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# EMPOWERING RURAL INDIA

WITH ELECTRICITY SUFFICIENCY



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## Abstract

Rural electrification is one of the main requirements for India with a major population of approximately 70% living in rural areas. For nearly seven decades since independence, the nation witnessed a lack of political will and systematic attempts to comprehensively identify and analyse the drivers and barriers to rural electrification and weed them off within the specified time limit. Also, the existent sources of energy made it difficult for electricity to be available to the people belonging to rural areas, who don't have much source of income. In such a scenario, development goals remained mere statistics on paper. Electricity that was the fuel for the growth engines remained unpredictable, and unreliable, and stalled the development of the nation to its full potential.

Post-2014, a fundamental transformation in India's culture of governance happened, and the ruling governance became a byword for swift action. The nation transformed its village from being power deficient to power sufficient. Lessons learned from India's electrification story during these times are translated globally to accelerate progress toward universal access.

**Keywords:** Power, Rural, Farmers, Access, Reliable

## Introduction

In 2019, the small town of Leisang in the northeastern state of Manipur made headlines around the world when it became the **"last Indian village to be electrified"**. All homes in Indian villages have access to power, as an outcome of a vision centered on not just availability, but also on reliability and equity.

Ensuring 24 by 7 electricity access for all citizens goes beyond infrastructure development. It directly impacts the socio-economic fabric of the nation. Rural household electrification has been one such area where India has seen commendable progress. **In 2004, only six states**—Kerala, Tamil Nadu, Punjab, Haryana, Gujarat, and Andhra Pradesh—reported that over 99% of their villages were electrified according to the new definition (CEA, 2005). Today, **100% of all villages in rural communities are** electrified. A decade ago, India grappled with unexpected power outages; today, **it is nearing universal electricity access**.

The story was quite different a decade back. What was it? This paper highlights some aspects of the pre-2014 scenario in India, where blackouts, power thefts, and limited access to affordable electricity were the norm across the rural and urban populace. **This changed for the better in India in the last decade.**

## Methodology

As secondary sources, this study uses data from discussions, books, journal articles, and think tank reports to develop a strategic understanding of government policy for ensuring electricity access in villages, particularly households. This methodology has been selected for this research because it offers insight into those involved directly in making the strategy and the educated class. One possible weakness of this methodology could be the reliability and bias of the results. However, to minimise bias and enhance the reliability of the findings,

this paper will only present the results and outcomes found common among all the primary and secondary data sources.

The paper goes on to highlight how the historically under-served rural communities got priority in access and were assured of a reliable supply at affordable prices. Rural economy fructified as it spurred growth, higher number of home-grown businesses in those pockets and hamlets, and elevated them to a higher standard of living. Improved grid capacity and cost recovery were simultaneously accompanied by optimizing grid functioning. By accommodating renewable energy to meet growing energy needs, enhanced electricity supply lowered the cost of energy. Strong governance reforms weeded out the remaining operational inefficiencies that had traditionally served as a major hiccup to the reforms in the power sector. Outcomes at the grassroots have been, thus far path-breaking.

### **Research Findings For Pre-2014: The Reality of Massive Blackouts, Exclusions & Lost Opportunities**

Only 1,500 villages had electricity around the time of independence. The task of electrifying villages was humongous. Some were remote mountain-top villages, while others were deep in forested areas—inhabited by communities long overlooked by India. By 1950s, only 3000 villages were electrified. The snail-paced progress persisted across the 1950s slightly shifting toward the electrification of irrigation projects and villages.

### **Transition in Priorities in Rural Access to Electricity**

In the late 1960s and 1970s, the government promoted electric irrigation pumps for farmers with low electricity tariffs and credit schemes to boost demand. The policy succeeded, with the widespread adoption of electric pumps by farmers. However, tariff subsidies, meant to support the transition to irrigated agriculture, had to be borne by industries through cross-subsidisation instead. Seasonal demand, high costs for limited use, and ongoing subsidies reduced the financial incentive of state-owned electricity companies financial incentive to

maintain power lines. The infrastructure to transmit electricity to the entire village was inadequate, and the existing system was poorly maintained. **Rural households were a lower priority for electricity access.** It was only in the late 1970s that the Indian government began focusing on rural household electricity access but the delivery of electricity never reached the rural areas. There were few green off shoots. Between 1997 to 2002, and rural electrification was the key to fuelling rural development.

