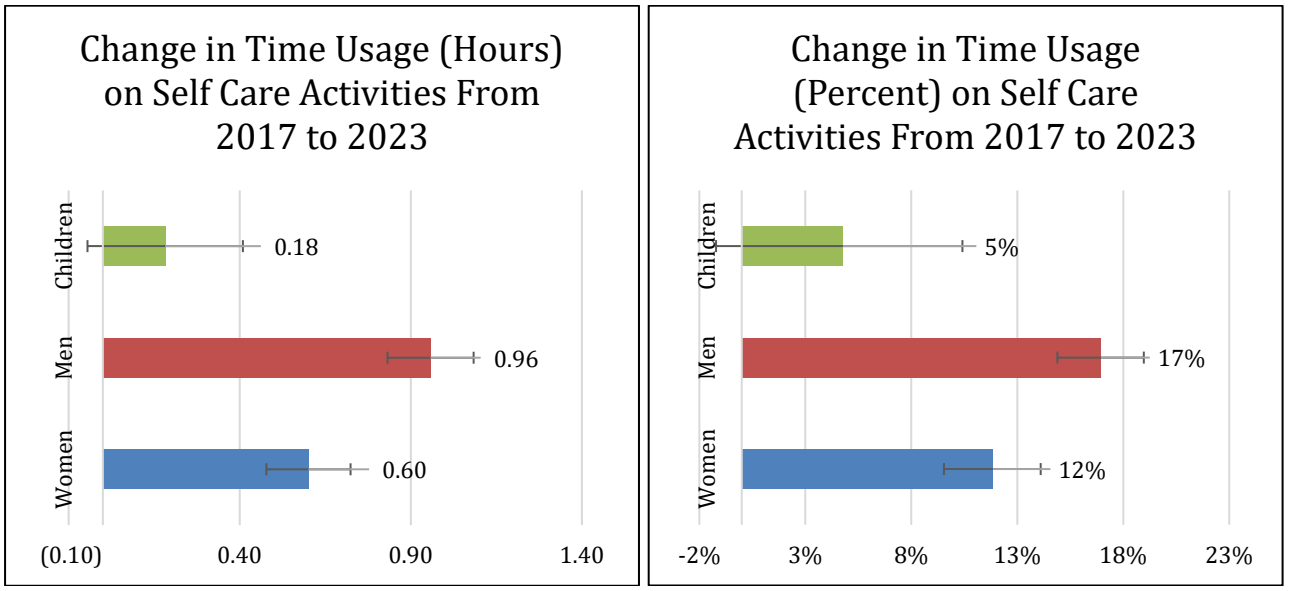


Figure 27: Temporal Shifts in Self-Care

Figure 28 illustrates the change in time usage (both as hours and as a percentage) dedicated to educational activities from 2017 to 2023. The data reveals a consistent upward trend, indicating an overall increase in the allocation of time towards educational pursuits during the specified period. It is important to note education includes time spent in school and reading at night.

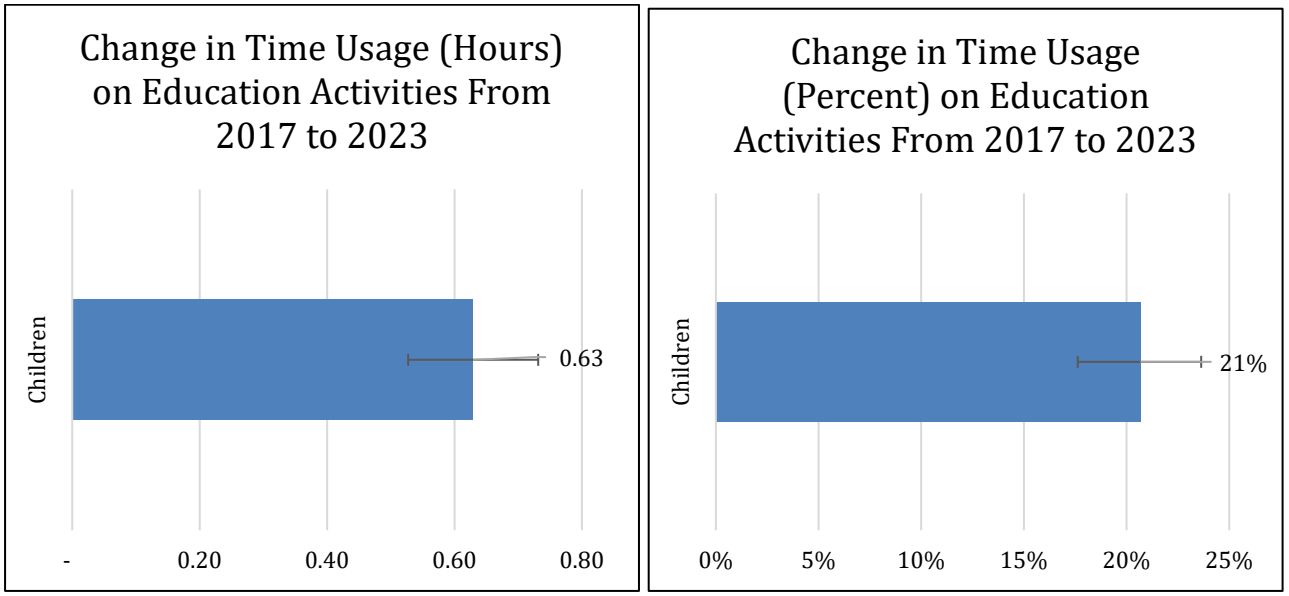


Figure 28: Enhanced Commitment to Education

4.1.6. Household Consumption

This section explores how household expenditure changed from 2017 to 2023.

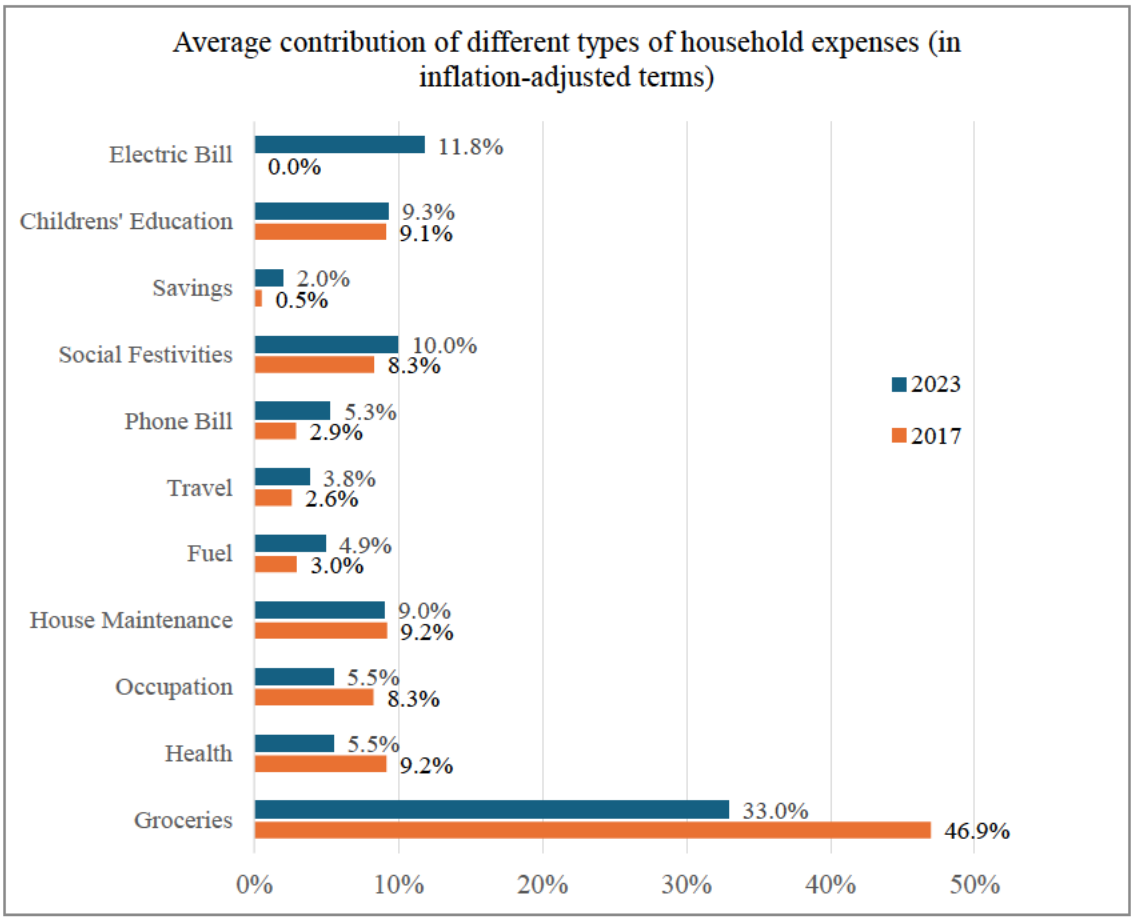


Figure 29: Dynamic Trends in Household Consumption in real (inflation-adjusted) terms

Figure 29 shows the average contribution of each major category of household expenditure for which we collected data Pre- (2017) and Post-SAUBHAGYA (2023). Please note that this figure is only for households that reported no expenditure on electricity pre-SAUBHAGYA and also that we estimate average shares based only on the total expenditure across the categories for which we specifically collected and not total monthly expenditure. Expenditure on each item in the figure is adjusted for inflation for the respective basket of commodities.[26] Some types of expenses are clearly directly impacted by SAUBHAGYA such as electricity bills, some are likely directly or indirectly impacted by SAUBHAGYA such as health expenditure (which declines) while other expenses are likely not due to SAUBHAGYA (such as groceries or travel) but shown for the sake of comprehensiveness. It is worth reiterating that due to the lack of a control group and information on baseline income, it is difficult to say how much of this was attributable to SAUBHAGYA. The increase in average electricity expenditure is unsurprising and largely attributable to SAUBHAGYA. Households report spending about 12% on electricity in 2023 compared to no expenditure before SAUBHAGYA. which points to a substantial willingness to pay for electricity, which in turn points to the value of electricity services to beneficiaries. An increase in spending on phone bills and modern fuel can also be plausibly attributed to electricity access. We also find that spending on health decreased to 5.5% in 2023 from 9% in 2017 which is consistent with households reporting improved health outcomes (See

[26] Category specific CPI increase from 2017 to 2023 used to compare changes in real terms were as follows (Food and beverages: 1.4427, Housing: 1.332, Fuel and Light: 1.3476 and Miscellaneous/Other: 1.3378

Figures 19 and 20), which can be partially attributed to SAUBHAGYA. Total expenditure across all items for which data was collected increased by 33%, which is consistent with rising monthly incomes. Expenditure on fuel increased from 3% in 2017 to 4.9% in 2023 which is consistent with an overall increase in expenditure from rising income.

It is important to note that the median income of the survey respondents was 7500 Rs while the national minimum monthly income was 5340 Rs. However, it is important to caveat that there are some areas of nonresponse for household consumption. Some categories received a high degree of response: groceries (91%), house maintenance (90%), health (90%), and kids' education (90%). Other categories received a lower degree response: travel (46%), insurance (3%), and other (3%). While the rest fell somewhere in the middle with around 60-75% responding. In addition, some households do not report positive expenses in all categories. There are other caveats as well. Changes in bank/ SHG/ savings, groceries, and education could be a function of many things, but it is not implausible that SAUBHAGYA played a role via an income effect. However, it is difficult to fully attribute these changes to SAUBHAGYA without more information, such as the ability to track employment and economic activity as a direct result of electricity access. Analyzing the change in household consumption from 2017 to 2023, this figure highlights notable shifts in spending patterns. The most substantial increases were observed in groceries, kids' education, electric bills, and bank/SHG/savings.

4.2. COMPARISON OF GRID-CONNECTED BENEFICIARIES WITH OFF-GRID BENEFICIARIES

We next compare two groups of beneficiaries - the Off-Grid group and the Grid group. The Off-Grid group was part of the SAUBHAGYA program but received only solar panels since such households were deemed too far away from the grid to be connected. The Grid group was part of the SAUBHAGYA program that received an electrical connection to the grid. However, there are a couple of caveats with this analysis. First, only 3.75% of the sample received an off-grid connection. Second, the off-grid connection group is still "treated" in the sense that they received a solar connection due to SAUBHAGYA. A pure comparison group would have experienced no changes during the study period. Additionally, the off-grid group is fundamentally different from the grid group by virtue of being remotely located. In order to draw causal inference, we would need to credibly assume that the Off-grid group and Grid-group are either similar to each other in the pre-SAUBHAGYA period, or the difference between the outcomes of these two groups remain constant over time (parallel-trends assumption) such that in the absence of the SAUBHAGYA program, we could use earlier outcome trajectories to estimate how electrification affected the Grid-group by comparing the deviance in trajectories. Collecting multiple time points of accurate data from a pre-SAUBHAGYA period based on recall would not have been feasible, implying we cannot test if the parallel trends assumption holds. To examine whether these groups are similar, we compared summary stats for both the grid and off-grid groups, which can be found in the Appendix 7.3. Overall, more of the grid group was self-employed in agriculture, whereas the off-grid group largely identified is engaged in other types of work. Both groups are similar in the proportion of households that own their home. However, there are some differences in social characteristics. Whereas the majority of households in both groups practice Hinduism, a larger share in the off-grid group practice Islam. Whereas most of the grid group is other backward class, most of the off-grid group is scheduled caste.

Given that these groups are very different on both economic and social characteristics which are often criteria to target several other government programs and benefits, attributing a change in outcomes between 2017 and 2023 only to the SAUBHAGYA program becomes challenging. Fundamental ways in which these groups differ are also a part of such an estimation. With this caution in mind, we describe some mean comparisons below.

In order to compare outcomes for these groups, we compare mean trends in how outcomes for these groups changed from 2017 (pre-SAUBHAGYA) to 2023 (post-SAUBHAGYA). In *Table 6*, we highlight the group-specific change in means over time and how this trend differs across the groups in order to see if the grid households had a different effect than the off-grid households. While this analysis is analogous to a difference-in-differences methodology in spirit, we refrain from interpreting it as such since our data does not allow testing for the prerequisites for difference-in-differences like parallel trends in outcomes using at least 2 periods of pre-SAUBHAGYA data. Such tests ensure that the trends in outcomes for these groups were moving parallelly over time without the introduction of SAUBHAGYA and any relative change in the trend post-SAUBHAGYA can be attributed to the scheme. Since we are unable to do this and the two groups appear different from each other, we only present mean differences in the trends as suggestive evidence without attributing causality in the absence of further information.

Table 6: Household Asset Ownership

Outcome	**Mean Value for 2017**		**Mean Value for 2023**		**Difference between the within-group changes**
Household Ownership	**Off-Grid**	**Grid**	**Off-Grid**	**Grid**	**(Change in Off-Grid - Change in Grid)**
At Least 1 Electrical Asset (%)	71.01	79.87	100.00	99.73	9.13%
Total Number of Electrical Assets	0.91	1.05	1.98	3.81	-1.68
Basic Electrical Assets (Percent of Households that Own at Least One of the Asset)					
Bulbs	0%	4.34%	0%	28.29%	-23.95%
Cell Phone	40.26%	72.18%	100%	93.46%	38.46%
Fan	0.%	4.29%	48.15%	88.54%	-36.10%
Television	0%	6.01%	0.08%	56.85%	-50.75%
CFLs	0%	0.15%	0%	12.70%	-12.55%
Other Electrical Assets (Percent of Households that Own at Least One of the Asset)					
Electric Stove	0%	0.18%	0%	6.31%	-6.12%
Electric Sewing Machine	0%	0.01%	0%	0.96%	-0.95%
Tubelight	0%	0.30%	0%	35.97%	-35.67%
Iron Press	0%	0.64%	0%	14.34%	-13.70%
Heater	0%	0.70%	0%	6.51%	-5.81%
Mixer	0%	1.29%	0%	14.91%	-13.62%
Motor Pump	0%	4.46%	0%	15.39%	-10.93%

There are several main takeaways from this analysis. In the pre-period, the grid group had a slightly larger percentage of households owning at least one electrical asset. In the post period, all households owned at least one electrical appliance (29% increase for off-grid, 20% increase for grid), which is represented in Figure 30 below. Additionally, in the pre-period, both groups owned similar levels of total number of electrical assets. In the post-period, both groups increased ownership, but the grid group owned significantly more electrical assets (117% increase for off-grid, 263% increase for grid). We also looked at key electrical assets of interest. Mobile phone penetration was low for the off-grid group in the pre-period. However, there was a large jump from the pre-period to the post-period that bridged the gap between the two groups (60% increase for off-grid, 19% increase for grid, bringing both above 90% penetration in 2023). For electrical fans, both the grid and off-grid groups majorly increased ownership between the pre-and post-period, but the grid group experienced a larger increase (48% increase for off-grid, 84% increase for grid). For televisions, only the grid group experienced a significant increase in ownership (0.08% increase for off-grid, 50% increase for grid). For CFL lighting, there was no change in ownership for the off-grid group, however, there was a small increase in ownership for the grid group (0% increase for off-grid, 12% increase for grid). In other electrical assets, the off-grid group did not have any increases in ownership (all 0%), while the grid group had small to moderate increases with the largest change being tube lights (35%).

