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INDIA'S POWER SECTOR REFORMS AND STATE RESPONSES : UJALA'S CONTRIBUTION TO CLIMATE CHANGE MITIGATION AND ENERGY EFFICIENCY IN INDIA

SHASHI KANT PANDEY[1], VIKAS TIWARI[2]

[1]Professor, Department of Political Science,BBAU, Lucknow, U.P. INDIA
[2]Research Scholar, Department of Political Science, BBAU, Lucknow, U.P. INDIA

ABSTRACT

"This study investigates the transformative impact of the Unnat Jyoti by Affordable LEDs for All (UJALA) program on India's power sector reforms. Over the past 8 years, UJALA has distributed a staggering 368 million affordable LED bulbs, showcasing India's commitment to sustainable development. Furthermore, UJALA emerges as a successful model of state-led initiatives within India's power sector reforms, showcasing the efficacy of collaborative efforts. As the nation continues to navigate the complexities of climate change and energy demands, the UJALA program stands as a beacon of innovation, emphasising the critical role of comprehensive initiatives in fostering a greener, more resilient, and economically vibrant future for India. Focusing on climate change and energy efficiency, this paper highlights UJALA's multifaceted contributions. The program not only signifies a monumental stride in climate change mitigation but also plays a pivotal role in fostering energy efficiency in India. Examining the nexus between UJALA, state response, and power sector reforms, this study provides crucial insights into India's holistic approach towards addressing climate challenges and enhancing energy efficiency."

KEYWORDS: *UJALA program, Power sector reforms, State Responses, LED bulbs, Climate change, Energy efficiency.*

INTRODUCTION

India's Unnat Jyoti by Affordable LEDs for All, known in short as UJALA, is a program aiming to provide LED bulbs to households on a large scale. It is world's largest program of its kind, as it operates without relying on subsidies, according to the International Energy Agency's report in 2017. Inaugurated in 2015, its objective was to substitute the yearly purchase of nearly 758 million traditional light bulbs in 2012 with eco-friendly LED bulbs (EESL, 2015).The initiative was estimated to yield annual savings of around 50 terawatt hours (TWh) in electricity usage, resulting in a decrease of roughly 19 gigawatts (GW) in power generation capacity (ibid).Before the UJALA program was implemented, various evaluations showed that lighting accounted for 18% to 27% of India's total residential electricity consumption (PEG 2016).Prior to UJALA, India had implemented various small-scale utility programs to promote Compact Fluorescent Lamps (CFLs), primarily by reducing their price compared to incandescent bulbs (PEG, 2014). One such national-level program, Bachat Lamp Yojana (BLY), was initiated in 2009 to replace 400 million incandescent bulbs. However, BLY encountered setbacks, including the decline in carbon prices under the Clean Development Mechanism (CDM) of the Kyoto Protocol, which funded the price difference of CFLs. Subsequently, the Energy Efficiency Services Ltd. (EESL), a public sector company, developed and implemented UJALA by leveraging the architecture and best practices of BLY while avoiding reliance on the volatile international carbon market. Consequently, Ujala aimed to alleviate the strain on distribution transformers and mitigate power cuts caused by transformer overloading. Studies have demonstrated a positive correlation between increased power supply reliability and improved welfare (Rao, 2013). Therefore, a systematic study of UJALA's accomplishments is necessary .

RESEARCH METHODOLOGY

In this study, a descriptive research methodology was employed to evaluate the impact of the Ujala on climate change, energy efficiency, and manufacturing. Secondary data was gathered from diverse sources, including previous studies, Ministry of Power and EESL reports, government estimates, state government documents, and data from the National Ujala Dashboard. To comprehend the impact of the UJALA initiative, three key inquiries guided our investigation. Firstly, we assessed the program's processes in achieving India's climate goals and their influence on climate change. Secondly, we examined the program's impact on India's energy-efficient lighting market. Lastly, we investigated how the program

1: Corresponding Author

influenced the Indian LED manufacturing industry. This research methodology aimed to provide a comprehensive overview of the program's implications, offering valuable insights for policymakers, researchers, and stakeholders invested in India's sustainable development and energy landscape.