Despite this, nearly **78 million rural households were left out of access to electricity in India (Census 2001).** Electricity costs were too high for many, and poor people faced numerous hurdles in securing and keeping connections. The majority of the unelectrified households in villages retained their status quo of dependence on informal coping mechanisms by relying on kerosene lamps and firewood as it was more pocket-friendly and they enjoyed their comfort space with traditional options. Without reliable energy, families faced persistent poverty, poor social services, and fewer opportunities for women and girls to access education. Tall electric posts with dead cables were a mockery of the entire electrification scheme in rural areas.

### **Impact on Reliability In Access & Blackouts; A Norm**

In the period spanning 2000-2014, there have been **multiple instances where Indians were left stranded without power**, trains got halted, miners were trapped underground, subway lines were paralyzed, critical surgeries were put off, and traffic came to a standstill.

In 2004, though the government pledged electricity for all villages by 2009 and full household electrification by 2012, the task proved tougher than promised. Addressing the flaws in the prevailing schemes, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) launched a major program to extend the grid and strengthen rural electricity infrastructure (GoI 2005). The plan aimed to develop a rural distribution backbone, village-level infrastructure, and decentralized

power generation to boost agriculture, industries like khadi, and small businesses. Electricity would support irrigation, refrigeration, healthcare, education, and IT, with businesses receiving 90% capital subsidies and the rest financed through REC loans or state funds.

However, the journey towards implementing rural electrification got complex day by day. It involved the coordination of multiple national ministries, state electricity companies, and renewable energy agencies. **Overlapping responsibilities and lack of clear leadership lead to conflicts, making the program execution challenging.**

India experienced its largest-ever and worst electrical blackout in July 2012, which **impacted around 670 million people across nine states**—about 10 percent of the global population. The collapse of three interconnected northern power grids caused outages that stretched nearly 2,000 miles, from the eastern border with Myanmar to the western border with Pakistan. Power could only be **fully restored after two days of grid failures**. Government officials escaped responsibility by quoting that energy-hungry states drew power beyond their allocated limits.

In 2001, a similar grid failure plunged north India into darkness. Not many lessons were learnt which was reflected by the 2012 episode. Frequent grid failures harmed the nation's image due to **30% distribution loss due to theft and inefficient networks (compared to the global average of 15%)**. Additionally, coal supply bottlenecks and related insufficient capacity investment commensurate **to absorb the demands of population rise trapped India in a vicious circle of inefficiencies**.

### **National Electricity Deficits**

Since 1951, India has consistently missed its electricity generation targets. According to the Load Generation Balance Report (2011-12) by the Central Electricity Authority, all regions of India faced a significant electricity supply shortfall, **with a nationwide deficit of 8%**.



Over the years, various government committees, including the Fuel Policy Committee and the Advisory Board on Energy, developed programs for rural energy, such as electrification, biogas, improved cookstoves, and renewable energy technologies. Despite these efforts spanning nearly two decades, **their impact on rural energy remains limited**. Further, meddling by politicians in electricity expansion and service plans **stalled the speed and scale of power reforms**.

With such a state of affairs, reaching out to the remotest villages in borders, especially in the Northeast got neglected. During the rainy season and natural disasters, poor infrastructure, and harsh terrains made these villages nearly inaccessible. The situation worsened when the key road and rail links were severed.

### **Global Picture of Lost Competitiveness**

As per World Bank 2017 report, India topped the list of **most power-deficient countries** in 2014 along with Nigeria due to its large population. A generous dose of political will was missing due to which India's power sector seemed to have been written off internationally leading to lost opportunities in the form of better competitiveness to counterparts like China, Brazil, etc.

### **Research Findings For Post 2014-Seizing Growth Opportunities & Capitalising It for "Nation First"**

The current government chose to scale up the electrification work in villages due to its large-scale progressive scale impact. With the rural population forming 70% of the Indian population, lower-income households were to benefit more from access to electricity than higher-income households. The main obstacles to household electrification were **lack of awareness, high costs for new connections, and logistical challenges in the connection process were eased off**. Past research has confirmed that rising electrification is associated with substantial improvements in households' income, expenditure, employment, and educational achievements. This was brought into reality with a pragmatic approach,



wherein success at the state level was used as a stepping stone to widen the impact at the national level as well.