In this analysis, we also examined differences between the two groups for fuel expenditure. Comparing the grid and off-grid groups, the off-grid group increased their use of modern fuels more, increasing from 0Rs to 1927.7Rs, while the grid group increased from 858Rs to 991.25Rs. For traditional fuels, the grid group decreased their consumption from 309Rs to 251Rs, while the off-grid group increased from 14.65Rs to 134.24Rs(see Table 11 in Appendix). For kerosene expenditure, the grid group used 40% more kerosene for lighting in the pre-period than the off-grid group. In the post-period, the grid group decreased kerosene usage by nearly 40% (when compared to the pre-period off-grid group). However, there were no changes in kerosene usage for the off-grid group between the pre- and post-periods. Kerosene for lighting is particularly important to examine for the grid group as decreased usage is likely because of the grid connection, especially since there are positive increases in bulb and tube light ownership. However, it is important to caveat this analysis since there is missing information for the off-grid group in the pre-period. There is little to no usage of any fuel aside from kerosene, so it is difficult to establish a baseline to compare them against the post-period or against the grid group.

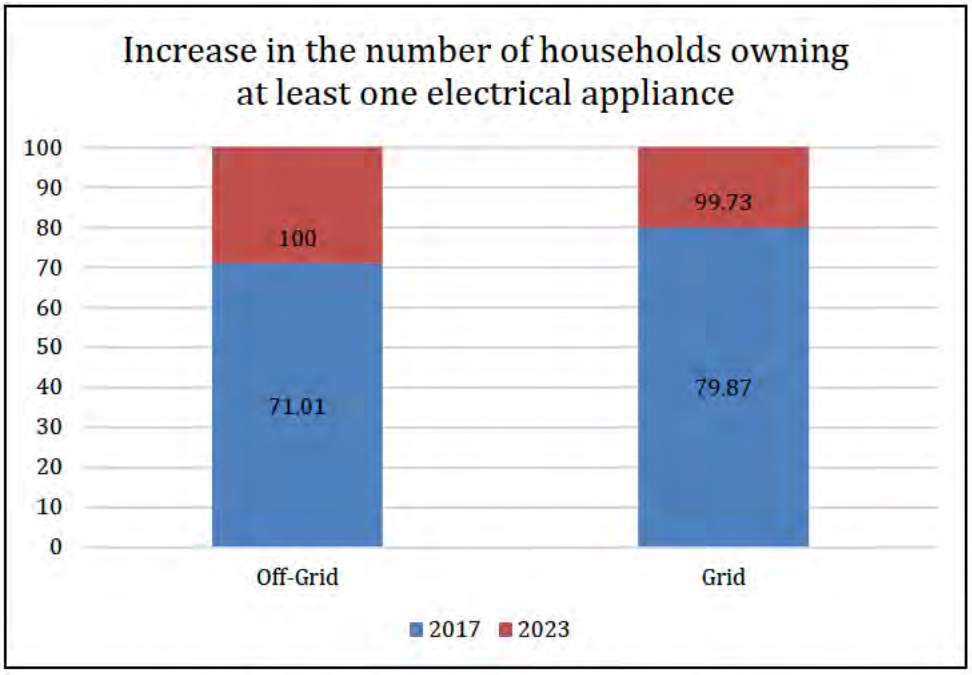


Figure 30: Change in Penetration of Electrical Appliances

5. LINEAR DATA ANALYSIS OF THE ELECTRIFICATION IMPACT

The impact assessment was aimed at providing holistic understanding of the impact of electrification (see Figure 31).

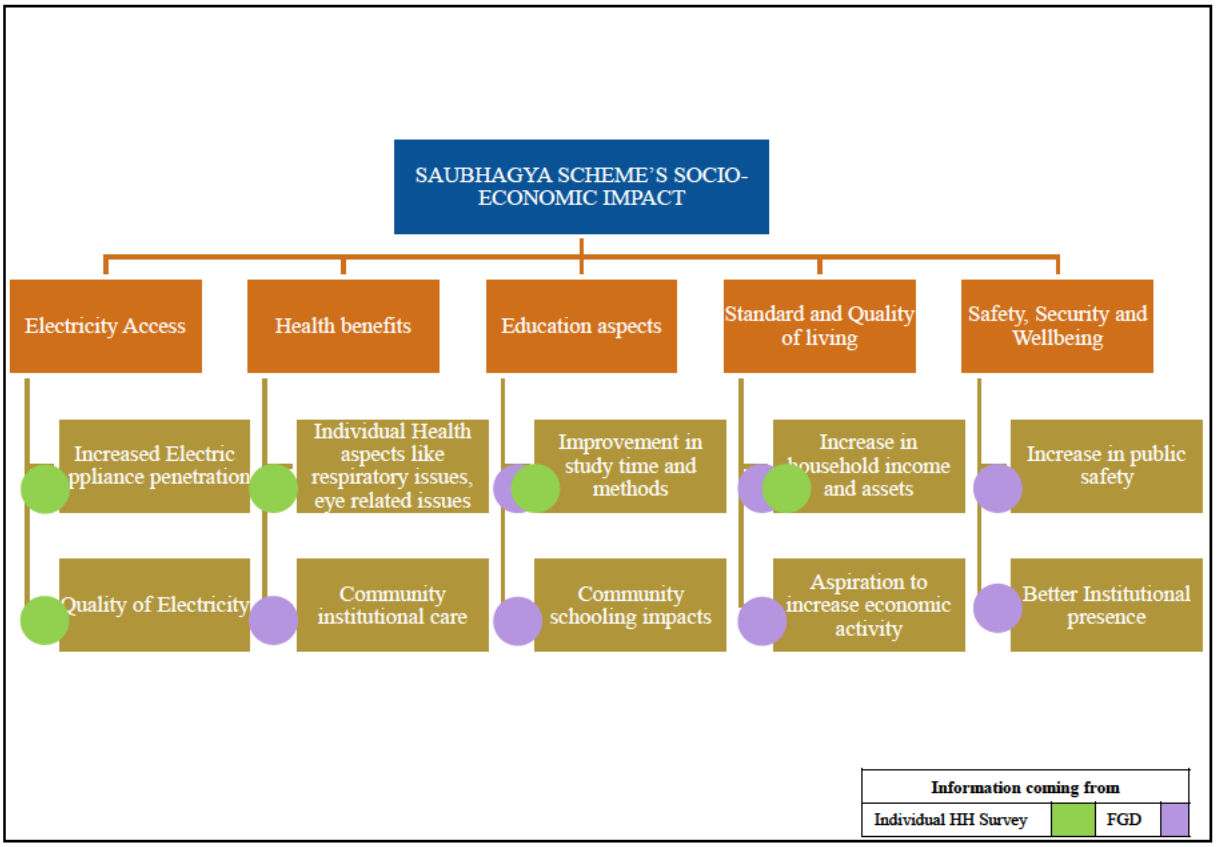


Figure 31: Impact assessment framework (Source: RTI and UCLA)

Gaining access to electricity is a transformative development for households and communities as mentioned below:

- It facilitates the increased penetration of electric appliances, which can significantly enhance the convenience and efficiency of daily tasks. Households can adopt a variety of appliances, ranging from basic lighting to more recreational and household devices, improving their overall quality of life. The quality of electricity supplied is paramount.
- Electricity access has profound implications for health. On an individual level, it can lead to a reduction in respiratory issues and eye-related problems, often caused by the use of traditional, polluting sources of light and heat.
- On a broader scale, community institutional care is enhanced with better-equipped healthcare facilities, ensuring timely and more effective treatment. As per the study conducted by M Kangawa, 2008, enhanced electricity access can result in improved educational outcomes i.e. literacy rates.[27]
- Students gain from increased study time and enhanced learning methods, facilitated by adequate lighting and the availability of electronic learning resources. Furthermore, community schooling impacts are significant, with better-resourced schools contributing to a more conducive learning environment.

[27] Kanagawa, M., & Nakata, T. (2008). Assessment of access to electricity and the socio-economic impacts in rural areas of developing countries. Energy Policy, 36, 2016-2029.

- Access to electricity plays a crucial role in elevating the standard and quality of living. Households experience an increase in income and assets, as electricity opens up new avenues for economic activity and employment. There is a noticeable shift in aspirations, with individuals and communities striving for increased economic participation and prosperity.
- The dimensions of safety, security, and well-being are significantly enhanced with electricity access. Public safety is increased, with well-lit streets and public spaces reducing the risk of accidents and criminal activity. Furthermore, the presence of better institutional infrastructure ensures that communities are well-supported and have access to essential services, contributing to an overall sense of well-being and security.

The household survey throws light on the receipt of the connection by the beneficiary. The Figure 32 illustrates a gradual growth in the number of connections over the years, with a notable surge in 2018. The gradual increase in connections from 2017 suggests a consistent effort to expand access to electricity in different states.

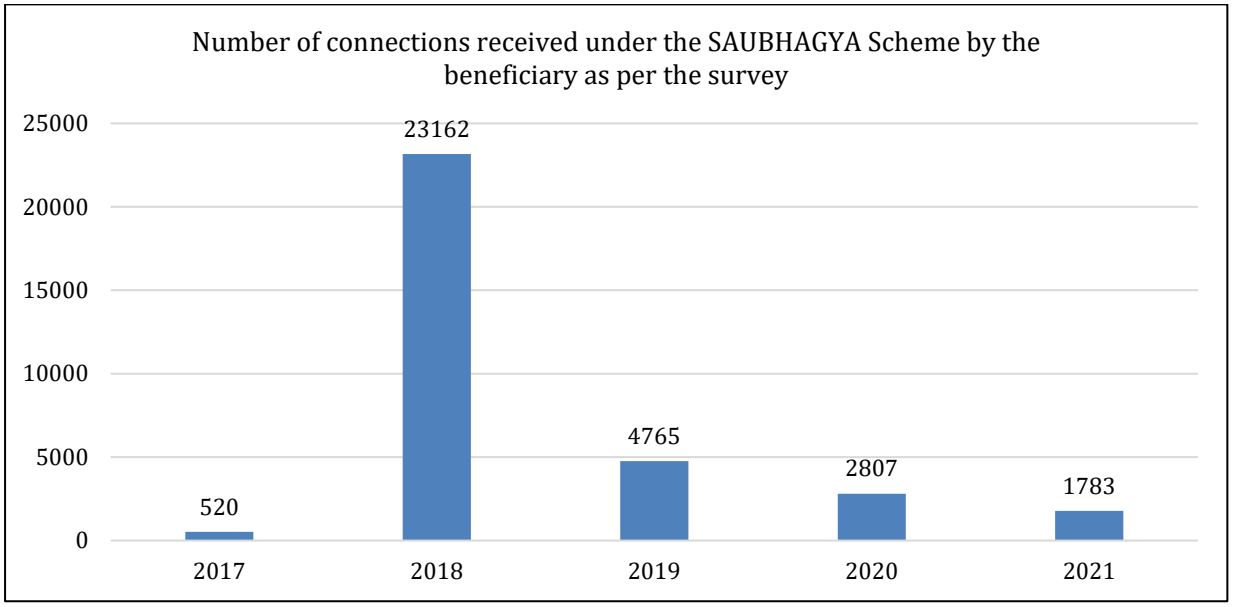


Figure 32: Connections received under the Scheme as per the survey

Per the report released by REC on the SAUBHAGYA scheme's progress in 2019[28], ~20 million + connections were released by the end of 2018.

Table 7: SAUBHAGYA scheme progress as shared by REC

Achievement Date	**Number of Electrified Houses**
25.09.2017	Launch
05.08.2018	10 million
28.09.2018	15 million
19.11.2018	20 million
16.02.2019	25 million

5.1. PENETRATION OF HOUSEHOLD ELECTRICITY APPLIANCES

Data shows an increase in the ownership of electrical assets (Figure 33). These assets are categorized as either primary household appliances or secondary/aspirational household appliances. The category

[28] Lighting Lives, REC, https://recindia.nic.in/uploads/files/SAUBHAGYA-Coffee-Table-Book--low-resoltion-Final.pdf

of primary electrical assets is intended to represent appliances essential for day-to-day functioning and this includes lighting equipment like LEDs, bulbs, tube lights, smartphones, fans, and televisions. Secondary electrical assets refer to slightly costlier appliances and include items such as electric stoves, sewing machines, iron presses, heaters, mixers, and motor pumps. Survey data indicates a substantial uptick in the ownership of primary electrical appliances post-SAUBHAGYA. This trend is particularly pronounced for basic electrical appliances, while secondary appliances showed minimal increases. Quantitatively, the average household ownership of electrical appliances underwent a significant transformation.

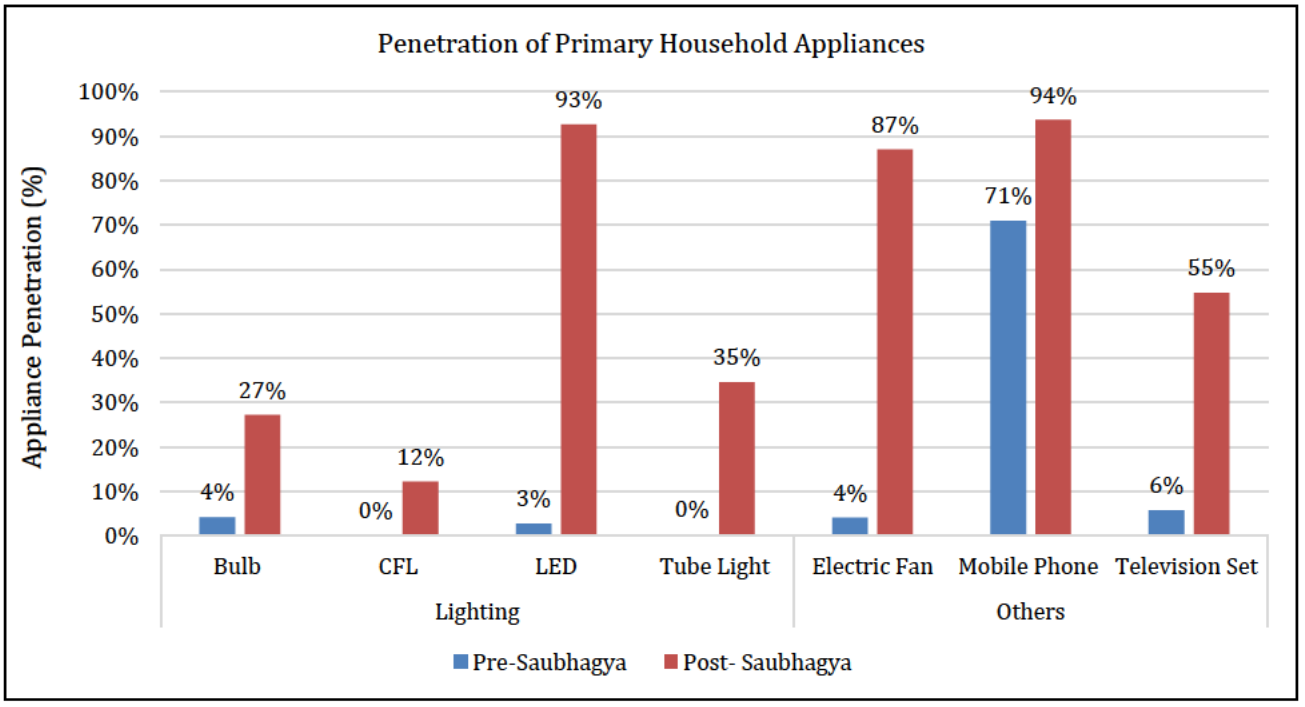


Figure 33: Pre and Post SAUBHAGYA Appliance penetration

The penetration of electrical appliances such as LED lights, tube lights, fans, TVs, and mobile phones has seen a substantial increase post-SAUBHAGYA, which can lead to numerous positive impacts as shared by multiple global research highlighted below. While these are generic positive aspects of appliance penetrations, the following aspects are not the direct result of the study conducted on the ground.

