Abstract—The Indian power sector value chain can be broadly segmented into the generation, transmission, and distribution sectors. The availability of electricity is very much important in attracting investment as well as economic growth. Hence if a state has made significant improvement in the reducing power deficit then that state must have shown better economic growth. Madhya Pradesh is also among the fastest-growing states in the country. Economic growth is a result of many factors, and the availability of electricity is one of them. In this survey paper, we are focusing on the reforms of the power sector for MPSEB (Madhya Pradesh state electricity board). This paper gives a brief review of the Indian power sector, Madhya Pradesh state electricity board, need of power sector reforms, infrastructure, and also discussed the recent REWA solar plant project of Madhya Pradesh which enhances the MP POWER SECTOR.

Keywords—MPSEB, Power sector reform, REWA solar plant, Indian Power sector, Electricity.

I. INTRODUCTION

To socio-economic development, electricity is a line. Efficient electricity supplies do not only indirectly contribute to economic wellbeing through economic development but are also essential to fundamental human requirements for education and health, electricity access has a direct bearing on living standards & improving poverty While Indian power sector (PS) experienced significant development in post-independence era, sector in last few decades has suffered from serious functional issues. Every year power sector accounts for considerable expenditure (about 13% to 18%) [1], but the majority of State Electricity Boards (SEBs) in India, which operate under resource crunch & have suffered massive commercial loss, have been working. Therefore, both in quality terms & quantity, electricity services offered to customers by these SEB are ‘bad.’ Over the years, India’s electricity supply deficit has steadily increased and the majority of Indian countries face serious power shortages. Through 1990/91 the power deficit rose to 11.5% and the peak deficit to 18% [2]. Annual trade losses have also seen a spiraling pattern from more than Rs 15,000 million in 1985 to more than Rs 40,000 million in 1991[3]. The difference among average supply cost as well as the average rate went up by 25 paise/kWh in 1985-

1986 to 110 countries/kWh from 2002 to 2003, causing huge losses for SEBs. In India, electricity consumption enhanced by 178 kWh in 1985-86 to 338 kWh in 1996-1997 [4] as well as to 592 kWh in 2003-04 [5], is less than one twenty-fourth of that prevalent in the United States and less than half of that prevailing in China [6].

Additional capacity was completely inadequate to satisfy growing demand, as well as to ensure electricity & peak power deficits became the order of the day. The sector continued to decline its financial and operational efficiency, with commercial losses in 2001 to 2002 to over Rs. 292,520 million [7] losses of T&D of up to 33.98% & energy and peak shortages of 7.1% & 11.8%. The main reasons for this loss were identified with unpaid tariffs and poor techno-commercial management [8]. The functional inefficiency of govt. SEB’s assets, incapability of utilities to mobilize ample capacity expansion, upgrading resources and so on, for all aspects of electricity generation & usage (along with metering, tariff setting, revenue collection, and billing), utilities inability to mobilize sufficient resources to capability expansion & modernization; have been referred to as main purposes to crisis [9].

Electric power is recognized and given the highest priority as the main input to the economic growth of the country. Since its independence, the overall installed capacity of power utilities has enlarged, however demand-supply gap continues to rise each year. SEBs & central agencies like National Thermal Power Corporation (NTPC), National Hydro Power Corporation (NHPC), are regulators responsible for production, transmission & distribution of electrical power. In the 90s, the government resolved to open the electricity sector to private sector investment by beginning the procedure of reforming PS in response to the growing demand gap as well as poor financial positions of SEBs. Most countries have now started reforming the power sector and move through the various phases of reforms. Yet sadly, changes that began so vigorously & enthusiastically didn’t meet their fate so far. The development of the Indian electricity sector, SEBs & central utilities emerging under various electricity Acts.[11]

II. HISTORY OF INDIAN POWER SECTOR

Since independence, PS in India has made important progress. The country had an installed power of 1362 MW in 1947 when India became independent. Major sources of electricity generation were hydropower and coal-based thermal power. Electrical power generation and distribution were largely performed by private utilities. Calcutta Electric is unique among them and still exists. Power had been accessible only in some urban centers; rural areas as well with no electricity. After 1947, the state and central government agencies were responsible in every way for new energy generation, transmission & distribution in urban & rural centers, which did not serve private utilities. In all countries, SEBs were created. At the end of the ’60s, nuclear power is evolving at a slower rate. The idea of regional operating power systems crossing states ‘political boundaries was implemented at the beginning of the 1960s.