## **Learnings From CM Days**

Narendra Damodardas Modi has not been new to scripting turnarounds his keen foresight and extensive experience came in handy in revolutionising the power sector. When he assumed the office of Gujarat's chief minister in October 2001, the power condition in Gujarat was abysmal. GSEB had reported huge losses, did not have the money to increase its generation capacity on its own, and could not convince the private sector to invest in the sector. Having identified the best bureaucrat for the job, efforts were concentrated on shaping up staff morale and putting the finances of the power utility on a stronger wicket. Having discovered that GSEB had borrowed at interest rates of at least 18%, debt restructuring was pursued and lenders were convinced to trim their rates thereby netting Rs. 500 crore in savings during 2002–2003.

Another ground-breaking program, the Jyotigram Yojana was designed and carried out by Narendra Modi when he was Gujarat's Chief Minister in India. This initiative, which addressed both home and agricultural power demands, was introduced in 2003 to modernise the Gujarati rural power industry. It gave rural communities a dependable, continuous, three-phase electricity supply. The inconsistent and constrained electricity supply that rural areas had been used to markedly change with this.

The Jyotigram Yojana's novel strategy entailed dividing electricity feeders among those used for agriculture and those not. Because of this division, the government was able to continue supplying electricity to rural homes, businesses, schools, and hospitals while also giving the agricultural sector a scheduled, dedicated power source for irrigation. Outcomes such as reduced reliance on diesel pumps lowered farming costs and cut the carbon footprint. A steady power supply improved rural life, enabling better education, access to information, and

enhanced healthcare services. It went on to be replicated in transforming the fate of power-strapped states.

This was followed by a rooftop solar power project that aimed to produce 5 MW by placing panels on 50 public and 500 private buildings to turn Gandhinagar into a solar city. In 2012–13, similar projects will be carried out in Rajkot, Surat, Bhavnagar, and Vadodara. In addition, the State started producing solar energy by installing panels on the branches of the Narmada canal and commissioning a 1 MW facility close to Chandrasan, which has also stopped 90,000 lakh gallons of water from evaporating.

A **catalyst scheme that was a** pioneering initiative, uniquely focused on large-scale household electrification **at the national level** has been the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA).

### **The Centre-Sponsored Saubhagya Scheme**

SAUBHAGYA provided electrical connections to all non-electrified households, regardless of their BPL status. BPL households receive free connections, while non-BPL households pay a nominal fee of Rs. 500 in 10 installments. The scheme has allocated Rs. 14,000 crores for rural households, with 70% funded by central government grants and the remainder covered by DISCOM contributions and loans (MoP, 2017).

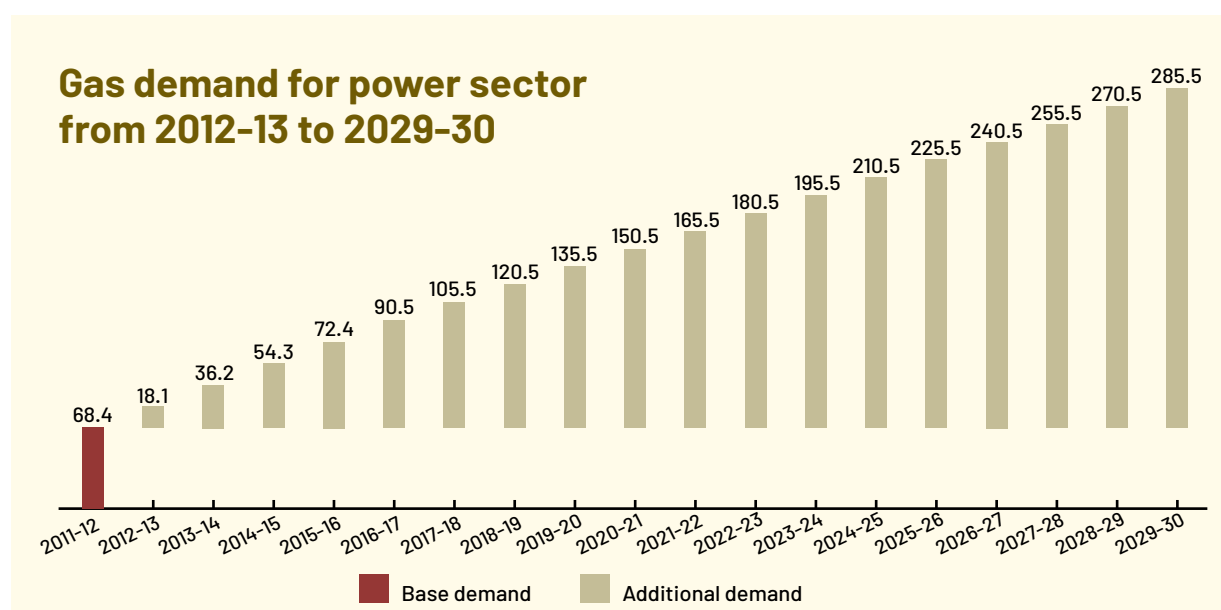
In October 2017, the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA) was launched to achieve universal household electrification. All willing unelectrified households in rural areas and urban poor households now had the opportunity to access free electricity. India made remarkable strides in village electrification from 2015 to 2018, expanding grid coverage nationwide.