Energy Efficient Lighting Penetration:

- Improved Light Quality: LED lighting provides better quality of light and color rendering compared to conventional lighting systems. This results in enhanced visual comfort and safety in rural households and workspaces[29]
- Energy Efficiency: LEDs are highly energy-efficient, requiring less electricity to produce the same amount of light as traditional lighting solutions. This leads to lower energy bills and contributes to the reduction of the overall energy consumption in rural areas[30].
- Longevity and Reduced Maintenance: LEDs have a longer lifespan and are more reliable than traditional lighting options, reducing the need for frequent replacements and maintenance. This is

[29] M. Schratz, C. Gupta, T. J. Struhs and K. Gray, "A New Way to See the Light: Improving Light Quality with Cost-Effective LED Technology," in IEEE Industry Applications Magazine, vol. 22, no. 4, pp. 55-62, July-Aug. 2016

[30] V.S.K.V. Harish, Arun Kumar, A review on modeling and simulation of building energy systems, Renewable and Sustainable Energy Reviews, Volume 56, 2016,

particularly beneficial in rural settings where access to lighting products and maintenance services can be limited.

- Environmental Benefits: LED lights have minimal ultraviolet (UV) emissions, reducing the risk of product degradation and insect infestation. Additionally, LEDs do not contain harmful chemicals like mercury, making them more environmentally friendly and safer for rural communities[16].
- Reduced Energy and Maintenance Costs: The switch to LED lighting can lead to significant savings in energy and maintenance costs while simultaneously improving light quality and reliability. This is particularly advantageous for rural areas, where resources are often limited and efficiency is key [16].

Fans

- Enhanced Comfort and Thermal Environment: Fans are effective in improving the thermal comfort of occupants by increasing air movement, which can make higher temperatures feel more comfortable. Research supports the idea that fans are popular in various building types due to their ability to provide comfort in warm environments by elevating neutral temperatures and reducing the need for air conditioning.[31]
- Energy Efficiency and Conservation: Fans consume significantly less power than air conditioning systems, offering a more energy-efficient solution for cooling. The use of fans in mixed-mode buildings has been shown to reduce AC-use rates, contributing to energy conservation[18].
- Affordability: Fans are generally more affordable than air conditioning units, making them accessible to a wider population. This affordability extends to both the initial purchase price and ongoing maintenance costs, providing a cost-effective solution for improving comfort in rural areas.

TVs

- Increased Appliance Ownership and Economic Growth: Electrification has led to incrementally higher ownership rates of power-intensive appliances, including televisions, fans, and pressure cookers, in rural households. Each additional year of electricity access is associated with a higher total stock of appliances, indicating a gradual accumulation of household assets and contributing to economic growth in rural areas.[32]
- Modernizing Influences of Television: Television has played a crucial role in the modernization of rural life, affecting consumerism, urban modeling, restructuring of human relationships, and linguistic hegemony. It has introduced rural populations to broader societal norms and global cultures, influencing social change at both structural and psychological levels.[33]
- Empowerment and Educational Opportunities: The spread of television has been associated with significant social benefits, including the empowerment of women and increased educational opportunities for children. Television exposure has been linked to decreases in the acceptability of domestic violence, increases in women's autonomy, and higher school enrollment for younger children.[34]

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[31] Bao-Jie He, Junsong Wang, Huimin Liu, Giulia Ulpiani, Localized synergies between heat waves and urban heat islands: Implications on human thermal comfort and urban heat management, Environmental Research, Volume 193, 2021

[32] Jennifer Richmond, Johannes Urpelainen, Electrification and appliance ownership over time: Evidence from rural India, Energy Policy, Volume 133, 2019

[33] Johnson, K. (2001). Media and social change: the modernizing influences of television in rural India. Media, Culture & Society, 23(2), 147-169.

[34] Robert Jensen & Emily Oster, The Power of TV: Cable Television and Women's Status in India, Aug 2007

Furthermore, we also see increased adoption of small but significant aspirational appliances (Figure 34), including electric stoves, electric sewing machines, heaters, irons, mixers, and motor pumps over the years. These appliances are termed "aspirational" because they embody the desires and ambitions of rural households to improve their living conditions, achieve socio-economic progress, and enjoy the conveniences of modern life.

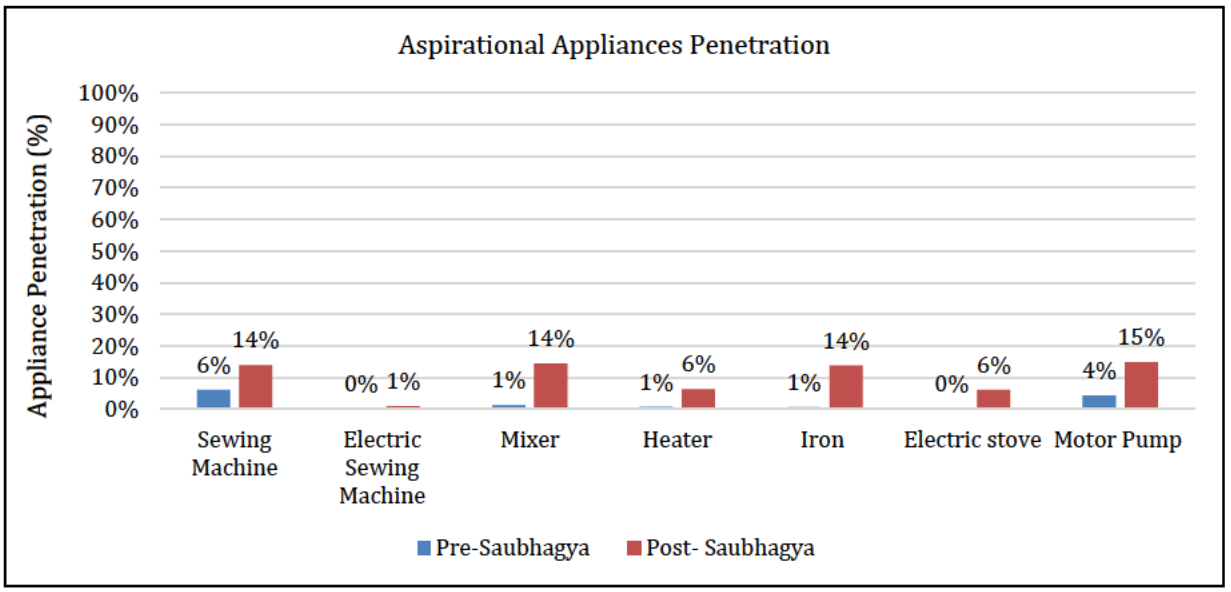
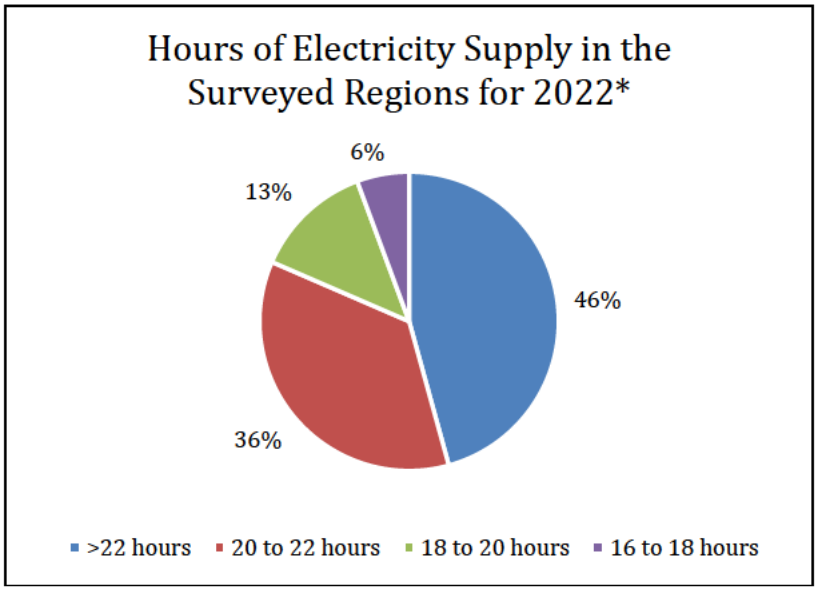


Figure 34: Pre and Post Aspirational Appliance Penetration

5.2. QUALITY OF SUPPLY

The primary data collection from the household survey findings indicates majority of the consumers reported>20 hours of electricity supply (Figure 35). This supply of electricity enhances the overall well-being of residents, ensuring comfort and convenience, especially during hot and humid summers.



(*Question asked about power outage for the past year from the respondent i.e. 2022)

Figure 35: Power Outages

The relationship between the duration of grid-electricity supply and its impact on electricity consumption and appliance ownership in rural India has been substantiated through empirical research. A study conducted by Agrawal et al. (2020) illustrates this dynamic, showing that a 1%

increase in the number of hours of electricity supply correlates with a 1.245% uptick in electricity consumption among rural households. This finding underscores the direct impact of enhanced electricity supply on consumption levels, suggesting that improvements in supply reliability and duration can significantly benefit users by catering to unmet electricity demand in rural areas.[35]

Furthermore, Richmond and Urpelainen (2019) highlight the incremental benefits of prolonged electricity access on appliance ownership. Their analysis, based on data from the ACCESS survey across six energy-poor states in India, reveals that every additional year of electricity access contributes to a gradual increase in the ownership of more power-intensive appliances, a higher probability of possessing a larger inventory of appliances, and a greater likelihood of owning key appliances such as televisions and fans. This evidence points to the role of electrification in facilitating the acquisition and use of modern appliances and enhancing living standards and comfort in rural households.[36]

These studies collectively suggest that improving the quality and duration of electricity supply in rural India not only meets basic lighting needs but also supports a broader range of household activities and economic opportunities through increased appliance ownership. Enhanced electricity supply, therefore, plays a crucial role in the socio-economic development of rural areas, offering a pathway to improved quality of life and enabling the productive use of energy for various domestic and entrepreneurial activities.

Government of India's effort towards power quality enhancement [37]

- Since April 2014, the Indian government, under the guidance of the Ministry of Power, has made significant strides in addressing the country's power deficiency issue. An addition of 196,558 MW in generation capacity has been achieved, marking a leap from a state of power deficit to one of power sufficiency. This augmentation represents a 72.3% increase in generation capacity, rising from 248,554 MW in March 2014 to 428,299 MW by December 2023.
- This expansion in generation capacity has had a profound impact on the availability of power supply across the nation. In rural areas, the duration of power supply has seen a notable increase, moving from an average of 12.5 hours per day in 2015 to 20.6 hours per day in 2023. Urban areas have experienced even greater improvements, with the power supply reaching up to 23.78 hours per day in 2023.
- Furthermore, the discrepancy between Energy Requirement and Energy Supplied has significantly narrowed, dropping from 4.2% in the fiscal year 2013-14 to a mere 0.3% in 2023-24. It's important to note that the residual gap in meeting energy requirements is largely attributed to challenges within State transmission/distribution networks and the financial constraints faced by DISCOMs.

These improvements can be attributed to a series of reform measures implemented by the government. Firstly, rules have been established to ensure timely payment for any government-declared subsidies, while tariffs have been kept up to date. Additionally, the reduction of legacy dues of Generation Companies (GENCOs) under Late Payment Surcharge Rules has significantly decreased from around

[35] Shalu Agrawal; S.P. Harish; Aseem Mahajan; Daniel Thomas and Johannes Urpelainen, (2020), Influence of improved supply on household electricity consumption - Evidence from rural India, Energy, 211, (C)
[36] Jennifer Richmond, Johannes Urpelainen, Electrification and appliance ownership over time: Evidence from rural India, Energy Policy, Volume 133, 2019
[37] PIB, Feb 2024

INR 1400 billion to approximately INR 520 billion. Moreover, measures such as ensuring timely payment to GENCOs, implementing energy accounting and audit, and enforcing revised Prudential Norms for DISCOMs and GENCOs have contributed to loss reduction.

Furthermore, the distribution system has been strengthened through extensive infrastructure investments, including the addition of 2927 new sub-stations and upgrading of 3965 existing ones, installation of 692,200 Distribution Transformers, and feeder separation covering 113,938 Circuit Kilometers (CKm). The government has also approved the Revamped Distribution Sector Scheme (RDSS) with a substantial outlay of INR 3037 billion, aimed at further improving distribution infrastructure and reducing losses. Additionally, measures have been taken to ensure that loss-making DISCOMs cannot draw funds under any Power Sector Scheme unless they implement loss reduction measures. The positive impact of these reforms is reflected in the decrease of financial losses of distribution utilities from INR 465.21 million in FY 2020-21 to INR 310.26 million in FY 2021-22, as reported by the 'Report on Performance of Power Utilities' published annually by Power Finance Corporation Ltd. (PFC). Overall, these efforts signify a concerted push toward enhancing efficiency, reliability, and sustainability in India's power distribution sector.

5.3. IMPACT ON HEALTH OF HOUSEHOLD MEMBERS DUE TO ELECTRIFICATION

In the context of the SAUBHAGYA scheme's impact on household health outcomes (Figures 36 and 37), of the respondents who reported a health issue prior to obtaining a SAUBHAGYA electricity connection, a significant majority (60.62%) observed an improvement in the health condition post-electrification. This observation suggests a potential correlation between electrification and enhanced health outcomes within these households. However, it is crucial to consider concurrent environmental and health policy interventions, notably the shift towards liquefied petroleum gas (LPG) for cooking. The transition from traditional biomass stoves, which contribute to indoor air pollution through particulate emissions, to cleaner LPG cooking solutions could also be a contributing factor to the reported health improvements. Thus, while the SAUBHAGYA scheme may have direct and indirect benefits on household health, the observed health improvements might also be influenced by parallel reductions in indoor air pollution due to increased adoption of LPG cooking methods.

Electrification plays a pivotal role in shaping various aspects of human life, including health outcomes within households. This section explores the impact of electrification on the health of household members, drawing insights from empirical research and scholarly literature. Electrification brings forth a multitude of health benefits to households, primarily through improved access to modern amenities and services.

- Studies have shown that electrification leads to better lighting conditions, which in turn reduce the risk of accidents and injuries within households.[38]
- Additionally, access to electricity facilitates the adoption of electric appliances, such as fans and air conditioners, which contribute to thermal comfort and mitigate heat-related illnesses during hot seasons.[39]

[38] Khandker, Shahidur & Barnes, Douglas & Samad, Hussain. (2012). The Welfare Impacts of Rural Electrification in Bangladesh. The Energy Journal. 33. 10.5547/ISSN0195-6574-EJ-Vol33-No1-7.