A. Structural Development of the Power Sector

The 1948 Electricity Act provides a detailed institutional framework and funding criteria for the production of the domestic electricity industry. Act envisaged establishment in their respective States of SEBs for planning & implementation of electricity development plans. Act too given for the establishment of central generation companies to establish & operate central
sector generation facilities. Central Electricity Authority comprised under Act is liable to power development at the state level [12].

B. Overview of the Power Sector In India

PSs strongly linked to private investment opportunities in growing economies in general & India, in particular. The output of pre-reforming PSs was in very bad condition as energy was reduced & demand shortening increased. The reforms in the 1990s were implemented in order to revitalize the industry with the decline of the Indian power sector. The main issue with the changes was the implementation question, namely that the policy was not enforced the way it was intended when it was implemented [1].

<table>
<thead>
<tr>
<th>Sector</th>
<th>MW</th>
<th>Relative Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Sector</td>
<td>86596.63</td>
<td>24.20</td>
</tr>
<tr>
<td>State Sector</td>
<td>105076.86</td>
<td>29.36</td>
</tr>
<tr>
<td>Private Sector</td>
<td>166201.99</td>
<td>46.44</td>
</tr>
<tr>
<td>Total</td>
<td>357875.48</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Total Installed Generating Capacity in the Country

III. THE NEED OF REFORMS

Electricity is a very essential part of increasing economic growth in a country such as India, just like any other infrastructure. The need for reform was urgent because of the performance of PS deteriorating day after day. India consumed far less electricity per capita than other countries such as the United States. Specifically, in the "Transmission and Distribution System," peak demand shortages were strong, in line with operational inefficiencies. Initial measures after Independence included the "Indian Electricity Supply Act, 1948," which encouraged a state-owned electricity-sector system through the establishment of "SEBs." Although the situation improved, issues such as enormous energy shortages, PLF (low plant load factor) & a poor financial state were encountered [13]. Fig. 3 explains India’s PS structure in advance of reforms. "SEBs, central Public Sector Undertakings (CPSUs)," among others, were main generators of electricity including private licensed companies [14].

A. A scenario of Indian Power Sector Reforms

There have been many changes in PS, which started in 1990 when it became clear that previous measures have not been successful. Major reforms have been made, but there have been no significant results. In order to encourage greater investment in electricity generation, the "Indian Electricity Act 1910" reforms were amended. The creation of a regulatory framework was another important decision to enhance the financial status of "SEBs." "Power Trading Corporation (PTC)" was established in 1995, serving as a negotiator between buyers & sellers (SEBs & megaproject managers). "SERCs (State Electricity Regulatory Commissions)" has been set up in around 22 Indian states & "CERC" has been established, the main function of which is to control all kinds of power-generating companies’ tariffs. For a well-developed power sector, a competitive arena and a sense of transparency are required. APDRP (Accelerated Power Development and Reform Program) developed by the Union government in 2001 has dealt with distributive efficiencies" [15].

IV. Power Infrastructure of Madhya Pradesh

In the country's central part, Madhya Pradesh (MP) holds an important place on a number of criteria, including spatial, population, economic & political, in India's sub-national political economy. It remained India's greatest state by size between 2 state reorganizations in 1956 & 2000. At present, it is 2nd largest state with 9% of national geographical area and has a population of 6% (fifth according to population). The state is agrarian, with 72 percent of the population living in rural areas & mainly reliant for livelihood on agriculture (Census, 2011). MP was long regarded as a symbol of uneven economic & societal development (Shah, 2005). In the past, it has been at the lower part of the regional difference in the country & is part of recognized BIMARU states1. Although acceleration of economy in 1990, growth rate of 2 mp could not attract much foreign investment, & household investment, more complex, during the 1990s, after a slower than average growth in the 1980s (Ahluwalia, 2002) [16].