Saubhagya, in an unprecedented move, provided 200-300Wp solar home systems for households in remote areas, unlike earlier programs that only addressed basic lighting needs. By April 2018, every village in the country had been connected to the power grid. As a result, **28.6 million households across the country gained access to electricity**. All

of India's 597,464 census villages got electrified, 12 days ahead of the schedule by April 2018. International Energy Agency, this was the fastest expansion of **energy access ever recorded globally**.

Several **key policy measures have been simultaneously implemented to strengthen power generation, transmission, and distribution while enhancing the financial viability of state distribution companies**. To meet growing electricity demand and reduce CO2 emissions, expanding gas-based power generation is seen as crucial as shown in the graph below. Gas projects are relatively environmentally friendly, highly efficient, have shorter setup times, and require less land and water compared to coal-based stations, which face long development periods and lagging domestic coal production. **Given the coal shortages during the 12th plan period, the priority was set on additional gas-based capacity.**

**Due to the foresight of the government**, natural gas demand has risen sharply in recent years due **to increased availability, expanded transmission and distribution infrastructure, cost savings from using natural gas over alternative fuels, and favorable pricing**. This has made it easier for sectors like power, fertilizer, CGD, and various industrial and commercial establishments to **switch to natural gas for their energy needs**.



The distribution systems were reinforced on an unprecedented scale, with a total sanctioned cost of ₹2,01,722 crores for strengthening schemes across all states. Due to consistent efforts by the Centre to provide free LPG connections to families below the poverty line, nearly 36 million connections have been established. This initiative has significantly enhanced the quality of life for many, especially women and children in rural India, by reducing indoor air pollution and saving the considerable time currently spent gathering biomass.

### **Powering Economic Transformations in Rural Lives**

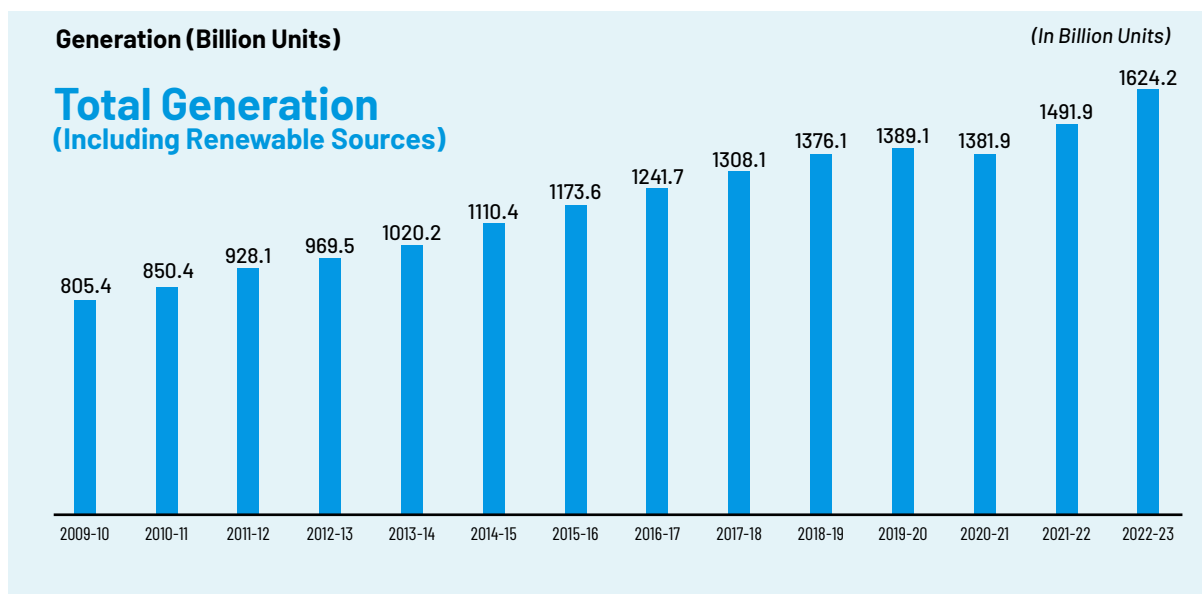
Due to strong political commitment, universal electricity access remains achievable now and **unseen transformations are underway in the heart of India, i.e. villages. The bottom of the pyramid has powered India's growth story.**