[39] Colelli, F.P., Wing, I.S. & Cian, E.D. Air-conditioning adoption and electricity demand highlight climate change mitigation–adaptation tradeoffs. Sci Rep 13, 4413 (2023). https://doi.org/10.1038/s41598-023-31469-z

- One of the most significant health benefits of electrification is the reduction in indoor air pollution, particularly in households that transition from traditional biomass cooking methods to cleaner energy sources. Research has demonstrated that indoor air pollution from biomass stoves is a major contributor to respiratory diseases and other health issues, especially among women and children [40]
- Electrification enables households to shift towards cleaner cooking solutions, such as liquefied petroleum gas (LPG) or electric stoves, leading to substantial improvements in indoor air quality and respiratory health outcomes.[41]

The socio-economic development catalyzed by electrification also has indirect implications for health outcomes. Studies have shown that improved economic opportunities, educational attainment, and access to information associated with electrification contribute to better health-seeking behavior and overall well-being within households.[42]

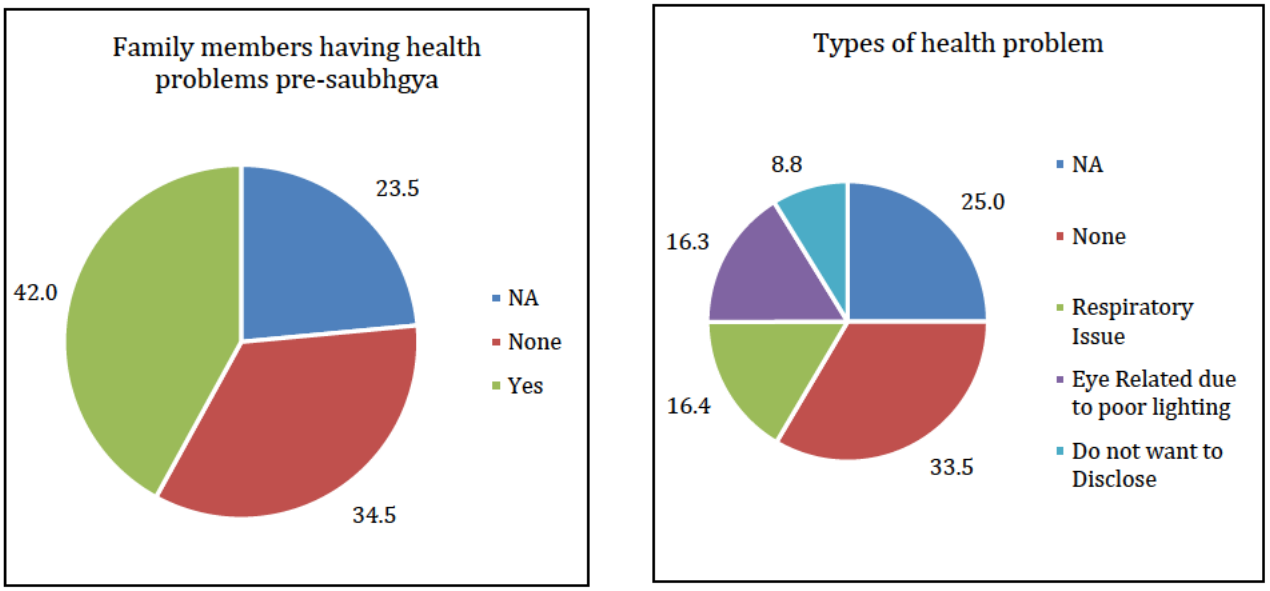


Figure 36: Health concerns pre-SAUBHAGYA (Source: FGDs)

[40] Pant, G., Alka, Garlapati, D. et al. Air quality assessment among populous sites of major metropolitan cities in India during COVID-19 pandemic confinement. Environ Sci Pollut Res 27, 44629–44636 (2020). https://doi.org/10.1007/s11356-020-11061-y
[41] Rehfuess, E., Puzzolo, E., Stanistreet, D., Pope, D., & Bruce, N. (2014). Enablers and Barriers to Large-Scale Uptake of Improved Solid Fuel Stoves: A Systematic review. Environmental Health Perspectives, 122(2), 120–130. https://doi.org/10.1289/ehp.1306639
[42] Ghosh, Sajal. (2002). Electricity consumption and economic growth in India. Energy Policy. 30. 125-129. 10.1016/S0301-4215(01)00078-7.

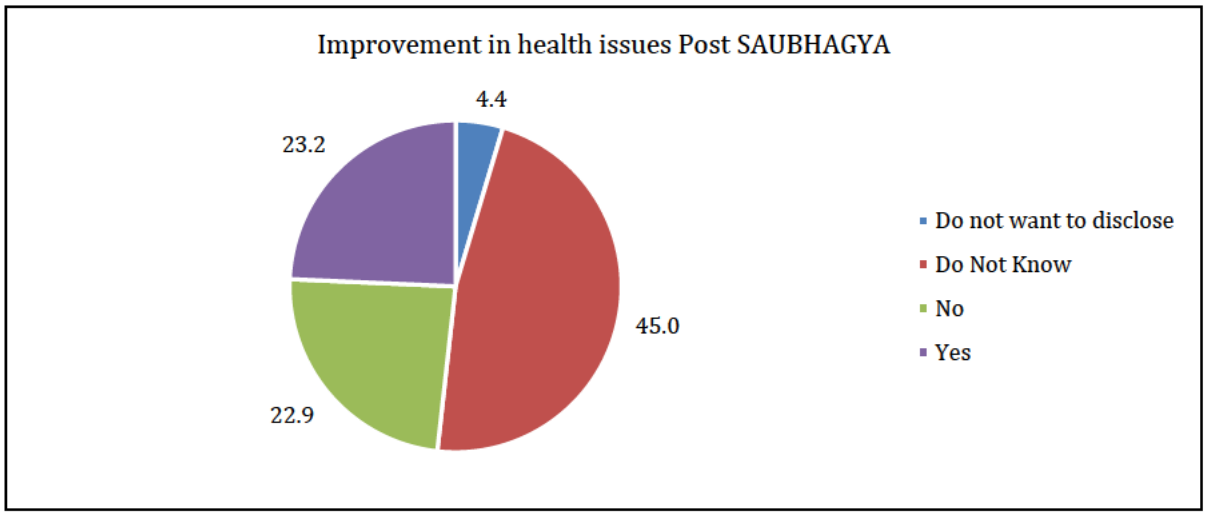


Figure 37: Improvement in Health Conditions Post SAUBHAGYA (Source: On Ground Surveys and FGDs)

Poor lighting conditions are known to contribute to eye strain, discomfort, and potentially long-term vision issues, particularly in settings where individuals engage in visually intensive tasks under suboptimal lighting. The provision of electricity can facilitate the use of efficient lighting systems, such as LED lights, which offer brighter and more consistent lighting. This transition can significantly enhance visual comfort and reduce the incidence of eye-related discomforts, contributing to overall well-being.

5.4. IMPACT ON EDUCATION

The findings from the qualitative FGDs bring to light a crucial aspect of improved electricity access—its positive influence on children's ability to study in the evening (Figure 38). The presence of better lighting systems and appliances such as phones has enhanced this capability. This development is of paramount importance as it directly contributes to educational outcomes and future opportunities for young learners. The availability of reliable lighting systems not only extends study hours but also creates a conducive environment for focused learning, which can significantly impact academic performance. Furthermore, the use of modern tools like phones and fans further enriches the study experience, making it more comfortable and effective. Ultimately, these findings underscore how enhanced electricity access goes beyond mere connectivity to empower the educational aspirations of the younger generation, potentially leading to improved socio-economic prospects for these communities.

~78.4% of respondents responded positively to the usage of smartphones for education purposes, especially during and after COVID–19. While, this is not a direct impact of SAUBHAGYA, ~68.8% of respondents quoted that student attendance has increased in the nearby schools which can also be an impact due to the increase in education possibilities at the household.

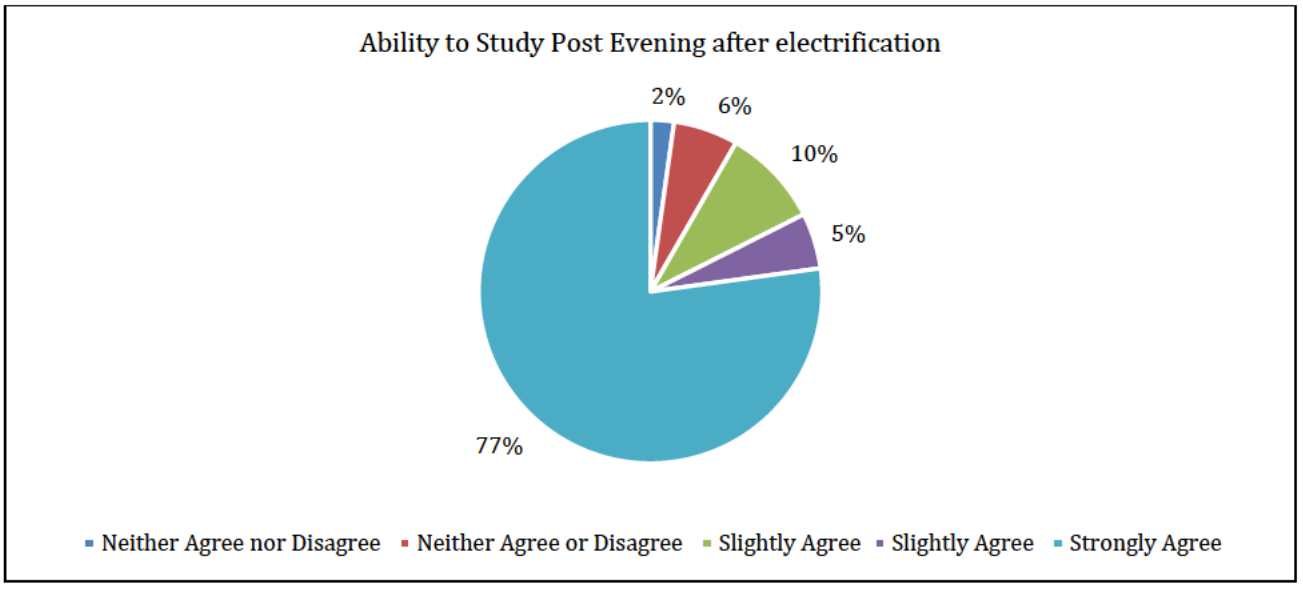


Figure 38: Ability to study in the evening post electrification (Source: FGDs)

5.5. IMPACT ON QUALITY AND STANDARD OF LIVING

In 2023, the average reported annual income in the surveys was 91,560 INR while the median was 96,000 INR. This compared to the average monthly income of INR 4998 or annual income of INR 59976 from Cultivation and Wage Labour activities in a rural household (as reported by NABARD in 2018) is a significant jump.[43] The increase in income cannot be directly attributed to the availability of electricity, however, it does play a significant role.

Rural electrification is a transformative force in rural India, with far-reaching implications for the economic prosperity of households. The availability of electricity in rural areas brings about a myriad of benefits, significantly enhancing the quality of life and income levels of rural households. Research has shown that access to electricity not only improves household lighting but also creates new employment opportunities, particularly in small-scale enterprises and cottage industries (Khandker, Samad, & Ali, 2013). This is crucial as it fosters economic growth and reduces poverty by enabling rural residents to engage in productive activities and entrepreneurship.

In the IDI, the respondents highlighted that the availability of electricity has helped them in increasing income sources as well as starting a new business.

[43] NABARD All India Rural Financial Inclusion Survey FY17

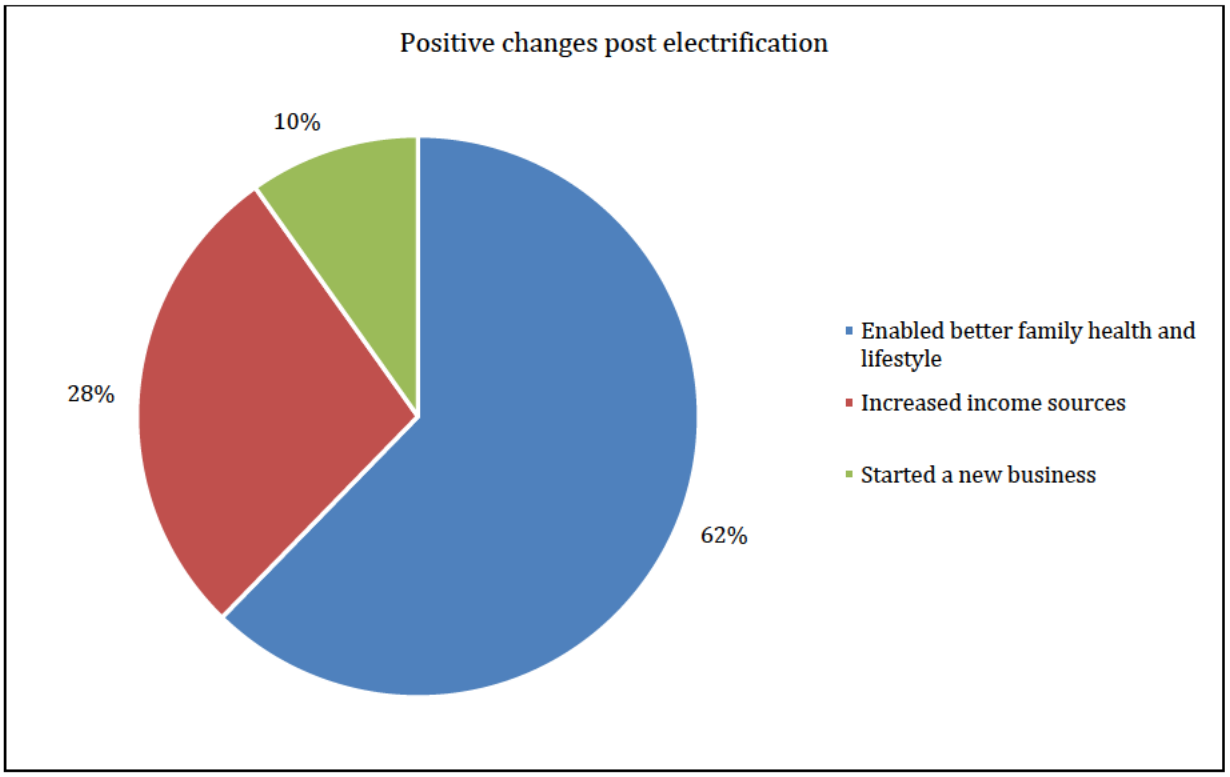


Figure 39: Positive Changes post electrification (Source:IDIs)

Research suggests that access to electricity has brought about significant transformations in rural businesses across India (Figure 39, 40).

- Electricity has provided rural businesses with adequate lighting, creating safer and more productive working environments, particularly during evening hours. This increased productivity and efficiency have been observed across various sectors, contributing to economic growth and development. [44]
- Furthermore, electricity has facilitated the establishment of cold storage facilities, enabling farmers to preserve perishable agricultural produce for longer durations, thereby reducing post-harvest losses. [45]
- Moreover, access to electricity has played a crucial role in facilitating financial transactions in rural areas through the establishment of banking and payment infrastructure, promoting economic inclusivity. [46]

[44] State of electricity access report 2017 (Vol. 2) : full report (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/364571494517675149/full-report

[45] R. Mishra, S.K. Chaulya, G.M. Prasad, S.K. Mandal, G. Banerjee, Design of a low cost, smart and stand-alone PV cold storage system using a domestic split air conditioner, Journal of Stored Products Research, Volume 89, 2020

[46] Shetty, Megha & Bhat, Sudhindra. (2022). A Case Study on the Growth of Rural Banking in India. International Journal of Case Studies in Business, IT, and Education. 346-357. 10.47992/IJCSBE.2581.6942.0201.