THEORETICAL FRAMEWORK

While electricity does not fall under the traditional meanings of the term 'the public goods or social goods,' we recognise public ownership of the electricity sector as a common feature in the electricity sector worldwide. The emergence of public ownership in the power sector has been influenced by various factors. The distinctive attributes of the power sector have prompted public involvement due to the undesirability of private sector monopolistic control over electricity. In India, the commencement of power sector reforms can be traced back to 1991 (Rao, 2002). Studies on the early phases of reform suggest that the restructuring period did not achieve social goals (Sharma et al., 2005). Reforms cannot rectify technical inefficiencies or overcome financial constraints encountered by utility companies. Nevertheless, recent research shows a more positive outlook. They offer proof of enhancements in operational management as well as the well-being and performance of employees (Kundu& Mishra, 2012). Despite being in the initial phases, the careful and partial execution of reform measures has yielded positive results regarding quality, reliability, and financial sustainability (Taneja et al., 2010). A recent investigation thoroughly reviews the literature on power sector reforms in the Indian context (Mukherjee et al., 2017).

A QUICK OVERVIEW OF REFORMS IN INDIA'S POWER SECTOR

The power sector in India has been facing challenges due to increasing power shortages and the financial struggles of State Electricity Boards (SEBs). These boards were meant to enhance power generation capacity and encourage private sector participation for additional resources, but their restructuring has been difficult. Reforms in the power sector began in the 1970s with the establishment of organisations like NTPC, NHPC, and CEA. The construction of the power grid in 1992 was another significant step. The Electricity Regulatory Commission Act of 1998 led to the creation of CERC and SERCs at the state level. The Electricity Act of 2003 replaced previous legislation and aimed to foster competition by separating generation, transmission, distribution, and supply functions. It also introduced open access to transmission and distribution infrastructure, allowing power generators and consumers to negotiate agreements and use shared access systems. However, the division of SEBs into separate entities has been limited, and expected benefits have not been realised.

Table 1. India's Power Sector Reforms

Year	Key Developments
1948	Electricity Supply Act, 1948: Created state-level vertically integrated utilities responsible for power generation, transmission, and distribution, and for setting tariffs.[19]
1991	1948 Act amended to allow private companies to set up their power generation plants.
1996-98	Some states (Odisha, Haryana) started restructuring their state electricity boards. Restructuring included segregating generation, transmission, and distribution segments, and allowing private participation in the distribution segments.
1998	Established Regulatory Commissions at both the central and state levels through the Electricity Regulatory Commission Act, 1998. These Commissions regulate inter-state and intra-state matters in generation, transmission, and distribution of power.
2003	Electricity Act, 2003: Gave more powers to the Regulatory Commissions; provided for unbundling of the state owned electricity boards and multiple discoms in an area; allowed open access; provided for elimination of cross-subsidies in the sector. The 1948 Act, and 1998 Acts were repealed.
2014	Electricity (Amendment) Bill, 2014 to segregate retail supply from distribution, and bring in multiple supply licensees.
2015-17	As of March 2015, the state discoms had accumulated losses of approximately Rs 3.8 lakh crore and outstanding debt of approximately Rs 4.3 lakh crore. The Ujwal Discom Assurance Yojana (UDAY) was introduced to allow states to help the discoms by taking over their debt.
2017- Now	India declared as a power surplus country. All villages have been electrified. New household electrification scheme, Saubhagya, launched. Draft amendments to the 2003 Act propose to segregate the network and supply business, and introduce a system of direct benefit transfers with regard to subsidies. Coal linkages are being allocated through auction (SHAKTI).

Source: PRS India (URL: https://prsindia.org/policy/analytical-reports/overview-power-sector)

A QUICK OVERVIEWOF REFORMS IN POWER SECTOR IN UTTAR PRADESH

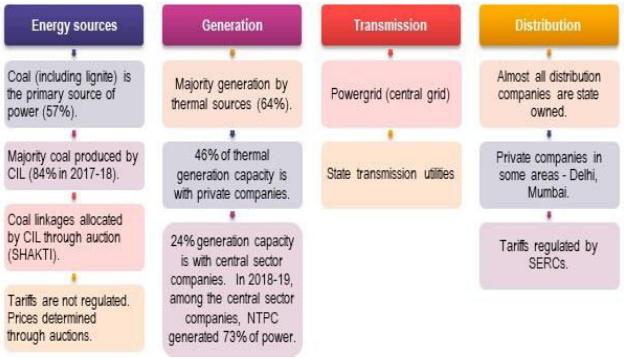
Uttar Pradesh grapples with frequent electricity crises, primarily stemming from an imbalance between demand and supply. The state consistently faces a shortage ranging from 10% to 15%, escalating to a staggering 43% during peak periods, resulting in power cuts, low voltage, and disruptions in industrial investment. The financial strain on the Uttar Pradesh Power Corporation Limited (UPPCL) is exacerbated by the government's purchase of electricity at elevated rates. Initiating power sector restructuring in 1999, Uttar Pradesh divided and privatised the sector, establishing entities like UPPCL, UPRVUNL, and UPJVNL for transmission, thermal power