This surge suggests a notable shift in energy consumption patterns, potentially leading to increased efficiency, modernization, and reliance on electric-powered tools and equipment.

### **Electricity Independence & Electricity Generators**

**Electricity consumers become electricity generators**, through PM Surya Ghar Muft Bijli Yojana. It is a central scheme providing free electricity to one crore households in India that install rooftop solar units. The Ministry of New and Renewable Energy (MNRE) is playing a key role in fostering **cooperative ownership in community solar** to empower rural communities. It fosters economies of scale by pooling resources and reducing cost per unit of energy produced. Modhera in Gujarat in 2022 became India's first fully solar-powered village. **Villagers no longer pay for electricity; instead, they earn from selling surplus solar power to the grid.** Over 1,300 homes were equipped with 1kW rooftop solar panels, linked to a 15 MWh Battery Energy Storage System in nearby Sajjanpura, generating ample power for the village.

Some of Modhera residents, used to pay Rs. 2000 for electricity bills have used savings from zero electricity bills to buy items like electric sewing machines, air conditioners, and pottery wheels. With lower costs, they afford better diets, invest in education, and use electric tools for crafts and earthenware. Land prices in the area have soared, with large landowners selling to builders for crores.



Rooftop solar systems have eased the power distribution burden by generating electricity where it's used, reducing the need for long-distance supply and minimizing losses. This localized approach **enhances energy independence and reduces supply disruptions.**

### Peak Load Balance

The Deendayal Upadhyaya Gram Jyoti Yojana successfully brought **electricity to the homes of India's poorest residents in 18,374 villages, providing power to un-electrified villages where grid connectivity is impractical or too costly.** Before 2014, due to inadequate and unreliable power supply, distribution utilities frequently resorted to load shedding, impacting both agricultural and non-agricultural consumers due to a shared distribution network. This changed with the scheme for good. Feeder separation provided dedicated electricity lines for agricultural and non-agricultural

consumers. This approach flattened the load curve by shifting **agricultural use to off-peak hours, improving peak load management, and reducing blackouts.**

### **Changing Agriculture Practises**

Electricity consumption in agriculture has undergone a significant change driven by improved agricultural practices. Pumped irrigation is a key factor in the prosperity of Indian smallholder farmers, with groundwater being the main source due to its low extraction cost. It is driven by higher irrigation demand for new crop varieties and subsidized electricity. The share of electricity in India's agriculture sector increased from **28.75% in 2009-10 to 37.1% in 2019-20 of the** total energy use.

**Electricity availability has increased to 23 ½ hours in urban areas and 22 ½ in rural areas in the last decade. In rural areas, it was a mere 12½ hours in 2014.** To help increase agricultural production, the net irrigated area in the country increased **from 692.70 lakh hectares in 2016-17 to 777.29 lakh hectares in 2020-21 to ensure an enabling environment for food availability and accessibility.** The food processing sector, which is highly impacted by the buoyancy of the rural economy has seen its GVA increase from ₹1.30 lakh Crore in 2013-14 to ₹1.92 lakh Crore in 2022-23. These factors enabled greater income in the hands of the farmers, higher per capita income, and facilitated ease of work.