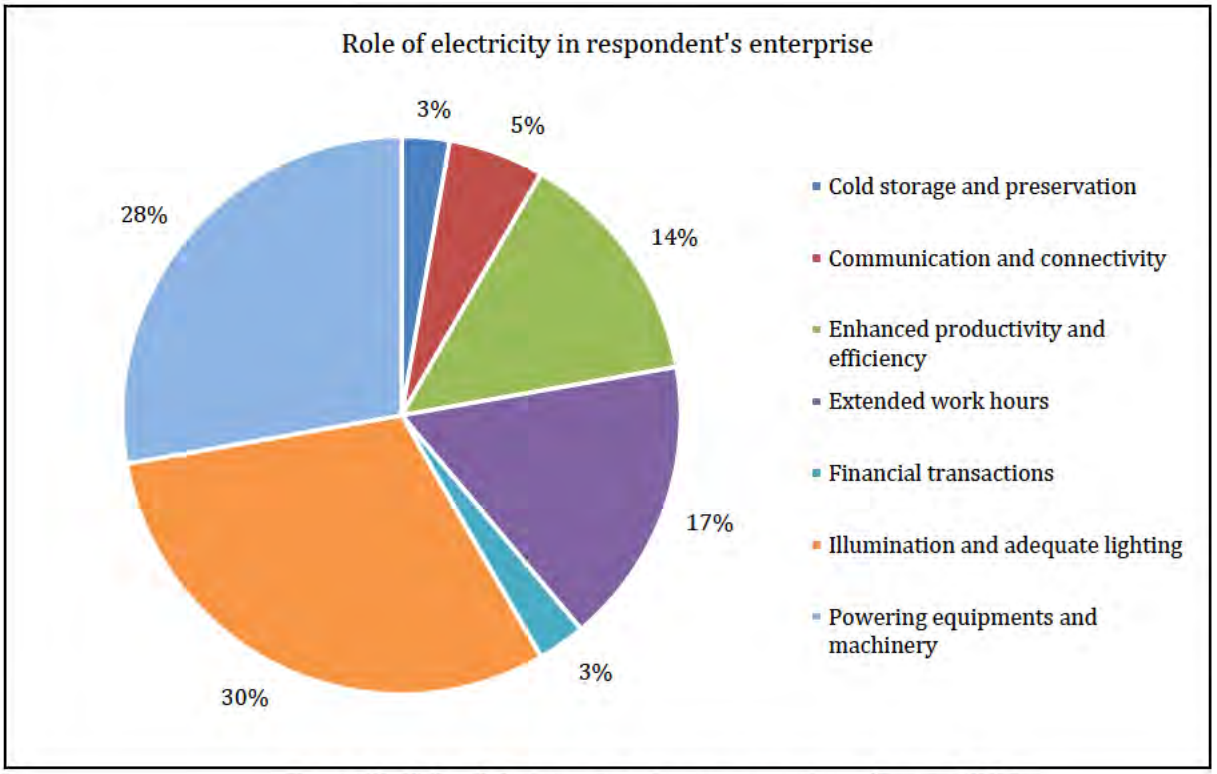
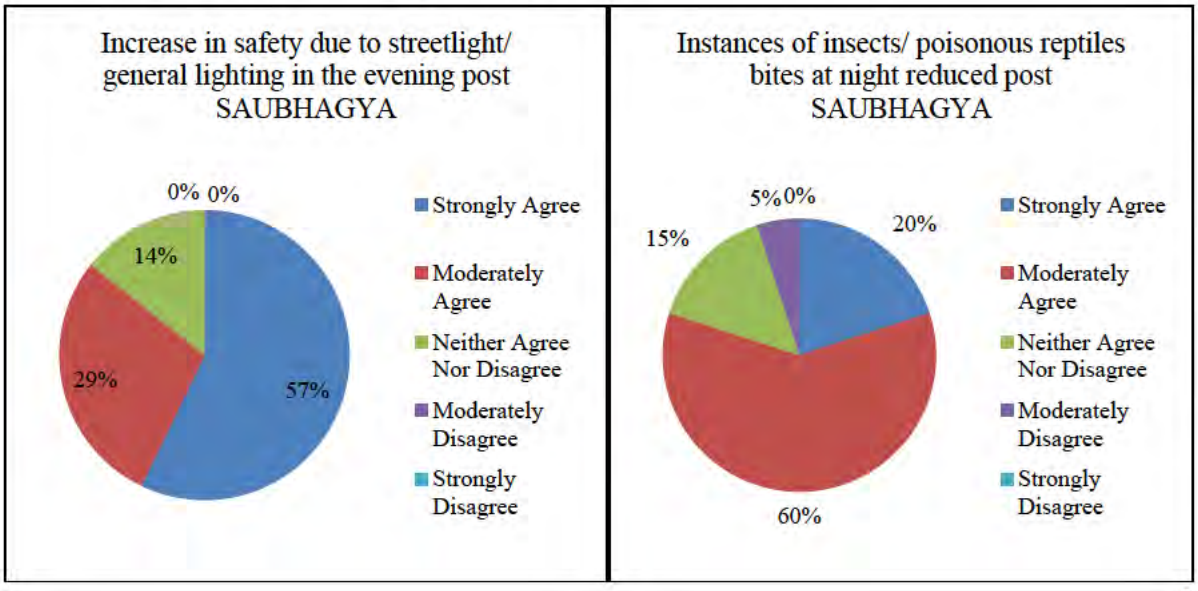


Figure 40: Role of electricity in enterprise operations (Source: IDIs)

5.6. IMPACT OF ELECTRICITY ON SAFETY AND SECURITY

The presence of improved electricity access has brought about an enhanced sense of safety and security in the evening, with several factors contributing to this positive change (Figure 41).

- Firstly, the availability of electric lighting reduces the risk of insect bites, providing relief from the discomfort and health concerns associated with mosquito-borne diseases.
- Furthermore, the well-lit areas act as a deterrent to potentially dangerous reptiles, lowering the likelihood of venomous snake or reptile bites, which is particularly critical in rural regions.
- Additionally, the presence of streetlights and improved outdoor visibility fosters a sense of security, particularly for women, enabling them to move freely during evening hours and access educational and economic opportunities.



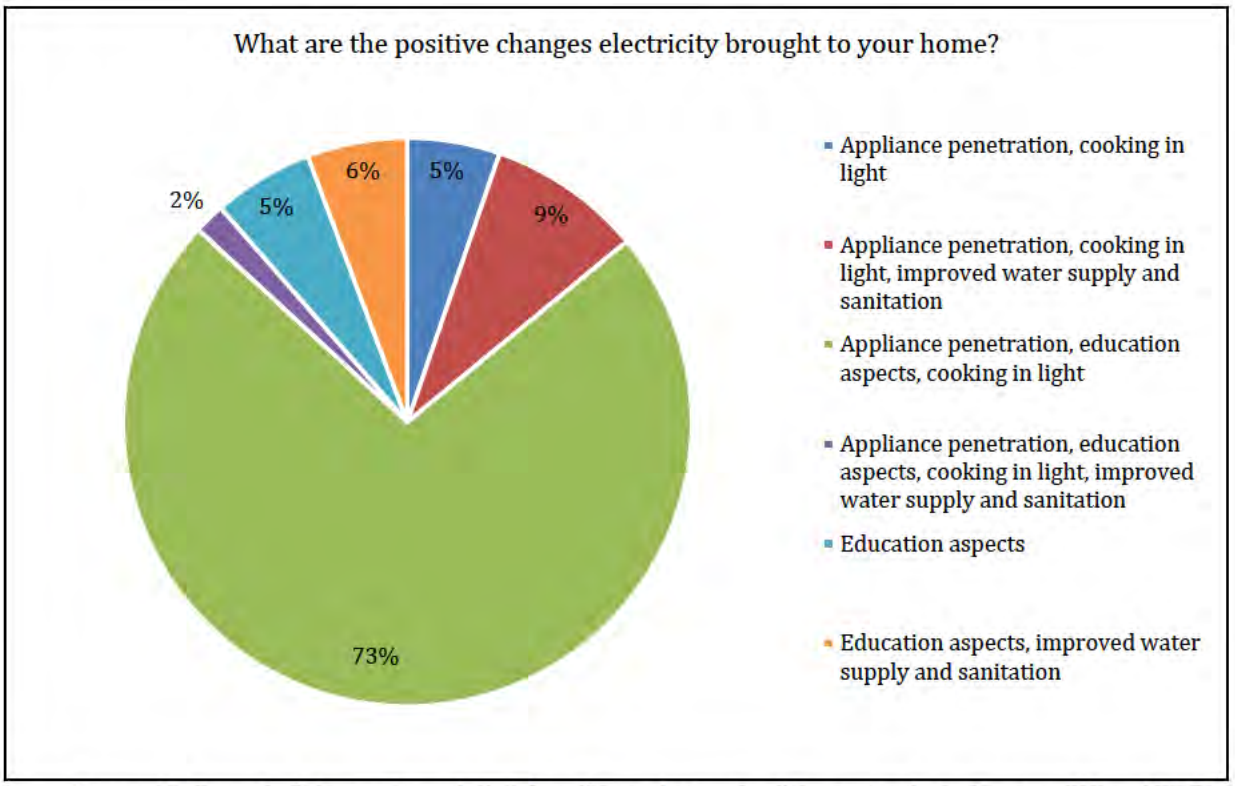


Figure 41: Impact of electricity on daily life, safety and security of the respondents (Source: IDI and FGDs)

Moreover, well-lit streets and public spaces discourage criminal activities and promote community security, encouraging social interactions and community gatherings. This multifaceted improvement underscores how electricity access goes beyond basic connectivity to enhance the safety, well-being, and cohesion of communities.

6. CONCLUSIONS

6.1. SUMMARY OF IMPACT OF THE SCHEME

A comprehensive survey of a large sample of 33,037 households was carried out to assess the impact of SAUBHAGYA. Analysis of this data reveals that households that received a connection through SAUBHAGYA are experiencing patterns of consumption that are consistent with a marked improvement in the quality of life for the household. The data also shows a clear increase in ownership of electrical assets. This is especially true for basic electrical appliances such as tube lights, bulbs, cellphones, and fans, which in turn are associated with a variety of different forms of health, economic, and social benefits. A majority of SAUBHAGYA households with more than one room in their dwelling report having more than one room electrified and also experience low levels of power outages (less than 4 hours on average). Over 85% of the households rated the quality of electricity supply as good, very good, or excellent.

With respect to health impacts, a majority of the households that reported a family member having health problems before SAUBHAGYA reported an improvement in health outcomes since electrification. Here too, however, caution is warranted in attributing this solely to SAUBHAGYA given concurrent environmental and health policy interventions, notably poor households gaining access to LPG for cooking through policies such as PMUY or Ujjwala which substantially lowers exposure to indoor air pollution from burning fuelwood and animal dung in traditional cookstoves.

SAUBHAGYA households are able to allocate a greater share of their time for enrichment activities (such as employment, leisure, and self-care) and allocate less time for chores and sustenance activities (such as domestic work and own production). The surveys also show that time allocated to education for children has increased after receiving electricity. It is worth reiterating that data collected on time spent on education refers to time spent both in school and studying at home at night.

Data also shows that SAUBHAGYA households saw an increase in consumption, measured as spending on different categories of goods and services. In addition to spending on electricity, which of course increases, households increase spending on modern fuels, phones, groceries, education, household maintenance, and health. However, it is important to remember that while it is not implausible that SAUBHAGYA played a role in raising incomes which enabled such increases, it is difficult to attribute these changes solely to SAUBHAGYA without more information, such as the ability to track employment and economic activity as a direct result of electricity access.

Data collected through IDI and FGDs lend further support to the conclusions above and also highlight additional dimensions of benefits that were not captured in the survey. For instance, respondents report that improved electricity access has brought about an enhanced sense of safety and security during evening and night times. Some specific examples include reduced risk of insect and snakebites, which is a common issue in rural regions. Electricity is also reported as providing relief from the discomfort and health concerns associated with mosquito-borne diseases.

While the above discussion highlights some of the major and positive impacts of SAUBHAGYA, it is worth reiterating that the study design has some limitations, and also that the surveys highlight areas for further work both from research and public policy perspectives. It is also essential to bear in mind that as the entire survey sample received the SAUBHAGYA scheme and since our sample does not include households without electricity access, we lack a meaningful control group without access to electricity relative to which one would estimate the true effect of formal access to electrification.

Attempts to overcome this limitation by comparing households that received connection earlier in the program and those that received later did not yield any major insights. This is not inconsistent with the scholarly economic literature on impact assessment of rural household electrification which suggests the effect of gaining electricity access in the short-run tends to be small. We recommend further research that tracks a representative sample of beneficiaries over a period of time for a more robust estimation of long-term benefits. Such longitudinal panels would allow for a more rigorous and causal inference of the long-term benefits of providing electricity access to poor households. For instance, data shows a low adoption rate of appliances such as electrical stoves, electric sewing machines, iron presses, heaters, mixers, and motor pumps.

Data collection on certain other important indicators for well-being such as financial income, and entrepreneurial information suffered from poorer response rates. The survey teams found it challenging to elicit a response on these sensitive pieces of information and these questions were often met with non-response. Additionally, there were also challenges with difficulty in reliably recalling data for pre-SAUBHAGYA periods, as well as for information like year of in-migration. While recall errors are likely to be present data-wide implying that our relative comparisons still yield sufficient suggestive information, the absence of data limits our ability to comment on progress in some sectors. While our questionnaire included detailed sections on different entrepreneurial ventures and occupational income from different sources, we were unable to address these comprehensively. A longitudinal study would help researchers to slowly build trust with respondents which will encourage them to share the types of data and insights necessary to develop a deeper understanding of the long-run phenomena and mechanisms by which electricity access improves quality of life in the long-run.

Last but not least, from a policy standpoint, beyond providing electricity access it is essential to continue to monitor and analyze trends in electricity consumption of beneficiaries over the long run. This can help identify potential systemic bottlenecks and barriers that might be inhibiting the rate of growth in electricity consumption for specific types of households in specific regions of the country and undertake remedial policy action. To this end, we recommend a joint team of government agency staff, industry professionals, and academics working with DISCOMS to continue to collect and analyze billing data for beneficiaries to understand patterns of growth in electricity consumption and monthly payments for electricity services.

6.2. SUMMARY OF SECTORAL LEVEL ISSUES & CHALLENGES

Following the ambitious drive towards universal household electrification in rural India, as realized through initiatives like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA), the post-implementation phase has unveiled a spectrum of sectoral challenges. These challenges underscore the complexities inherent in sustaining the achievements of rural electrification and highlight the critical areas requiring focused attention to ensure the durability of these efforts.

Table 8: Sectoral Level Challenges

Sectoral Level Challenge	**Description**
Infrastructure Sustainability and Maintenance	Post-implementation, the sustainability of electrical infrastructure emerges as a paramount challenge. The rugged and dispersed rural landscapes continue to pose logistical challenges for maintenance and upgrades of electrical infrastructure. Aging

Sectoral Level Challenge	Description
	equipment, vulnerability to natural calamities, and the challenge of ensuring consistent last-mile connectivity underscore the need for ongoing investment in infrastructure resilience.
Financial Viability	The financial health of State Electricity Boards (SEBs) and Distribution Companies (DISCOMs) remains a concern in the aftermath of electrification efforts. Despite the expansion of the electrical grid, financial strains manifest in the form of operational inefficiencies, and the persistent issue of revenue collection from newly electrified but economically vulnerable households.
Regulatory and Policy Adaptation	The post-implementation landscape demands adaptive regulatory and policy frameworks to address emerging challenges and to harmonize electrification efforts across different jurisdictions. The need for streamlined processes, dynamic policy frameworks, and enhanced coordination among central and state entities is critical to addressing the bottlenecks in sustaining electrification gains.
Community Engagement and Behavioral Change	Maintaining the momentum of electrification benefits requires continuous community engagement and education. Bridging the awareness gap about the benefits of sustained electricity use, promoting energy conservation practices, and encouraging timely bill payments are essential for embedding electrification into the social fabric of rural communities.
Technological Advancements and Capacity Building	Technological advancements such as smart metering and grid automation present opportunities for enhancing the efficiency of rural electrification networks. However, the successful integration of these technologies hinges on building local capacity, training personnel, and addressing the upfront costs associated with deploying and maintaining advanced technological solutions.
Environmental Impact and Renewable Integration	The environmental footprint of expanding rural electrification necessitates a thoughtful approach to integrating renewable energy sources and minimizing ecological disruption. Post-implementation efforts must prioritize the adoption of green technologies and the exploration of sustainable models for rural electrification that align with environmental conservation goals.

Future resilience in rural electrification calls for a multifaceted strategy that includes strengthening infrastructure, ensuring financial sustainability, refining regulatory frameworks, and fostering community buy-in. Emphasizing renewable energy, leveraging technological innovations, and prioritizing environmental sustainability will be key to overcoming post-implementation challenges. Moreover, cultivating partnerships across the government, private sector, and non-profit organizations can inspire new solutions and mobilize the necessary resources for addressing the ongoing challenges faced by rural electrification projects.

Tackling these sectoral challenges requires an integrated, innovative approach tailored to the unique needs and contexts of rural India. By focusing on these critical areas, India can ensure the long-term success of its rural electrification program, fostering socio-economic development and enhancing the quality of life for millions of rural households.

6.3. SECTOR WAY FORWARD

A logical next step once the basic objective of universal household access to electrification has been achieved is shifting focus to raising per capita electricity consumption of poor households to the minimum levels necessary to sustain a healthy and dignified lifestyle. To this end, it is essential to ensure that beneficiaries of SAUBHAGYA, but also more generally poor households across India, steadily raise their electricity consumption, which is essential to ensure reliable supply and affordability.

Emphasizing the Importance of Data Availability

The foundation for effective impact assessment of national-level schemes like SAUBHAGYA lies in the availability of comprehensive and accurate data. The collection and analysis of data pertaining to household electrification, consumption patterns, and demographic variables are crucial for evaluating the scheme's outcomes and identifying areas for improvement. Enhancing data collection mechanisms and employing advanced analytics can provide insights into beneficiary satisfaction, scheme reach, and areas requiring additional focus.

Addressing the Surge in Electricity Demand

The long-term success of a scheme such as SAUBHAGYA, which has enabled poor households to taste the benefits of electricity use at home depends on continuing to serve the already growing demand from these households in an affordable manner. This requires a multifaceted approach, combining grid enhancement, strategic integration of renewable energy sources and where needed targeted support for households struggling to maintain affordability.