Figure 1: central power generating stations

MP is one of the biggest countries in India. Currently, MP's power generating company has an output of 3724.7 MW, including 2807.50 MW of thermal and 917.20 MW of hydropower. The company also has a capacity in the Narmada Valley project to generate electricity for 2372 MW and is active in building central power plants. It represents over 96 lakhs, including 13.97 lakh customers in agriculture.

PS is a crucial component of infrastructure for the development of an economy. Reliable availability, high quality as well as reasonable power is essential if agriculture, industry & economic development of a country, in general, are to grow quickly. The state-owned company has developed new power projects with a view to bridging demand-supply gaps & catering for potential load growth. Prominent along with them are 2×600 MW SSTPP (Shree Singaji Thermal Power Station) & 2×250 MW STPS (Satpura Thermal Power Station) [17].

Figure 2: Power Infrastructure of Madhya Pradesh
V. REFORMS IN POWER SECTOR

Distribution is the main link in the whole value chain of PS. It is a cash register for the entire field, only interface among utilities & customers. Power is a contemporary subject under the Indian constitution, & it is the responsibility of states to distribute & supply power to urban & rural consumers [18].

Improvement schemes and power sector changes are as follows:

A. R-APDRP (Restructured Accelerated Power Development Programme):

On 31.07, the Central Sector Scheme of reforming APDRP was authorized. 2008 with a combined Rs. 51,577 crs. for IT facilitation and distribution enhancing part spending. The program’s main focus is on urban areas—towns and cities by over 30 thousand inhabitants (10,000 to particular category states).

B. National Electricity Fund (NEF)

In July 2012, GoI launched NEF (Interest Subsidy System) to give loan support for capital works authorized with financial institutions to develop distribution infrastructure through FY2012-13 and 2013-2014 in the distribution sector by both private and public distribution companies. A total of Rs.8,466 cr. spread over fourteen years of loan costs amounting to Rs. 21,00 cr. would be issued to the NEF for distribution systems approved in two years, namely, 2012 to 2013 and 2013 to 2014.

C. FINANCIAL RESTRUCTURING PLAN (FRP)

Ministry of Power Vide OM has notified the financial restructuring system for State-owned Discoms dated 05-10-2012 following CCEA approval to allow & ensure the long-term viability of state discoms. The scheme involves steps for State Discoms as well as State Government to achieve financial turnaround by a restructuring of their debts with help via a Central Government Transitional Finance System.

D. Ultra Mega Power Projects (UMPPs)

In 2005-06 Power Ministry initiated an initiative to support the growth of Ultra Mega Power Projects (UMPPs) at both coal-pithead & coastal locations, each with a capacity of 4,000 MW & more. These are awarded by Ministry of Power and GoI in section 63 of Electricity Act 2003 for developers chosen by means of an international competitive bidding method. 4 developers have previously received UMPPs (Mundra, Sasan, Tilaiya and Krishnapatnam).

E. Independent Transmission Projects (ITPs)

In 2003, the Department of Power started an ITPs increase program, with the participation of the private sector, to remove from power by producing stations, transfer power by pooling to additional grid stations & improve tariff-based competitive bidding processes in India, pursuant to Section 63 of Act on Electricity. Power Ministry, GoI, has been appointed as “Bid Process Coordinator” for ITPs production for REC Transmission Projects Company Ltd (RECTPL) and PFC Consulting Limited (PFCCCL).

F. Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)

Govt. has accepted system of “DDUGJY” using elements (i) Detaching feeders for agriculture & non-agricultural feeds that also help to sensitively roll supply to rural & non-agricultural consumers (ii) Improving and increasing the network for sub-transmission and distribution in rural areas, with consideration of metering transformer or feeder or consumer distribution [19].

VI. MADHYA PRADESH’S REWA SOLAR PARK

Sprng Energy Private Limited, Actis Private Equity Funds ‘ renewable energy company, has announced that its first India renewable energy project will be launched.