generation, and hydroelectric power generation, respectively. Further restructuring led to the creation of DVVNL, MVVNL, PVVNL, PUVVNL, KESCO, LESA, and UPPTCL. Despite efforts to bolster power infrastructure and establish new plants under UPRVUNL, challenges persist in meeting demand and improving UPPCL's financial condition.While the state invested in solar projects like the Rewa Solar Park and enhanced transmission and distribution infrastructure, hurdles remain, including high losses and billing inefficiencies. The government is implementing reforms to combat power theft, enhance metering accuracy, and promote energy efficiency. Continuous efforts are imperative to ensure a reliable, affordable electricity supply, emphasising improvements in generation, transmission, distribution, governance, and overall reforms in Uttar Pradesh's power sector (UPPCL, 2023).

UJALA AS A STATE RESPONSE

In the Indian power sector context, "state response" encompasses governmental initiatives, including policy formulation, legislative reforms, regulatory oversight, market reorganisation, promotion of renewable energy, infrastructure development, rural electrification, consumer protection, and capacity building. These actions are pivotal for effective governance and the sustainability of the power sector.

Table 2: Various stakeholders in Indian Power Sector



Source: PRS India (URL: https://prsindia.org/policy/analytical-reports/overview-power-sector)

Electricity, governed by entry 38 of the Concurrent List in the Seventh Schedule of the Indian Constitution, demands legislative action from both the Union and State Governments (MoP, 2018). This legislative intricacy positions the state as a crucial proponent of power sector reforms in India, exemplified by the success of UJALA. Although Ujala is primarily a central government initiative, providing overarching guidance, financial aid, and a policy framework (PIB, 2022), state governments are pivotal as implementing agencies. Their responsibilities encompass on-the-ground tasks such as LED bulb procurement, distribution network coordination, awareness campaigns, and progress monitoring.This cooperative federalism model fosters collaboration between central and state entities, allowing for resource pooling and leveraging strengths to effectively promote energy efficiency. Through this synergy, the UJALA program strives to maximise its impact nationwide, underscoring the vital role of cooperative federalism in India's quest for sustainable power sector reforms. UJALA stands as a paradigm, illustrating how cooperative federalism can drive shared objectives, promote sustainability, and amplify the positive influence of programs on a national scale. This cooperative approach sets a precedent for future power sector initiatives, highlighting the integral role of collaborative efforts in instigating meaningful and widespread change.

A COMPARATIVE DISCUSSION ON UJALA PROGRAM

The UJALA initiative in India was created and put into action by Energy Efficiency Services Ltd. (EESL), a government-owned enterprise founded in 2009 under the Central Ministry of Power. The objective of EESL is to support the central and state governments in executing energy efficiency and conservation initiatives in collaboration with the Bureau of Energy Efficiency (BEE), the governing body responsible for establishing energy efficiency policies and regulations in India. Prior to UJALA, India had implemented various small-scale utility programs to promote Compact Fluorescent Lamps (CFLs), primarily by reducing their price compared to incandescent bulbs (PEG, 2014). One such national-level program, Bachat Lamp Yojana (BLY), was initiated in 2009 to replace 400 million incandescent bulbs. However, BLY encountered setbacks, including the decline in carbon prices under the Clean Development Mechanism (CDM) of the Kyoto Protocol, which funded the price difference of CFLs. Subsequently, EESL developed and implemented UJALA by leveraging the architecture and best practices of BLY while avoiding reliance on the volatile international carbon market. UJALA serves as an extensive procurement program by EESL that strives to lower the cost of LED bulbs without relying on direct subsidies. Its objective is to bring about a transformation in India's lighting market. The program was launched nationally in 2015 by the Prime Minister Narendra Modi following a series of pilots at the utility level.

According to National Ujala Dashboard till November 2023, UJALA has sold around 36.86 crore (368 million) LED bulbs throughout India. As a result of this initiative, it is estimated that there has been an annual energy savings of 47.88 billion kilowatt-hours (EESL, 2023). Additionally, the company has also distributed nearly 7.2 million LED bulbs and 2.3