### **Qualitative Restructuring in Rural Lives of Women**

In homes in villages with electricity, qualitative enhancements in lifestyles for rural women were underway. The lack of reliable energy negatively impacted the entire family, especially women, who manage household energy needs. A study in 1996 found that women spend about 40 minutes per day collecting fuel and almost one-hour fetching water. They used to spend almost three hours cooking and close to six hours on other housework. Women's long, unrecognized labor in

unhealthy tasks often goes unnoticed. The use of biomass fuels and traditional stoves is tied to their low social status and limited access to paid work, leaving little time for education or personal growth.

Chores are not restricted to daylight. **There is a better balance of time for leisure and education, especially in colder regions for women.** This allows for time for paid work or leisure. Poor lighting from kerosene lamps no longer hinders reading and other activities.

### **Access To Educational & Leisure Pursuits**

Electrification played a key role in supporting women's education as their reading time increased. They accessed radio and television for updates, news and entertainment. Women in electrified homes are generally better able to balance paid work, household chores, and leisure than those in homes without electricity.

**Better leisure times allowed for more community events which enabled** better awareness of government schemes and wider access to correct information. This enhanced the penetration of the welfare schemes in rural areas. Saturation of the programs was made easier as people got more connected to the government officials disseminating information on the schemes. Walk-ins in the support centers rose.

### **Tilt In Favour of Regularity In Income Flow**

Household electrification leads to an increase in regular wage work adding additional days from the average that prevailed in 1999. This increase mostly came from a reduction in casual wage work. This trend aligned with the idea that electricity enables men to shift leisure from daylight to nighttime, resulting in a more consistent labor supply. Rural spending has risen by almost 40% over the last decade with significant changes in the consumption baskets. The per capita National Value Added (NVA) for rural and urban areas was Rs. 40,925 and Rs.98,435 respectively in the year 2011-12. All India annual per capita Net National Income (NNI) for **2014-15 and 2022-23 at current prices are**



**Rs. 86,647 and Rs. 1,72,000 respectively illustrating achievement in this regard.**

### **Impact On Health Facilities In Communities**

Along with reliable electricity access, the Modi government launched the Pradhan Mantri Ujjwala Yojana in 2016 to subsidize LPG for cleaner cooking in low-income households.

Commensurate to these measures, improvements in health facilities and cleaner air, due to reduced use of polluting fuels for cooking, lighting, and heating, have led to better health outcomes. Increased access to television enhanced health knowledge, while refrigeration has improved nutrition through better food storage.

Before 2012, 1.3 million annual deaths were common point from stroke, heart attack, diabetes, and lung cancer have been linked to indoor air pollution from biomass and dung fuels, which disproportionately affect women and children. Black carbon from these fuels has a warming potential 460-1,500 times greater than CO<sub>2</sub>, significantly contributing to climate change. **For women and children, as per WHO, it's equivalent to the damages of smoking 400 cigarettes per hour. They have been freed of this drudgery and improved** their health conditions.

Pre-2014, unreliable energy supply in hospitals was a severe problem. Electricity outages are used to damage medical and diagnostic devices. The diesel generator, which emitted harmful gases and smoke near newborns, did more harm than keep them the same. The commitment to universal access backed by last-mile coverage has improved things for the better. Diesel generators are now gone. Staff no longer need flashlights during blackouts thanks to the new rooftop solar panels. Now, the hospitals have installed rooftop solar panels, ensuring **reliable electricity for lighting, patient and staff comfort, and safe refrigeration of vaccines and medicines.**

## **Educational Opportunities For Children & Changing Mindset & Accountability -Absenteeism Among Teachers and Staff**

Children under six at anganwadis struggle to focus in dark, hot rooms, leading to high dropout rates. Conventional power is impractical in these areas due to challenging terrain, so solar electrification was chosen as a sustainable solution.

Since installing solar panels, attendance has increased, and children now benefit from ICT technologies. Electricity also enhanced staff retention and teacher training. The impact extends beyond education and nutrition, offering environmental benefits and cost savings.

It was found in recent years, that electrification across Indian schools, which was far behind household access to electricity has been on the rise.