250 MW of Rewa Ultra-Mega Solar Limited (RUMSL) solar projects were one of the first in violation of the tariff level of $2.979 (~$0.0445)/kWh, and a levelized tariff of $3.309 (~$0.0495)/kWh in the country. L&T Construction Limited was based at Rewa Ultra Mega Solar Park in MP. In accordance with the power purchase agreement (PPA), the project is commissioned within the timeline. Solenergi, a 100 percent holding company in Mauritius of Sprng Energy, participated and won the 1st 250 MW project at Rewa Solar Park Auction. The energy generated by this project will meet MP’s electricity needs as well as the Delhi Metro Rail company’s green electricity needs. A company says the project will help to reduce emissions of carbon by at least 0.35 million tons per year. Actually, Sprng Energy’s portfolio comprises almost 1.75 GW of solar and wind projects in India, with both construction and business properties.

In 2017, Sprng energy won a 197.5 MW wind energy project under a Phase I auction of $2.43 ($0.034)/kWh for a record-low tariff under Gujarat Urja Vikas Nigam Limited (GUVNL).2 projects were won in April 2018: one under SECI—Tranche IV wind energy, and other under NTPC Anantapur solar project with a capacity of 300 MW. An extra 250 MW of solar projects was won in Kadapa solar auction in June 2018 via SECI tenders. Mahindra Renewables, a wholly-owned subsidiary of Mahindra Susten, has already completed its project by providing Yes Bank loans to other financial institutions for $7.5 billion ($115.5 million) and $2 billion ($30.8 million). As a lead loan from IFC, World Bank Financial Arm for Rewa Project, Mahindra also got $50 million (~$3.2 billion). IFC also assisted Mahindra by the mobilization of the $100 million (approximately $6.4 billion) unionized parallel loans to establish, fund, construct, operate and maintain the solar grid supply project. In support of 250 MW solar project construction, development, financing, operation and maintenance of Rewa Solar Park, ACME Jaipur Solar Power Private Limited, an ACME Solar subsidiary wholly owned by ACME Solar, ACME Solar has given the US $50 million (~$3.2million) [20].

VII. LITERATURE REVIEW

In the overall research process, a literature review plays an important role.

A. Studies Focusing on The Technical And Financial Performance

L. Kishore and S.G. Varun Kumar (2018) The study makes three significant contributions to performance evaluation and benchmarking of PDUs in India. This study is the first to propose a conceptual model for performance optimization of PDUs in India, considering both operational and financial parameters as defined by MoP. To best of our knowledge, there is no such multi-variable study conducted in India considering the variables defined by MoP for performance evaluation of PDUs. Therefore, this study is making a major contribution to developing an alternate methodology for performance evaluation and ranking of PDUs as a possible substitute to the existing IRM of MoP incorporating all the

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IJRAR2001152 | International Journal of Research and Analytical Reviews (IJRAR) www.ijrar.org | 124

www.ijrar.org (E-ISSN 2348-1269, P-ISSN 2349-5138)
Operational and financial parameters as defined by MoP for performance evaluation of PDUs\textsuperscript{[21]}

Geetanjali Singh (2017)\textsuperscript{[1]}

PS is one of the key drivers in every country's growth. PS in India has extremely government-led policies and is focused on bidding policies for energy projects; power-transmission regulations between countries and consumer price pricing are also decided by the Government. Adoption in India of Electricity Act in 2003 provided an impetus for the sector to pave way for new electricity reforms. This paper offers an insight into Indian PS as well as an overview of the growth of PS as regards installed capacity, loss of transmission and distribution, energy usage, no of electrified villages, length of T&D lines per capita power consumption using a yearly compound growth rate \textsuperscript{[22]}