million fans with energy-efficient features as part of the program since its launch in 2015 (ANI, 2023). The program has also achieved a reduction of about 9,586 MW in peak load (National UJALA Dashboard, 2023), representing 2% of India's total installed capacity. Additionally, Ujala has been able to reduce approximately 39 million tonnes of CO2 emissions, helping India in achieving it's climate goals (EESL, 2023). Furthermore, it contributed to an approximate yearly monetary saving amounting to INR 19,333 crore in relation to consumers' electricity expenses (Economic Times, 2023).LED bulbs cost distribution via UJALA has decreased to one-fifth of its initial magnitude, from approximately ₹310 in 2014 to ₹75 per bulb in 2023 (ANI, 2023). Moreover, there has been a remarkable surge in LED lighting production within India, with the output reaching 80 times from the 2014 level (ELCOMA, 2017). Capitalising on its achievements, EESL (Energy Efficiency Services Limited) has extended the program's framework to encompassceiling fans, air conditioners, agricultural water pumps, and other devices, both at home and abroad. The LED bulbs' technical specifications were developed following the guidelines established by the Bureau of Indian Standards (BIS). Furthermore, these specifications were consistently upgraded with each bidding round to keep pace with market and technological advancements (EESL, 2016). Local vendors were engaged to handle marketing and sales operations (EESL, 2015). To broaden the distribution network, EESL has extended the availability of LED bulbs to select states by making them accessible at post offices and petrol pumps. The company also introduced mobile vans that travel from village to village, offering LED bulbs at further discounted prices.

UJALA'S CONTRIBUTION TO CLIMATE CHANGE MITIGATION IN INDIA

In a world where industrialisation is advancing at a rapid pace, climate change is no longer a distant concern but rather the most critical environmental challenge that demands immediate action. India, home to a population of 1.4 billion individuals, stands in 2023 as the world's most populous nation and ranks third among countries with the highest carbon emissions, trailing only behind the United States and China. With the increasing prominence of environmental concerns worldwide, New Delhi has made climate change a central focus of its development agenda. In order to diminish its impact on the climate, India has been transitioning towards low-emission energy sources and implementing policy frameworks to facilitate and execute its shift to a low-carbon economy. During COP 27, India's official declaration emphasised its intention to pursue a long-term growth strategy focused on low emissions, employing pathways that facilitate a transition towards a low-carbon economy in key sectors of its economy. In previous engagements such as COP26, Hon'ble Prime Minister Narendra Modi committed to attaining net-zero emissions by the year 2070, while in the G20 summit in Bali in 2022, he committed to generating 50% of India's electricity from renewable energy sources by 2030. Additionally, India updated its Nationally Determined Contribution (NDC) by vowing toutilise at least half of its installed power capacity from non-fossil fuel energy resources and targeting a 45% reduction in emissions intensity from the 2005 levels (Rishika Singh, 2023).

To achieve these ambitious climate targets and fulfill country's climate actions under the Paris Agreement through India's Nationally Determined Contributions; not only India needs new carbon-neutral technologies, such as renewable energy technologies and technology innovation, adoption, and deployment to diversify its energy basket but it also needs to increase energy efficiency, increase reduction in carbon emissions, to enhance the share of non-fossil fuel-based power generation, and create a sustainable low-carbon economy. The energy savings achieved through the UJALA have significant environmental implications. LED bulbs consume less electricity, which means a reduced reliance on fossil fuel-based power generation. This leads to a decrease in greenhouse gas emissions, such as carbon dioxide, contributing to the mitigation of climate change and environmental sustainability. It also supports SDG 13 (Climate Action) by reducing carbon emissions and mitigating the environmental impact of energy consumption.

Renowned as the world's most extensive program for distributing LED bulbs, this initiative has effectively promoted energy efficiency and aimed to foster an environmentally friendly and cleaner ecosystem. It has successfully aligned with the vision of creating aa cleaner and greener future. According to projections, the scheme has led to a substantial annual electricity saving of 48.3 billion kilowatt-hours, aligning with the principles outlined in the LiFE (Lifestyle For Environment) concept advocated by the Indian delegation during COP27. This initiative has resulted in an estimated reduction of3.9 million metric tonnes in CO2 emissions annually, which is equivalent to removing approximately 4.7 million cars from the roads each year (ANI, 2023). UJALA plays a crucial role In India's climate change mitigation efforts. By promoting energy efficiency and reducing carbon emissions, the program contributes to the overall goal of limiting global temperature rise. The program's influence in curbing energy demand and carbon intensity contributes to mitigating the negative consequences of climate change, including extreme weather events, rising sea levels, and the loss of biodiversity. UJALA supports India's Nationally Determined Contributions, which outline the country's climate

actions under the Paris Agreement. The program's focus on energy efficiency and the resultant reduction in carbon emissions align with India's commitment to enhance the share of non-fossil fuel-based power generation, increase energy efficiency, and create a sustainable low-carbon economy. By promoting the use of LED bulbs, the program has educated people about the environmental benefits of energy-efficient lighting. This increased awareness has translated into a shift in consumer behavior, with more individuals embracing energy-efficient technologies and making conscious choices to reduce their carbon footprint. The UJALA program contributes to SDG 7 (Affordable and Clean Energy) by promoting energy efficiency and access to sustainable lighting solutions. It also supports SDG 13 (Climate Action) by reducing carbon emissions and contributing to the global efforts to combat climate change. A World Bank energy economist has hailed India as a leading example in clean energy endeavors (MyGov, 2017). Recognising the urgency of climate action, the Government is embracing LED lighting and renewable energy sources. However, the public also bears a substantial responsibility to comprehend the significance of energy efficiency, demonstrate sensitivity toward environmental concerns, and actively participate in this transformative process.