- Grid Capacity Building and Enhancement: As electricity demand escalates, strengthening the existing grid infrastructure becomes indispensable to ensure reliability and prevent overload. This entails not only upgrading transmission and distribution lines but also incorporating advanced technologies for grid management. Smart grids equipped with real-time monitoring capabilities can dynamically manage electricity flow, detect and address faults promptly, and thus accommodate the increasing load without compromising service quality.
- Renewable Energy Integration: The integration of renewable energy sources into the rural electrification mix presents a sustainable solution to meet the rising demand. Solar energy, given its scalability and decreasing cost, emerges as a particularly viable option for rural areas. Decentralized solar systems, community solar projects, and solar-powered mini-grids can provide clean, reliable power, reducing dependence on the central grid and fossil fuels. Government incentives for rooftop solar installations and the development of local renewable energy cooperatives can accelerate the adoption of these green solutions.
- Innovative Strategies for Load Balancing: Leveraging innovative technologies and strategies for load balancing can further aid in managing the increased demand. Battery storage systems, for instance, can store excess energy during low-demand periods and release it during peak times.

Demand response programs that incentivize consumers to reduce or shift their electricity usage during peak periods can also play a crucial role in maintaining grid balance.

- Policy and Regulatory Support: Supporting these technical and operational strategies with conducive policy and regulatory frameworks is essential. Policies that facilitate the smooth integration of renewable energy, provide subsidies for energy-efficient appliances, and encourage investment in grid enhancement are critical. Regulatory measures to streamline the deployment of decentralized energy systems and promote private sector participation can amplify these efforts.

Leveraging Technological Innovations for Efficiency

The evolution of India's rural electrification landscape is increasingly intertwined with technological innovation. As the sector moves forward, leveraging cutting-edge technologies will enhance operational efficiency, improve service delivery, and ensure the sustainability of electrification efforts. This approach not only addresses the immediate challenges of increased electricity demand and grid management but also sets the foundation for a future-ready rural electrification infrastructure.

- Smart Metering and Grid Automation: At the heart of technological advancements in rural electrification is the adoption of smart metering and grid automation. Smart meters facilitate real-time energy usage monitoring, enabling consumers to manage their electricity consumption more effectively. For DISCOMs, these meters provide accurate data on electricity usage patterns, helping in demand forecasting, reducing energy theft, and improving billing efficiency. Additionally, grid automation technologies allow for the remote monitoring and management of the distribution network, enhancing fault detection, isolation, and restoration capabilities, thereby increasing the reliability of the power supply.
- Renewable Energy Technologies: The integration of renewable energy technologies, particularly solar photovoltaic (PV) systems, into rural electrification schemes offers a sustainable solution to meet rising electricity demands. Innovations in solar technology, such as high-efficiency panels and hybrid systems that combine solar with other renewable sources or storage solutions, can significantly enhance the energy independence of rural communities. The development and deployment of microgrids and standalone solar systems are particularly relevant for remote areas, where extending the central grid may not be feasible or cost-effective.
- Digital Platforms for Consumer Engagement: Embracing digital platforms can revolutionize consumer engagement and service delivery in rural electrification. Mobile applications and web portals offer platforms for easy bill payments, lodging complaints, and accessing real-time information on electricity usage and outages. These tools not only improve the consumer experience but also foster transparency and accountability in service delivery. Moreover, leveraging digital platforms for awareness campaigns on energy conservation and the benefits of electrification can enhance community participation in these initiatives.
- Data Analytics for Strategic Planning: The strategic use of data analytics can transform the planning and implementation of rural electrification projects. By analyzing consumption data, demographic trends, and geographical information, planners can identify areas with the highest need for electrification or potential for renewable energy integration. Predictive analytics can also aid in anticipating future electricity demands and planning grid expansions or upgrades accordingly.

- Capacity Building and Skill Development: Implementing these technological innovations necessitates a focus on capacity building and skill development among the workforce responsible for rural electrification. Training programs on the installation, operation, and maintenance of new technologies, as well as on the use of data analytics and digital tools, are essential for empowering local technicians, engineers, and DISCOM personnel. This not only ensures the effective deployment of technology but also contributes to local employment and skill development.

Innovative Financing Mechanisms for Rural Electrification

The ambitious goals of rural electrification in India necessitate not just technological and operational innovation but also creative financial solutions to support the extensive infrastructure development and service delivery required. Innovative financing mechanisms are essential to bridge the funding gap, making electrification projects financially viable and sustainable in the long run. This section explores various innovative financing strategies that can be leveraged to support India's rural electrification efforts.

- Public-Private Partnerships (PPPs): PPPs stand out as a strategic model for mobilizing resources for rural electrification projects. By combining public sector guidance with private sector efficiency and capital, PPPs can accelerate the deployment of electrification infrastructure and services. Tailored PPP models, including build-operate-transfer (BOT) and build-own-operate (BOO), can facilitate the involvement of private players in financing, constructing, and managing electrification projects, thereby reducing the financial burden on the public sector.
- Green Bonds: Green bonds are another financial innovation that can raise capital for renewable energy projects within rural electrification programs. Issued by government bodies, financial institutions, or corporations, these bonds specifically fund projects with environmental benefits, such as solar and wind energy installations. By investing in green bonds, investors contribute to sustainable development initiatives while receiving a return on their investment, making it a win-win for both the environment and the economy.
- Microfinance and Crowdfunding: Microfinance institutions and crowdfunding platforms offer grassroots-level financing solutions, enabling rural households and communities to access the capital needed for electrification. Microloans can support the purchase of solar home systems and energy-efficient appliances, facilitating individual and community participation in electrification efforts. Crowdfunding, leveraging online platforms to pool small contributions from a large number of people, can fund community-scale renewable energy projects, fostering local ownership and engagement.
- Climate Finance: Accessing international climate finance mechanisms, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF), can provide substantial support for rural electrification projects, particularly those focusing on renewable energy and energy efficiency. These funds are designed to assist developing countries in their efforts to mitigate and adapt to climate change, making them an appropriate source of financing for sustainable electrification initiatives.
- Result-Based Financing (RBF): RBF models tie the disbursement of funds to the achievement of specific project milestones or results, such as the number of new connections made or the amount of renewable energy capacity installed. This approach ensures that financing is aligned with project performance, encouraging efficiency and accountability among implementing agencies.

- Energy Service Companies (ESCOs): ESCOs can play a pivotal role in rural electrification by investing in energy solutions for rural communities and recovering their investment through the energy savings achieved. ESCO models, particularly for energy efficiency and small-scale renewable projects, reduce upfront costs for consumers and manage the financial risks associated with new technologies.

As India strides forward in its journey of rural electrification, the narrative that unfolds is one of resilience, innovation, and collective endeavor. The successful expansion of electrification across rural landscapes has been underpinned by strategic data utilization, adept management of increasing electricity demands, the integration of cutting-edge technological solutions, and the exploration of sustainable renewable energy avenues. Moreover, the development of a supportive policy framework, enhanced community engagement, and the deployment of innovative financing mechanisms have each played pivotal roles in addressing the multifaceted challenges inherent in this ambitious undertaking. The way forward for rural electrification in India is illuminated by the lessons learned and the successes achieved, guiding a path that promises not only to sustain the gains made thus far but also to enhance the quality and reliability of electricity supply to the nation's most remote areas. Embracing a holistic, forward-looking approach that harmonizes technological advancements with financial innovation, and policy support with community involvement, India is poised to ensure that the benefits of electrification reach every household, fostering socio-economic development and contributing to the global agenda of sustainable energy for all.

7. APPENDIX

7.1. DETAILS OF PERSONNEL FOR KEY INFORMANT INTERVIEWS

S.No	Name	Designation	Organization	State
1	Santosh Reddy	EE	HESCOM	Karnataka
2	Mr. R S Varur (S.E.)	SE	HESCOM	Karnataka
3	Ravindra Ghagaas	XEN	DHBVN	Haryana
4	Ranbeer	XEN	DHBVN	Haryana
5	Mr. Pankaj Kela	SE	PVVNL	UP
6	Rajeev Aggarwal	SE	PVVNL	UP
7	Manish Kr Singh	SE	PVVNL	UP
8	Mohd Sagir	SE	DVVNL	UP
9	Ram Prakash	SE	DVVNL	UP
10	A Chaubey	Dir. Technical	DVVNL	UP
11	M Shangpliang	Dir. Technical	MePDCL	Meghalaya
12	Soowakan Jowai	EE	MePDCL	Meghalaya
13	Kazi Pradhan			Sikkim
14	Dandasena		OPTCL	Odisha
15	Arun Kumar		PuVVNL	UP
16	H L Maurya		PuVVNL	UP
17	Navikaran P		PuVVNL	UP
18	Bhawani Singh		MVVNL	UP
19	Anay Dwivedi		MPPoKVVCL	MP
20	Amit Tomar	MD	MPPoKVVCL	MP
21	Loobo Jamir	REC		Nagaland
22	Ashok Kumar		MVVNL	UP
23	Balpia	EE		Mizoram
24	Kanka Raju	EE		Odisha
25	Arminder Singh	JE	PSPCL	Punjab
26	Nishant Singla	XEN	PSPCL	Punjab
27	V Mohan Rao	CGM Projects	TSNPDCL	Telangana
28	T Mruthyunjaya Rao	Div. EE	TSNPDCL	Telangana
29	Saraswati	CPM REC	REC	Mumbai
30	Satish Gautam	REC CPM	REC	Karnataka
31	Abhinesh Paula	CPM REC		Hyderabad
32	Pushpak Deshmukh			Mumbai
33	Jayendra Wadhankar	MEDA	MEDA	Mumbai
34	Naresh Sardana	HERC	HERC	
35	Joginath Pradhan	CPM REC		Bihar
36	Sanjay Tripathi	CPM REC		J&K
37	Yogendra Singh	CPM REC		6 states
38	Ajay Gupta	CPM REC		HP
39	Subhendu Roy	CPM REC		Kerala
40	DK Gupta	CPM REC		UP
41	Anjan Lahiri	CPM REC		Jharkhand
42	Pradeep Fellows	CPM REC		MP and Chattisgarh
43	V K Mohanty	CPM REC		Odisha
44	Arun Kumar Chaturvedi	CPM REC		Uttarakhand
45	Saraswati	CPM REC		Maharashtra

S.No	Name	Designation	Organization	State
46	Saumya Kant	CPM REC		Karnataka
47	A K Tyagi	CPM REC		PB and HR
48	N Venkateshan	CPM REC		Telangana
49	Santosh Aispu	GERC		
50	Reshma Setpal	CSERC		
51	Praveen Garg	RERC		
52	Avinask Kumar	BERC		
53	Harish Bhallabh	SDO		
54	Rajat		REC	
55	Kunal	EE		Jharkhand
56	Manoj Bajaj			Chattisgarh
57	Irshaad Ahmed			J&K
58	F A khan	IT		Chattisgarh
59	Sandeep Seth			J&K
60	Debasis Sarkar	MD	TSECL	Tripura
61	S. Arun Nair	Professor	IIM Ahemdabad	Gujarat
62	Jayant Dube	EE	NBPDCL	Bihar
63	Mr. Kishore Chaudhary	DGM	TERI	Delhi
64	Mr. Jitendra Tiwari	Fellow	TERI	Delhi
65	Dr. Anand Shukla	Sr. Advisor	SDC	Delhi

7.2. CASE STUDIES FROM THE GROUND

Overleaf

Case Studies

STORIES FROM THE FIELD

This section discusses secondary literature present on case studies, focusing on their definitions and their importance in research studies. Case studies are valuable for obtaining an 'in-depth' perspective from respondents or subjects which might not be available from structured surveys.

A. Women Empowerment

Case Study 1 : 'Rinku now shares equal financial responsibility within the family'

Prior to getting the connection, Rinku had to rely on candles and kerosene lamp for the lighting.

She used to face significant challenges while preparing evening meals, experiencing discomfort and strain on her eyes.

Post electrification, their family owns a refrigerator that not only provides them with chilled water during the summer months but also reduces the effort required to cook fresh meals daily.

Furthermore, they purchased an electric sewing machine after getting electrified. With the help of electric sewing machine, she can generate a monthly income of Rs 5000-7000 & making a valuable financial contribution to the family. Additionally, the electric sewing machine also provides her with the physical comfort, as she no longer needs to operate it manually, relieving strain on her legs.

"मैं अधिक घरेलू महिलाओं को अपने साथ जोड़ना चाहती हूं और अपने उद्यम का विस्तार करना चाहती हूं।"

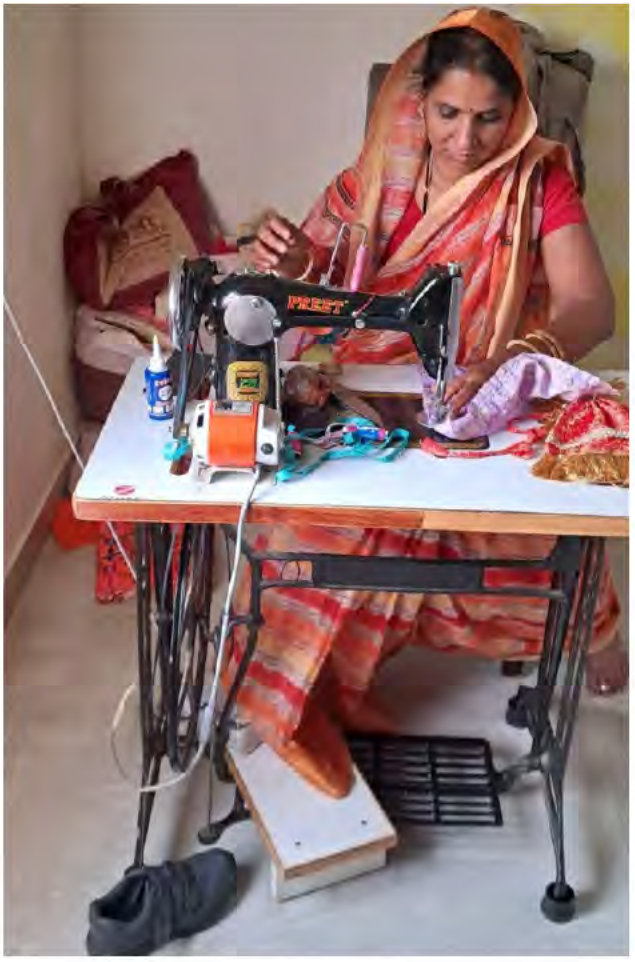


Image Source: RTI

B. Expanding Business Oppurtunities

Case Study 2 : 'Luvkush aspires to have a '*pucca*' shop in the nearby market'

Prior getting the electricity, Luvkush used to sell only chowmein (noodles) to make his livelihood.

There were many challenges as he had to laboriously make chutney and all the spices using grinding stone.

Post electrification, he has invested in refrigerator as well as mixer. The comfort of refrigerator allows him to prepare all the ingredients a day in advance such as boiling pasta, chow Mein, macaroni, etc. and this saves his time for the next day, and he has been able to start the business early.

The mixer has helped him to diversify his menu as, he not only sells chow mein but pasta, macaroni, etc along with the much-demanded chutney.

Now, he can earn approximately Rs 500-600 per day, which increases to around Rs 800- Rs 1000 per day during weekly markets. This is a significant improvement compared to before getting access to electricity, when he used to make only 100-200 per day, which increased to around 200-300 per day during weekly markets.

"मेरी इच्छा है कि बाजार में मेरी एक पक्की दुकान हो"

Image Source: RTI

C. Ease of doing business

Case Study 3: ‘Access to electricity has enabled the beneficiary to make more profits’

Image Source: RTI

After getting the electricity connection, the family completes half the process (making frames) for soup making at the night.

Now, the family can work comfortably during the evening hours and can produce an additional 30-40 units thanks to the availability of light.

The family's seasonal income has increased by Rs 4000 – 5000 per month (1 unit = Rs 100). Previously, they were making around 70-80 units, and now they can produce 150-160 units per month. During the wedding season, they can make an additional 20-25 units per day.

D. Increasing business opportunities

Case Study 4: ‘Access to electricity means access to aspirational appliances’

Flour Mill

After obtaining the electricity connection, the beneficiary invested in a flour mill that is adequate for grinding wheat for the family.

The machine has saved him a monthly expense of Rs 3000-Rs 4000, which he used to incur for grinding services from the market. Additionally, it has reduced transportation costs (Rs 300-Rs 400/weekly).

Moreover, during the harvest season (Feb-May), he earns an extra Rs 2000-Rs 3000 monthly. Furthermore, the machine provides him the freedom to grind at his convenience.

Image Source: RTI

E. Ease of doing business

Case Study 5: 'Access to electricity has enabled more business hours'

Image Source: RTI

Post electrification, the shop-owner is now able to open the shop till 10:30 PM. Also, the owner has installed a small fan into the shop which provides him to sit comfortably inside the shop even in the summers.