Dr. AB Angappappilai and P Kandasamy(2017)\textsuperscript{[2]}

Researcher attempted to evaluate the financial performance of the power industry of Tamil Nadu by using financial variables. The financial performance of PS has several factors. In this study, the researcher took into account several variables such as energy supply costs, tariffs, Tamil Nadu electricity board revenue & subsidies. The study also attempted, in 2 periods, to analyze the sector's level of financial efficiency. The aim of this analysis is to verify the subsidy hypothesis. The researcher utilized a comparative analysis method using appropriate statistical tools \textsuperscript{[23]}

B. Pricing Policy Of Power Utilities In India

N. K. Sharma et al. (2012)\textsuperscript{[3]}

This restructuring & deregulation of the electricity sector is a move to reduce customer prices through cost savings. The process of electricity pricing has changed due to the deregulation of power systems in a lot of parts of the world. India is in the midst of energy restructuring. Power planning will take part in a major role in Indian economic growth as a positive power reform. New investments can only be made by a financially and economically viable electricity sector. Restructuring is a major shift in Indian PS's energy planning, especially energy expansion planning methodology. Developments in India policy on transforming power and deregulation had to be seen to generate full benefits from the deregulation of power utilities. A decline in maintenance and new investment could be a significant possible effect of deregulation. This work highlights the Indian Government's current deregulatory strategies & policies \textsuperscript{[24]}

Thomas B. Smith (2004)\textsuperscript{[4]}

Theft of electricity could take the form of fraud (metric handling), robbery (illegal links) and billing anomalies that have been not paid. In 1980 and 2000 theft of electricity is estimated in an area of 102 states. The proof shows that theft is rising in many parts of the world. The financial consequences of theft minimize energy purchases and the need to charge customers more. Electricity theft has a close link with governance indicators with higher volatility rates in countries without efficient transparency, political instability, poor government performance and high corruption levels \textsuperscript{[25]}

C. Regulatory Reforms In Power Sector

Vishal Pawar et al. (2016)\textsuperscript{[5]}

Discusses an energy meter and a fraud detection system based on GSM. This Energy Meter has the capability to monitor & control remotely, to read automated meters, to detect theft, to alert the message, to automatically disconnect and connect if the fare is not payable. The Energy Meter uses the GSM network since communication with consumers is the fastest and easiest way. Consumers would receive SMS concerning electricity, warning & billing. Increasing energy conservation, energy efficiency and incorrect billing are also addressed through this initiative. The automatic billing system monitors real-time consumption and makes little difference. This project will benefit the energy supplier, IT Park, householder \textsuperscript{[26]}

Nidh P. Totare and Shubha Pandit (2015)\textsuperscript{[6]}

In field of fuel, policy issues & cost-efficient, the Indian energy sector is facing challenges. Therefore, systemic reform is needed to resolve these new challenges. The challenges are addressed by a green building scenario, peak power plant & power cost served on an Indian scenario. Green Building promotion is proposed & discussed as a regional come up to for policies and innovative financing schemes. A requirement for peak power stations and a gas-based selection criterion and a prison power station is proposed. Structure for the cost of power & several novel steps that will lead to decreased cost is put forth \textsuperscript{[27]}

Devendra G Kodwani (2000)\textsuperscript{[7]}

Argued that regulation of economic activities is often justified as a policy instrument to minimize the harmful impacts of market failure. But the role of a regulatory body should be decided clearly. The existing relationship between the regulator and regulated utilities needs to be rationalized. The role of a regulator is to promote economic efficiency protecting the economic interest of electricity consumers \textsuperscript{[28]}

CONCLUSION

In this paper, the Madhya Pradesh Power reform and its financial impact are discussed. India’s growing economy has forced the states within a country to increase installed power capacity on a yearly basis. Despite the growth in supply, the state is still facing major challenges in providing electricity access to all the households and also improving reliability and quality of power supply. Its power systems are struggling to overcome power shortages, poor power quality, T &D losses, AT &C losses etc. this survey is to focus on the major constraint in achieving the target in shortage of capital resources. For this, there is an immediate need for change in planning strategies from the traditional approach of increasing generation to meet in disciplined consumption to need, resource and conservation-based approach for economic and environmental benefits. So the brief survey on MPSEB will help the researcher to work better for the reforms and schemes of the electricity industry.

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