UJALA'S CONTRIBUTION TO ENERGY EFFICIENCY

Due to growing energy needs, energy shortages, and rising energy costs, the Government of India has emphasised enhancements in energy efficiency within the industrial sector since the 1980s.Energy Conservation Act of 2001 was enacted to promote efficient energy use, conservation, and capacity building through the BEE (Bureau of Energy Efficiency).To foster energy efficiency, the BEE was formed within the Ministry of Power in 2002, as per the directives of the Energy Conservation Act of 2001. The Perform, Achieve, and Trade (PAT) Scheme sets benchmarks for decreasing energy consumption in designated energy-intensive industrial establishments. The ECBC (Energy Conservation Building Code), implemented in May 2007, stipulates energy efficiency standards for commercial buildings in several states. According to a study, it is projected that by 2030, there will be a reduction of 131 million tonnes of CO2 emissions, equivalent to 10% of emissions from commercial buildings (Parikh et al., 2014). By 2030,it has the capacity to lower energy consumption by 13-40%. It encourages consumers to choose more energy-efficient appliances.

LEDs offer not only improved lighting levels but also lead to energy and cost savings that range from 50% to 88%. A 7W LED bulb offers equivalent or better brightness than a 60W incandescent lamp (MyGov, 2017). As of early June 2023, the UJALA program has distributed a staggering 368 million LED bulbs, resulting in an 85% cost reduction. According to National Ujala Dashboard, the UJALA program has conserved 47,880 million units of electricity yearly within a span of eight years. It all began in 2015 with a symbolic gesture at the Prime Minister's Office, where a single incandescent light bulb was replaced with an LED bulb. Prime Minister Narendra Modi designated the LED bulb as the "Prakash Path," symbolising the "path to light," and established a goal by substituting 770 million incandescent lamps with LED lamps by 2019 (EESL, 2023). This initiative has played a crucial role in driving the adoption of energy-efficient lighting throughout India (MyGov, 2017). UJALA has emerged as a key success of the Government in promoting and implementing energy efficiency. India's lighting revolution has not only brought a substantial transformation within the country but has also presented a model of energy transformation that other nations can embrace to support their sustainable development objectives. In fact, EESL is already replicating the UJALA program in the United Kingdom and Malaysia. The adoption of this model by these two countries marks another achievement in advancing the concept of energy efficiency, which aims to conserve resources and safeguard the environment.

CONCLUSION

The UJALA program has emerged as a significant driver in addressing climate change through its promotion of energy-efficient practices. The initiative has not only contributed to a substantial reduction in carbon emissions but has also played a pivotal role in enhancing energy efficiency. The success of the UJALA has showcased the feasibility of executing and replicating such initiatives for various appliances and equipment. This has been demonstrated by the successful execution of comparable initiatives for street lighting and water pumps. The concrete advantages of UJALA have fostered the spirit of "competitive federalism" among Indian state governments to create tailored energy efficiency programs and autonomously implement them by adopting scalable models introduced by EESL. In March 2021, following the success of Ujala, the Indian government has unveiled an ambitious initiative "Gram Ujala" to provide the most affordable LED bulbs in rural regions at a nominal cost of ₹10 (Mint, 2021). This initiative not only reinforces the country's climate change strategy but also leads tothe "Aatmanirbhar Bharat"(self-sufficient India) vision of the government. On the International level, UJALA has been replicated in some other countries such as UK (Business Standard, 2017) and Malaysia (PIB, 2017). The initiative has attracted attention from renowned business schools in India and is now featured as a case study on leadership conducted at the Indian Institute of Management (IIM), Ahmedabad. Also, there are ongoing discussions about

the possibility of incorporating it into the curriculum of Harvard Business School. (PIB, 2022). Overall, UJALA stands as a shining example of how proactive government initiatives, combined with industry collaboration and consumer awareness, can lead to significant advancements in energy efficiency, cost savings, growth of manufacturing industry and environmental sustainability.

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