Due to extended hours, the owner's income has slightly risen by Rs 100-Rs 200 per day by keeping the shop open late at night.

"भविष्य में, मैं छोटी मात्रा के बजाय थोक में कच्चा माल खरीदने की योजना बना रहा हूं। इस तरह, मुझे अधिक लाभ होगा"

F. Increasing business opportunities

Case Study 6: 'Access to electricity has bring access to new business avenues'

E-Rickshaw

The beneficiary purchased an E-rickshaw post electrification.

The E-rickshaw has given him a source of employment as well as income. He is now able to earn around Rs 10,000- Rs 15,000 monthly against an electricity expenditure of Rs 700-1000 monthly.

He is now able to contribute financially to the family income. Further, with the help of E-rickshaw, he is also getting multiple works such as dropping kids to the school, during festivals, etc.

Image Source: RTI

G. Standard of living

Case Study 7: 'Access to electricity has bring access to aspirational appliances'

Post electrification, the beneficiary has invested in the cooler.

Prior to getting the electricity connection, it was difficult for the beneficiary as well his families to get a comfortable sleep. Post that, he says, the entire family sleeps with the cooler on. Further, his children can study comfortably in the presence of the cooler.

Also, the cooler has brought a major lifestyle change i.e., the entire family sleeps under the roof, which was the not the case earlier as few of the family members used to sleep on the roof (usually male members), thereby, exposing themselves to insects' bites, etc.

Image Source: RTI

H. Ease of doing business

Case Study 8: ‘Electricity has been a bane in doing the business’

Footwear making

The beneficiary has been in the business of footwear making pre-electrification.

Pre-electrification, the entire process was day driven. Electricity has brought much relief to him as well as his family. Now his family, works comfortably in the presence of fan as well as light.

Pre electrification he used to make around 60-70 articles per day, which he used to sell for an average price of Rs 70.

Post electrification, with the help of lighting as well as ambient working condition (fan as well as electrical mosquito repellent), he makes around 120-150 articles, selling for an average of price of Rs 75-80.

Image Source: RTI

I. Electricity transforming women livelihood's

Case Study 9: 'Electricity has made working condition very smooth'

ELECTRIC SEWING MACHINE

After the electrification, Didi invested in an electric sewing machine, which has significantly improved her comfort while working. Additionally, it has enhanced her efficiency, enabling her to stitch more clothes in the same duration.

The impact of the electric sewing machine is evident in the reduced time it takes for her to complete the entire stitching process. As a result, she has attracted a growing number of new consumers. Post-electrification, she easily earns around Rs 12,000 to Rs 15,000, which increases to around Rs 20,000 during the festive season. Prior to electrification, her income ranged from Rs 5,000 to Rs 7,000.

"Thanks to the electric machine, my legs are at ease, and the lighting has opened up the possibility for me to work comfortably late till night."

Image Source: RTI

J. Ease of doing business

Case Study 10: ‘It has become so much comfortable to do business in the presence of electricity’

DIGITAL PAYMENTS

After getting electricity, the beneficiary got a fridge, cooler, and TV for their shop at home. They also started using a digital way to get money called **Unified Payment Interface (UPI)**. Now, they make more money by selling drinks and can earn around Rs 15,000-18,000 each month, compared to Rs 10,000- Rs 12,000 before. Customers now pay them digitally, and the person feels safer because all the money goes into their shared bank account with their wife. Also, the cooler helps them stay open during hot days, which they couldn't do before.

Image source: RTI

K. Standard of living

Case Study 11: ‘ Electricity has brought entertainment as well as global awareness’

TELEVISION

After getting electricity, the beneficiary bought a TV for entertainment. Before that, the family had no way to have fun, and because there was no fan, the kids couldn't sleep well at night. Now, the family spends about 2-3 hours watching TV for fun and to learn about what's happening around them. The fan is also great because it keeps bugs away, and the children can sleep well at night now.

Image source: RTI

L. Safety as well as Sanitation

Case Study 12: 'Electricity has made it easier to look after the cattle's'

ELECTRIC FAN

Before electricity, caring for the cattle was challenging because they attracted insects, leading to frequent illnesses. To repel insects, the caretaker would burn cow dung and place it near the cattle. Additionally, to keep the cattle cool, the family regularly bathed them, with the frequency increasing to twice a day in hot summers.

After electrification, the person installed an electric fan in the cattle house. The fan not only keeps insects away throughout the night but also maintains a cool environment for the cattle throughout the day.

Image source: RTI

M. Lighting the homes through off-grid

Case Study 13: ‘Off-grid has made it possible to light our homes even though we live very far-off”

OFF-GRID

The beneficiary got a solar connection in 2018 through the SAUBHAGYA scheme. Before that, the family lived in the dark at night because their home was far from the electricity grid, and it was too expensive to bring the grid to their location.

After getting the solar connection, things improved a lot. The family now feels safe at night, and the kids can play and study later. Cooking and taking care of the children have become much easier with the light from the solar connection. It's made a big positive difference in their daily life.

Image source: RTI

7.3. DETAILED INFORMATION ON GRID AND OFF GRID CONSUMERS

Table 9: Household Asset Ownership

Outcome	**Mean Value for 2017**		**Mean Value for 2023**		**Difference between the within-group changes**
Household Ownership	**Off-Grid**	**Grid**	**Off-Grid**	**Grid**	**(Change in Off-Grid - Change in Grid)**
At Least 1 Electrical Asset (%)	71.01%	79.87%	100.00%	99.73%	9.13%
Total Number of Electrical Assets	0.91	1.05	1.98	3.81	-1.68
Basic Electrical Assets (Percent of Households that Own at Least One of the Asset)					
Bulbs	0%	4.34%	0%	28.29%	-23.95%
Cell Phone	40.26%	72.18%	100%	93.46%	38.46%
Fan	0.%	4.29%	48.15%	88.54%	-36.10%
Television	0%	6.01%	0.08%	56.85%	-50.75%
CFLs	0%	0.15%	0%	12.70%	-12.55%
Other Electrical Assets (Percent of Households that Own at Least One of the Asset)					
Electric Stove	0%	0.18%	0%	6.31%	-6.12%
Electric Sewing Machine	0%	0.01%	0%	0.96%	-0.95%
Tubelight	0%	0.30%	0%	35.97%	-35.67%
Iron Press	0%	0.64%	0%	14.34%	-13.70%
Heater	0%	0.70%	0%	6.51%	-5.81%
Mixer	0%	1.29%	0%	14.91%	-13.62%
Motor Pump	0%	4.46%	0%	15.39%	-10.93%

Table 9: Household Fuel Expenditure

Outcome	**Mean Value for 2017 (Rs)**		**Mean Value for 2023(Rs)**		**Difference between the within-group changes**
	Off-Grid	**Grid**	**Off-Grid**	**Grid**	**(Change in Off-Grid - Change in Grid)**
Modern Fuels (All)	0	858.08	1927.70	991.25	1794.53
Traditional Fuels (All)	14.65	309.66	134.24	251.82	177.43
Modern Fuels					
Solar	0	7.97	469.00	9.31	467.66
Bulbs	0	91.56	501.45	178.47	414.54
Charge LEDs	0	9.24	0	19.15	-9.91
Biogas	0	2.16	0	0.51	1.64
LPG	0	486.93	870.93	600.16	757.70
Electric Stoves	0	16.46	86.31	22.05	80.71
Traditional Fuels					
Kerosene for Lighting	14.49	49.26	14.36	28.13	21.00

Outcome	Mean Value for 2017 (Rs)		Mean Value for 2023(Rs)		Difference between the within-group changes
	Off-Grid	Grid	Off-Grid	Grid	(Change in Off-Grid - Change in Grid)
Candles	0	125.89	1.24	62.06	65.07
Torch	0.16	69.99	33.70	38.87	64.66
Coal	0	120.16	7.54	2.46	125.23
Animal Dung	0	94.41	14.95	65.44	43.92
Fuel Wood	0	50.85	62.45	49.64	63.66

Table 10: Comparison of Off-Grid and Grid Groups

Parameters	Grid	Off-Grid
Agricultural Labour	29.05%	24.40%
Self-Employed in Agriculture	44.40%	6.76%
Self-Employed in Non-Agriculture	5.20%	16.75%
Other	21.35%	52.01%
Hinduism	83.68%	63.29%
Islam	8.50%	31.64%
Christianity	5.50%	4.91%
Other	2.32	0.16%
OBC	38.75%	3.70%
SC	25%	50.72%
ST	19.65%	10.39%
Other	16.61%	35.19%
Own	99.14%	98.39%
Mean	91,647.01 Rs	89,362.32 Rs
Median	96,000 Rs	96,000 Rs

7.4. QUESTIONNAIRE

CONSENT OF RESPONDENT

*Hello, my name is*_____

Purpose

We have come from Research Triangle Institute (RTI) International, New Delhi through REC Limited.We are conducting a survey to collect information on the ***Impact assessment and Socio-Economic Conditions of rural households after the implementation of the SAUBHAGYA Scheme****. You are being invited to participate in our survey.*

Procedures

We would like to speak with an adult in this household, preferably household head, who is knowledgeable of financial and other major household decisions. This could be the head of the household, his/her spouse, or any other adult in the household. The interview will take about 20 minutes.

Risks and Benefits

You will not receive any direct benefit from the interview, nor will you be penalized in any way for refusing. This interview will cover how your household uses energy, such as from electricity, and alternative sources and how much you spend for that energy, as well as information on demographics, income-generation activities, children's education, and women's time-use. There will be no identifyinginformation collected for you. Your name will never be published in any report. When the results are published, they will be combined with information provided by thousands of others.

Voluntary Participation & Confidentiality

This interview is completely voluntary. You can choose not to answer any question. The information you share with us will be kept confidential. Only those involved in conducting this study will have accessto the information you provide, and data will be stored securely.

Questions: *Please ask questions about anything you don't understand before you decide to participate.If you would like more information, please call [NAME], our survey coordinator, at XX.*

Do you have any questions for me?

Yes		*No*	

Consent: *Do you agree to participate in following interviews?*

Yes		*No*	

Questions		Directions
A. Under which scheme did you receive your connection?	1. DDUGJY 2. SAUBHAGYA 3. Don't know	• If 1, stop the questionnaire and move onto the next consumer • If 2, go to question C • If 3, go to question B
B. When did you receive your connection?	1. Between Sep 2017 to Dec 2021 2. Before Sep 2017 or after Dec 2021 3. Do not know	• If 1, go to question C • If 2 or 3, stop the questionnaire and move onto the next consumer
C. What kind of electricity connection do you have?	1. Metered/ Grid Connected Connection 2. Off grid Connection 3. Unmetered/ Theft Case (Only Observe) 4. No connection	• If 1, conduct the grid connected survey • If 2, conduct the off – grid survey • If 3 and 4, stop the questionnaire and move onto the next consumer

Household Location Information	
Parameter	**Value**
Region	
District name	
Block name	
Gram Panchayat name	
Village name	
Tola or hamlet name if any	
Household head name	

GPS Reading	
Parameter	**Value**
GPS reading for latitude	
GPS reading for longitude	

Basic Household Information	
Parameter	**Value**
Household Size	
Household Type	• Self-employed in non-agriculture • Agricultural labour • Other labour • Self-employed in agriculture • Others

Basic Household Information	
Parameter	**Value**
Religion	• Hinduism • Islam • Christianity • Sikhism • Jainism • Buddhism • Zoroastrianism • Others
Social Group	• Scheduled tribe • Scheduled caste • Other backward class • Others
Dwelling Unit	• Owned • Hired • No dwelling unit • Others
Whether the household has access to internet at home on the date of survey	• Yes • No

Section A: Demographics

The section will deal with information on the interviewee and its family members in the household. Household is defined as all members linked to one kitchen and pooling in their resources to meet theirexpenditures jointly. The questions below will be filled for all the members of the households.

Demographic Information	
Parameter	**Value**
Name	
Age (in years)	
Sex	• Male • Female • Transgender
Marital Status	• Never married • Currently married • Widowed • Divorced/ Separated
Your relationship to the head of household	• Self • Spouse of head • Married child • Spouse of married child • Unmarried child • Grandchild • Father/mother/father-in-law/mother-in-law • Brother/sister/brother-in-law/sister-in-law • Uncle, aunt and other relatives • Servants/employees/other non-relative

Demographic Information	
Parameter	**Value**
Is he/she literate?	• Not literate • Anganwadi • Literate but below primary (1-4th) • Literate till primary (5th) • Middle (8th) • Secondary (10th) • Higher secondary (12th) • Graduate and above
Does he/she attend school at present?	• Yes • No
Please tell us about your occupation	• Crop Cultivation • Dairy • Poultry • Petty Shop • Agri Wage laborer • Non Agri wage laborer • Artisan/Independent Work • Organized Trade /Business • Construction Contractor • Student • Govt./Non Govt Service • Home Industry • Unemployed • Unemployed but don't need employment • Home maker
For members above the age of 5, Was this member a part of the household before Sep 2017	• Yes • No
If not, then in which year did they join?	Mention the year

Section B: Household Status and Resources

This section will collect information on the house and its resources.

Basic Information on House Ownership and House Type	
Parameter	**Value**
Do you have your own house to live in?	• Yes, it is mine or my father's. • No, I rent it. • Others
Is the house you live in a fixed house or a temporary house?	• Temporary or "kutcha" • Fixed or "pukka" • Mixed
How many rooms does your house have?	

What type of roof do you have in your house?	• Concrete • Metal • Straw/thatch • Tile • Cement Sheet • Asbestos • Other

Section C: Household Assets

This section will collect information about the household assets one has for various purposes. (Filldetails)

Household Assets					
S.No.	**Appliance type**	**Current Number (Put 0 if you do not have)**	**Capacity**	**Number before Sep 2017 (Put 0 if you do not have)**	**Capacity**
Cookstove Appliances					
i)	Mud Chulah				
ii)	Smokeless Chulah				
iii)	Kerosene Stove				
iv)	Electric Stove				
v)	LPG Gas Stove				
vi)	Any other (specify)				
Household Items					
i)	Torch				
ii)	Iron safe/ Almirah				
iii)	Sewing machine				
iv)	Electric Sewing machine		W		W
vii)	Bulb		W		W
viii)	CFL		W		W
ix)	LED		W		W
x)	Tube light		W		W
xi)	Iron (Press machine)		W		W
xiii)	Heater		W		W
xiv)	Electric fan		W		W
xv)	Mixer		W		W
xvi)	Utensils				
xvii)	Hand pump				
xviii)	Refrigerator				
xix)	Washing Machine				
xx)	Any other (specify)				
Entertainment items					
i)	Television set		W		W
iii)	Transistor or stereo/cassette				
iv)	Radio				
v)	Any other (specify)				
Communication devices					
i)	Land Line				

Household Assets					
S.No.	**Appliance type**	**Current Number (Put 0 if you do not have)**	**Capacity**	**Number before Sep 2017 (Put 0 if you do not have)**	**Capacity**
ii)	Cell phone				
iii)	Any other (specify)				
Business / Agriculture related items					
i)	Tractor		Horsepower		Horsepower
ii)	Motor pump		Horsepower		Horsepower
iii)	Tube well		Horsepower		Horsepower
iv)	Diesel Generators		kVA		kVA
v)	Any other (specify)				
Vehicle information					
i)	Cycle				
ii)	Motorcycle/Moped/Scooter				
iii)	Car/ Bus/Truck/Jeep				
iv)	Bullock cart, horse drawn cart etc.				
Land and other assets					
i)	Agricultural land owned		Acre		Acre
ii)	Non agriculture land owned		Acre		Acre
iii)	Gold/Precious jewels				
iv)	Livestock				

Section D: Connection related information of the Household

The section will cover in detail the energy consumption of the household

Connection Information			
S.No.	**Question**	**Options**	**Directions**
1	Do you have any electric connection at present?	1. Yes 2. No	If "1" then go toD4
2	Did you have electricity in the past 5 years?	1. Yes 2. No	If "2", go to "D3" and then toSection F, If "1" go to D4
3	If you do not have an electricity connection,why not?	1. Electricity connection is not available 2. We cannot afford the electricity connection 3. We have no need for electricity 4. Don't Know 5. Other, specify _____ 6. We do not want to disclose	Go to Section F after this question