<b>Recorded in UDISE+, total schools in the country have electricity during the year 2019-20 to 2021-22 are as under:</b>			
<b>Year</b>	<b>2019-20</b>	<b>2020-21</b>	<b>2021-22</b>
<b>Total Schools with Electricity</b>	1208636	1266435	1289245
<b>Total number of schools</b>	1507708	1509136	1489115
<b>Percentage</b>	80.16	83.92	86.58

## **Highest-Ever Railway Line Electrification Facilitated Green Connect Nationwide**

The Centre invested in a future-ready infrastructure in terms of railway electrification. Nearly 6,565 RKM got electrified in 2022-23 up from 610 RKM in 2013-14. This benefitted the rural economy. It has sustained the segment's growth momentum and connected the remotest location and backward areas.

## The Power Supply Position in India During 2009-10 to 2023-24

	Energy				Peak			
Year	Requirement	Availability	Surplus+/-	Deficit	Peak Demand	Peak Met	Surplus(+)/	Deficit(-)
	(MU)	(MU)	(MU)	(%)	(MW)	(MW)	(MW)	(%)
2009-10	8,30,594	7,46,644	-83,950	-10.1	1,19,166	1,04,009	-15,157	-12.7
2010-11	8,61,591	7,88,355	-73,236	-8.5	1,22,287	1,10,256	-12,031	-9.8
2011-12	9,37,199	8,57,886	-79,313	-8.5	1,30,006	1,16,191	-13,815	-10.6
2012-13	9,95,557	9,08,652	-86,905	-8.7	1,35,453	1,23,294	-12,159	-9
2013-14	10,02,257	9,59,829	-42,428	-4.2	1,35,918	1,29,815	-6,103	-4.5
2014-15	10,68,923	10,30,785	-38,138	-3.6	1,48,166	1,41,160	-7,006	-4.7
2015-16	11,14,408	10,90,850	-23,558	-2.1	1,53,366	1,48,463	-4,903	-3.2
2016-17	11,42,929	11,35,334	-7,595	-0.7	1,59,542	1,56,934	-2,608	-1.6
2017-18	12,13,326	12,04,697	-8,629	-0.7	1,64,066	1,60,752	-3,314	-2
2018-19	12,74,595	12,67,526	-7,070	-0.6	1,77,022	1,75,528	-1,494	-0.8
2019-20	12,91,010	12,84,444	-6,566	-0.5	1,83,804	1,82,533	-1,271	-0.7
2020-21	12,75,534	12,70,663	-4,871	-0.4	1,90,198	1,89,395	-802	-0.4
2021-22	13,79,812	13,74,024	-5,787	-0.4	2,03,014	2,00,539	-2,475	-1.2
2022-23	15,11,847	15,04,264	-7,583	-0.5	2,15,888	2,07,231	-8,657	-4
2023-24	2,66,951	2,66,360	-591	-0.2	2,21,370	2,21,347	-23	-0.01

Upto May 2023 (Provisional), Source: CEA

## Entrepreneurship In Rural Areas/ Clean Tech Start-Ups & Slowdown in Migration Due to Better Employment

7,000 agri startups have been registered in DPIIT, providing innovative solutions in these sectors. In 2014-15, only 50 such startups existed in the country. The ease of business and brimming potential in the agricultural sector with a rising consumer base have spurred this change. These startups are revolutionizing agriculture with innovative and affordable solutions. These ventures are bridging gaps between farmers, input dealers, wholesalers, retailers, and consumers, ensuring strong marketing connections, lucrative unseen employment avenues, and timely delivery of quality produce.

## Conclusion

It was noticed early on by PM Modi, that prior government machinery was not acting with the required speed and urgency to fulfill the welfare demands of the nation. Piecemeal solutions were inflicting a high cost on the exchequer with significant laggards in development targets. Since electricity access is heavily tied to local development, especially education and healthcare, it had to be ensured that physical progress and financial spending indicators are balanced well. Since this vision and political will were missing, the Modi-led government preferred to work with integrative policies and practices. It stands out with unprecedented results. In his first term, the ambitious mission to electrify 18,000 villages still in darkness despite 70 years of independence was launched and achieved.

Similarly, **the Saubhaya scheme received world recognition for the scale of access it reached.**

*IEA's India Energy Outlook 2021 mentions that "India has made great progress on electricity access in recent years through the Saubhagya Scheme, and government data indicate that more than 99% of households were connected to electricity in 2019.*

In his third term, he committed to slashing electricity bills to zero by ensuring every household draws renewable power from rooftop solar panels. So India from a nation of power deficiency has risen to a stature of power sufficiency.

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