4	What are the sources ofelectricity you have used in the past 5 years?	1. Govt. Electricity under the SAUBHAGYAscheme 2. Govt. Electricity under Other scheme 3. Govt. electricity but do not know the scheme 4. Solar energy 5. Diesel Generator 6. Don't Know 7. Others, Pls Specify		For every option chosen, create thebelow table
5	When have you takenthese connections? (For every option chosen, create the table)	**Source**	**Since when**	**Status**
		Govt. Electricity under the SAUBHAGYA Scheme		1 = running 2 = closed
		Govt. Electricity under Other scheme	M M y y y y	1 = running 2 = closed
		Govt. electricity but do not know the scheme		1 = running 2 = closed
		Solar Energy	M M y y y y	1 = running 2 = closed
		Diesel Generator	M M y y y y	1 = running 2 = closed
		Other, specify	M M y y y y	1 = running 2 = closed

Section E: Measuring the quality of the connection

This section will cover the aspect of quality for the connection received

Connection Information			
S.No.	**Question**	**Options**	**Directions**
1.	How did you receive the connection?	1. Submitted a written application to the Discom officials 2. From a SAUBHAGYA camp 3. Was identified under the SAUBHAGYA Scheme/ other schemes by the discomofficials themselves 4. Applied online 5. Others (Pls Specify)	
2.	Did you receive any external help for the connection?	1. Yes 2. No	If Yes, then E3 or else E4

3.	Who was instrumental in helping you provide an electricity connection?	1. Discom Officials 2. Lineman 3. Pradhan 4. Influential Village Person 5. Person who already received theirelectricity connection 6. Others, Pls specify	
4.	When you received the connection, how long did it take to get connected after signing up? (in days)	1. 15 days 2. 15 – 30 days 3. 30 – 60 4. >60 days	
5.	How much did you pay the DISCOM/ Substation officials as a connection fee? (Rs)		Enter "0", if the user paid nothing
6.	How much did you pay to install the meter at your premises? (Rs)		Enter "0", if the user paid nothing
7.	After receiving the connection, how much power outagesdid you observe in the last year's summer months?	1. 0 – 2 hours 2. 2 – 4 hours 3. 4 – 6 hours 4. 6 – 8 hours 5. 8 - 10 hours 6. >10 hours	
8.	After receiving the connection, how much power outagesdid you observe in the last year's winter months?	1. 0 – 2 hours 2. 2 – 4 hours 3. 4 – 6 hours 4. 6 – 8 hours 5. 8 – 10 hours 6. >10 hours	
9.	What kind of voltage issues did you experienced in the last year?	1. No voltage issues 2. Slight Fluctuations 3. Brownout 4. Blackout 5. Appliances fused out due to voltage	
10.	Is the electricity scheduled in your region?	1. Yes 2. No	

Section F: Electricity Settings of the Household

The section will cover the electricity settings in the household of the beneficiary

Electricity Settings of the household								
Question	**Rooms**							
	(Courtyard)	**(Bed R-1)**	**(BR2)**	**(BR3)**	**Kitchen, If any)**	**Toilet, if any)**	**Cattle Shed, if any)**	**Others, If any**

Do you have electricity in given Room(s) 1. Yes 2. No								
Is there a meter on any electric line in this household?	1. Yes 2. No 3. Don't know							

Section G: Energy Consumption Information:

The section will cover in detail the Energy consumption of the household on a daily basis.

Lighting Information			
S.No.	**Question**	**Options**	**Directions**
1.	What type of fuels and energy sources do you use for lighting?	1. Kerosene for lamp lighting 2. Candles 3. Battery Torch 4. Solar lantern 5. Electric bulb/LED Bulb 6. Chargeable LEDs 7. Others, Pls Specify	Multiple choice answer, the enumerator will have to fill thequestions below for all the options selected
2.	How many days in a month during a typical month did you use these sources, respectively?		
3.	How many hours, on an average in a day, you use these sources, respectively?		
4.	How much quantity of these resources do you use in a month?		Enter specific units (for instance,liters for kerosene, nos. for candles, etc.)
5.	How much quantity of these resources did you use in a month before Sep 2017?		Enter specific units (for instance,liters for kerosene, nos. for candles, etc.)
6.	What is the average monthly expenditure done on resourcesused?		
7.	Where did you get the supply ofthese resources?		
Cooking Information			
S.No.	**Question**	**Options**	**Directions**

1.	What type of fuels and energysources do you use for cooking?	1. Biogas 2. LPG 3. Coal 4. Animal dung 5. Fuel Wood 6. Electric stove 7. Others, Pls Specify	Multiple choice answer, the enumerator will have to fill the questions below for all the optionsselected
2.	How many days in the last month did you use these sources, respectively?		
3.	How many hours, on an average in a day, you use these sources, respectively?		
4.	How much quantity of these resources do you use in a month?		Enter specific units (for instance, liters for kerosene, nos. for candles,etc.)
5.	How much quantity of these resources did you use in a month before Sep 2017?		Enter specific units (for instance, liters for kerosene, nos. for candles, etc.)
6.	What is the average monthly expenditure done on resourcesused?		
7.	Where did you get the supply ofthese resources?	1. Shop/ market 2. Field 3. Forest 4. Animals 5. Govt. ration store 6. Private generator 7. Govt. provided electricity	

Section H: Household Characteristics

Further details about the family social and economic characteristics

Household Characteristics						
S.No.	Question	Options				Directions
1	Does your family come in BPL category, recognized byGovernment?	1. Yes 2. No 3. Don't know				If "2" or "3", go to H3.
2	If Yes, please show your BPL card and tell us the color of thecard	Colour	Red(BPL)	Yellow	Green (APL)	
			A	**B**	**C**	
		Total Number				
3	Does your family have aMNREGA (Job) card?	1. Yes 2. No				If "2" skip toH5

Household Characteristics					
S.No.	Question	Options			Directions
4	If yes, has any member in yourfamily taken job under MNREGA activities in the pastyear?	1. Yes, got work in NREGA works 2. sought but did not get work in NREGAworks 3. did not seek work in NREGA works			
Household Heath and Sanitation					
5	Have you or your family members had any respiratory problems ***in the last 5 years?***	(Adult Men) **A** 1. Yes 2. No	(Adult Women) **B** 1. Yes 2. No	(Children) **C** 1. Yes 2. No	If "2" in every section skip tosection I
6	Do you think the respiratory issue gets worse when the cooking stove is burning?	1. Yes 2. No			
7	Do you think the respiratory issues gets worsewhen the kerosene lamp is lit?	1. Yes 2. No			
8	Do you think the respiratory issues can be reducedwith the use of the electric cookstove?	1. Yes 2. No			

Section I: Household Income and Expenditure

This section will detail out the respondents household income and expenditure

Type of Income Generating Activities		
Category	**Activity**	**Activity Code**
Agriculture and Related Activities	Farming one's own land	11
	Farm laborer	12
	Cultivating on someoneelse's land	13
	Fisherman	14
	Animal Rearing	15
	Chicken Rearing	16
	Fruit Producer	17
Pension and Income	Govt Pension	21
	Old Age Pension	22
	Widow Pension	23
Small business	Fruit or vegetable shop	31
	General Store	32
	Beetel Leaf / Supari Store	33
	Clothing Store	34
	Ice Cream Stall	35
	Beauty Parlour	36
Professional	Doctor	41
	Engineer	42
	Lawyer	43
	Village doctor	44
	Govt. teacher	45

Type of Income Generating Activities		
Category	**Activity**	**Activity Code**
	Govt. job	46
	Health Worker	47
	Moneylender	48
	Private job	49
	Barber	410
	Washerman	411
	Servant/ Cook	413
Small Industry/ Mill/ Factory	Processing wheat	51
	Iron welding	52
	Woodwork	53
	Terracotta work	54
	Sewing	55
	Factory work	56
	Mechanic	57
	Goldsmith	58
Transportation	Rickshaw driver	61
	Boatman	62
	Driver	63
	Other transportation work	64
Construction	Mason	71
	Laborer	72
	Other construction related	73
Rent/ Dividend	NA	8
Forest Based Livelihood	NA	9
Others	Pls Specify	10

Please tell us about your income source, income amount, mobile phone usage and electricity usage relating to your income generating activity?							
Income Source Code	**Income**		**Mobile Phone**		**Electricity**		**Has your income in this activity gone up since Sep 2017?**
Choose the accurate code from the list above	**In the last month**	**Annual**	**Do you use your mobile phone for this?**	**For what purpose**	**Do you use your electricity for this?**	**For what purpose**	
Options			**1.Yes 2.No**	**1.to talk 2.for SMS 3.For payment purposes 4.Other, pls specify 5.NA**	**1.Yes 2.No**	**1.Lighting 2.To use a machine 3.NA 4.Don't Know 5.Other, specify**	**1.Yes 2.No 3.Don't know**

i)							
ii)							
iii)							
iv)							
v)							
vi)							

Expenditure Details			
If the respondent does not provide a numerical input, kindly use the following options 1.Not Applicable 2.Don't Know 3.Other, specify 4.Do not want to disclose	Expenditure heads	Expenditure	
		In the last month	In a similar month before you got electricity or before Sep 2017, whichever was later
		A	B
	i) Food: Rice, lentil, flour, oil etc.		
	ii) Soap/Shampoo		
	iii) House maintenance		
	iv) Health Expense		
	v) Kids' Education		
	vi) Travel		
	vii) Phone bill		
	viii)Social Function/ festival		
	ix) Occupation related		
	x) Electricity Bills		
	xi) Fuel		
	xii) Insurance		
	xiii)Bank or SHG Savings		
	xiv) Other (specify)		

Section J: Information on enterprises and business

The section will ask more details about the Enterprises owned and managed by the household members

Enterprise Name	Nature of Enterprise	Primary activity of the Enterprise	Location of the enterprise	Year of Establishmentof this enterprise? (Year)	Which HH member (enter ID from roster) spends the most time in	Number of Staff		Number of Staff Before Sep 2017	
						P	C	P	C

					the enterprise				
1									
2									
3									
4									
5									

P= Permanent, C= Casual

Operating Expenses for Each Business/Craft Activity for upto 3 businesses

Enterprise number	Raw Material		Rent		Fuels		Machinery		Labour		Other operating expenses	
	LY	B17	LY	B17	LY	B17	LY	B17	LY	B17	LY	B17
1												
2												
3												

LY = Last Year; B17= Before Sep 2017

Section K: Financial Assets and liabilities

Information about the respondents key financial assets and liabilities.

S.no	Financial Asset	Current value	Before Sep 2017 value
1	Commercial Banks		
2	Private Banks		
3	Post Office		
4	Chit funds		
5	SHG		
6	Co-op		
7	Cash in hand		
8	Money owed to you by others		

S.no	Loans	Total pending now	Total pending before Sep 2017
1	Bank loans		
2	Coop Loan		
3	Employer/Landlord loan		
4	Money lender loan		
5	Store credit		
6	Relative/friends' loan		

Section L: Daily Activities

Please select the male or female households head, one female adult, and one child (randomlyselected) from the household roster, and answer questions about their daily activities.

1. What time do you start working in the morning?

		Hrs

2. How many do you work on average in a given day?

		Hrs

Member ID [ ]	
*Now I will ask you about your daily activities. Please tell against time indicated, your "**main activities**" you do in house and /or outside, during the day. Please highlight the activities you do inhouse and those require a **'electricity source'.***	
Code **1= Bath/ toilet** **2= Cleaning utensils/ filling water** **3= Child care** **4= Agriculture related** **5= Wage labor** **6= Shop/ business** **7= Government job** **8= Reading/ Writing/ Studying during the day** **9= reading/studying during the night** **10=Attending school/college or educational institute**	**11= Entertainment related** **12= Talking with neighbors / family members** **13= Cooking/ Eating/ Serving food** **14= Taking care of animals** **15= Fuel wood/ fodder collection** **16= Going to the market** **17= Children playing** **18= Sleeping/ Relaxing**

Activity No	**Activity conducted in** 1. Inside the house 2. Outside the house	**Does the activity require electricity** 1. Requires electricity 2. Does not require electricity	**Time spent in this activity before electricity access (in mins)**	**Time spent in this activity after electricity access (in mins)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

Agricultural time use:

S.no.	Type ofCrop	No. of workers andAvg. no. of days worked	Labor use for ploughing					
			Non Family Labour			Family (incl exchange labor)		
			M	F	C	M	F	C
1	Horticulture	W (No.)						
		Days						
2	Food crops	W (No.)						
		Days						
3	Livestock rearing	W (No.)						
		Days						

M = Male, F = Female, C = Child; W = Workers

Final Questions to the beneficiaries	
How would you rate the overall quality of supply and services by DISCOM?	1-Poor, 2- Fair, 3-Good, 4-Very Good, 5-Excellent
How would you rate the availability of uninterrupted power supply by your DISCOM	1-Poor, 2- Fair, 3-Good, 4-Very Good, 5-Excellent
Considering all your experience post electrification of your household with help of SAUBHAGYA Scheme, how do you like to rate your overall feeling on a 5-point scale where	1-Extremly dissatisfied, 2- Dissatisfied, 3-Neither dissatisfied nor satisfied, 4-Satisfied, 5-Very much satisfied

Survey Status Code

Survey Status Code	
01	Complete
02	Death/ Left village
03	No one was home
04	Respondent partially unavailable
05	Respondent completely unavailable
06	Did not consent
07	Refused to complete survey

FGD Questionnaire

General Information

Parameters	Input
Name of surveyor(s)	
Date of Survey	
Time of Survey	
Gram Panchayat	
Village	
Block	
District	
State	
Geolocation Input (GPS)	

FGD Details

Parameters	Input
FGD Number	
FGD Place	
Name of Pradhan	
Contact number of Pradhan	
Number of attendees	
Name of attendees	

FGD Questionnaire

S.No	Question	Answers
1	Are you aware about the SAUBHAGYA Scheme?	
2	When did you receive a metered connection from the DISCOM in your village?	
3	How did you receive a connection?	
4	What was your economic status (BPL/ Non BPL) under which you received connection?	
5	Has the economic status changed post electrification?	
6	What have been major lifestyle changes post electrification?	
7	Has your dependence on alternative electricity sources increased or decreased? Why?	
8	How has the availability of electricity impacted your children's education?	
9	Has electricity given you a sense of safety as well security at night? (Kindly capture the crime rates in the area, able to walk safely at night, Areas which are well-lit now)	
10	Do you think post electrification the health issues have subsided for your family?	

S.No	Question	Answers
11	Are you looking forward to enhancing your income through other activities now that you have electricity access? How?	
12	Do you think services in the village has become better in terms of commercial activity, health facilities and education institutes after electrification? Kindly elaborate?	
13	Are you looking forward to buying other new appliances in the future? If yes, which ones?	
14	Do you look forward to investing in electric scooters/ rickshaws/ autos? Why?	
15	Do you feel there are still households that are not availing electricity through correct means? If yes, Is there an underlying reason for the same? How can we improve this situation?	
16	Are there still any households that have not taken electricity connection? Why? What can be done to help them take up a connection?	

In Depth Interview

General Information

Parameters	**Input**
Name of surveyor	
Date of Survey	
Time of Survey	
Gram Panchayat	
Village	
Block	
District	
State	
Geolocation Input (GPS)	
SAUBHAGYA Connection Date	
Connection Number	

In depth Interview Details

S.No.	**Question**	**Answer**	**Instructions**
1.	Name		
2.	Age		
3.	Gender		
4.	What are the positive changes electricity has brought in your life?	1. Started a new business 2. Enabled better family health and lifestyle 3. Increased income sources 4. Others, kindly explain	If answer is 1, ask 5 - 10 If answer is 2, ask 10 - 12 If answer is 3, ask 13 - 14 If answer is 4, ask 15
5.	From how long you have been running the enterprise?		
6.	What role has electricity played in running your enterprise? Kindly Elaborate?		
7.	Kindly state the benefits obtained after getting the electricity connection (Change in income before or after getting the connection, increase in manpower, cost savings, improved efficiency, or any other positive outcomes)		
8.	Kindly state the expenses in running the trade/enterprises (Raw material, electricity bill, operating expenses, or any other)		
9.	What are your future plans for the business?		
10.	What are the positive changes electricity brought to your home? (note any new		

S.No.	Question	Answer	Instructions
	appliance penetration, education aspects, cooking in light, etc)		
11.	Can you elaborate about your situation before receiving electricity and how it has changed now?		
12.	Are you planning to increase your income sources in the coming years?		
13.	How has the income sources increased for you post electricity availability?		
14.	What are your future plans regarding this?		
15.	Can you kindly elaborate further on the positive changes post electrification?		

Photos of Enterprises/ HHs/ Positive impact of electrification