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Understand Madhya Pradesh's Energy Personality in 10 Questions

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Madhya Pradesh is endowed with ample natural resources such as coal, coal bed methane, hydro, wind, and solar, and it enjoys a locational advantage at the center of the country that has helped to spur its industrial and commercial growth. Madhya Pradesh has the opportunity to further its role as a surplus electricity supplier to other states but must balance this with its need to provide electricity to those still unconnected within its rural regions. Madhya Pradesh scores well on a number of energy sector performance indicators relative to other Indian states but still has challenges with the efficient use of its resources. How well the state develops its resources will depend on its ability to improve operational efficiencies in the coal sector and improve meter reading at the distribution level. The success of the sector depends upon state agencies' ability to utilize the resources in an efficient and profit-generating manner. Data collection and utilization at various stages of production and supply is critical to ensuring that Madhya Pradesh retains and builds upon its resource and competitive advantage.

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Question 1: What Are the Key Drivers of the Energy Sector?

Population and spread:[1] Madhya Pradesh is the fifth-most populated state with 5 percent of India's population and is India's second-largest state by area. Madhya Pradesh has a population of about 72 million (almost twice the population of California) and a population density of about 610 people per square mile (United States' is 86 people per square mile). Twenty-eight percent of the state's population lives in urban areas (the average for lower-middle-income countries is 39 percent). Madhya Pradesh is also among the most impoverished states[2] in India with 32 percent poverty (national average is 22 percent). Its large and poor population, which predominantly lives in rural areas, keeps the power consumption levels low at a per capita consumption of 739 kWH, compared to the national average of 1010 kWH. Even though most of the Madhya Pradesh's population lives in rural areas, because many of those people lack energy access, it is the urban areas with higher levels of consumption that drive the energy demand within the state.

Major cities and towns:[3] Indore, Bhopal, Jabalpur, Gwalior, and Ujjain serve as both population and commercial activity centers.

Major industries:[4] Madhya Pradesh is mineral rich—it has coal and coal bed methane reserves. Although the predominantly rural population is agriculture dependent, its location at the center of the country has allowed for industrial and commercial activity. The state has special economic zones (SEZs), a strong cement production industry, textile manufacturing facilities, and auto industry.

Future of energy: Madhya Pradesh is a power surplus state and power exporting state[5]; it generates 20 percent more power than it consumes. Madhya Pradesh is a key power exporter to other states. Despite the surplus power in the state, Madhya Pradesh has the highest concentration of accumulated losses from the power sector, after Uttar Pradesh, Maharashtra, and Tamil Nadu.[6] The losses stem primarily from collection inefficiencies, power theft and unmetered consumers (9 percent of consumers were still unmetered as of 2015), and past debt. Operational inefficiencies also increase the cost of borrowing for the state's distribution companies (DISCOMs).[7] The state has, however, made progress in reducing these losses, with 11 percent reduction[8] in aggregate technical and commercial losses from 36 percent in 2011 to 23 percent in 2015.

Private players dominate renewables-based power generation in Madhya Pradesh. Although the state has transitioned from feed-in-tariffs for renewables to reverse auction, the 750 MW solar park Rewa Ultra Mega Solar, in the Rewa district of Madhya Pradesh, achieved the lowest tariff seen until that point in a reverse

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[1] Census 2011, "Madhya Pradesh Population Census Data 2011," http://censusindia.gov.in/2011-prov-results/data_files/mp/Final%20Data%20Sheet_mp.pdf.
[2] Reserve Bank of India, "Number and Percentage of Population below Poverty Line 2011–12," https://www.rbi.org.in/scripts/PublicationsView.aspx?id=15283.
[3] Ibid.
[4] Indian Brand Equity Foundation, "Information about Madhya Pradesh: Agriculture, Industries, Economy Growth, Geography," http://www.ibef.org/states/Madhya Pradesh.aspx.
[5] Central Electricity Authority, Ministry of Power, Government of India, *Load Generation Balance Report 2016–17*, iii, http://www.cea.nic.in/reports/annual/lgbr/lgbr-2016.pdf.
[6] Sheoli Pargal and Sudeshna Ghosh Banerjee, *More Power to India: The Challenge of Electricity Distribution* (Washington, DC: World Bank, 2014), 57.
[7] Care Ratings, "UDAY: State's response reasonable; effective implementation key for the success of biggest ever reform measure in power sector," July 13, 2016, http://www.careratings.com/upload/NewsFiles/SplAnalysis/Ujwal%20DISCOM%20Assurance%20Yojana%20-%20Article.pdf.
[8] Government of India and Government of Madhya Pradesh, "24 X 7 Power for All," 27, http://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_madhya%20pradesh.pdf

bidding process. With an April 2018 target for commissioning data and buyers already lined up for the power generated from the project, the renewable energy landscape in Madhya Pradesh looks encouraging.

Madhya Pradesh is also faced with air quality and pollution problems that stem from its coal mining industry. At the same time, there is ample unexplored coalbed methane potential in the Sohagpur Coalfield.[9] A significant portion of the power generated in the state is hydroelectricity. Dams on the rivers Narmada, Tapi, and Chambal, which are crucial to the hydro-based generation, have displaced thousands of people and been subject to controversies and delays.

IMPRESSION

As a power surplus state, efficient use of the state's generation and distribution assets is imperative, for Madhya Pradesh's and India's energy security.

Disribution reform: In August 2016, Madhya Pradesh joined Ujwal DISCOM (distribution company) Assurance Yojana (UDAY), the central government's bailout program to revive the state's electricity distribuition companies. Under the program, the Madhya Pradesh government took over $4.04 billion (Rs. 26055 crore) of DISCOM debt, accounting for 75 percent of the total outstanding debt of $5.4 billion (Rs. 34739 crore). Besides helping the DISCOMs to bring about a financial turnaround, UDAY requires improvements to the operational efficiencies of the DISCOMs.[10] Through financial and operational efficiencies, the credit rating[11] of the DISCOMs is likely to improve—ratings are currently at B, that is, below average operational and financial performance capability. This will help DISCOMs raise cheaper funds for future capital investment. As of April 2017, the Madhya Pradesh government had issued bonds for 62 percent ($1.14 billion) of the total $1.8 billion for which bonds need to be issued.[12]

Question 2: What Is the State of the Power Sector?

Power access: In 2016,[13] 90 percent of the households in Madhya Pradesh had access to electricity (98 percent of those in urban areas, 86 percent in rural areas). This is significantly higher than the average for electricity access for lower-middle-income countries like India, which is at 78 percent.[14] However, 5.25 million households in the state remained unelectrified at the end of 2015.[15]

According to Madhya Pradesh's "24X7 Power for All" document[16] (a document submitted by all Indian states describing the state of the power sector), the per capita electricity consumption in the state stood at 739 kWh in the year 2014–15, while the country average was 1010 kWh. Several reasons underscore Madhya Pradesh's low

[9] K.N. Singh, "Coal Bed Methane potentiality—Case studies from Umaria, Korba and Ib-valley coals, Son-Mahanadi Basin," *Journal of the Geological Society of India* (2010) 76: 33, doi:10.1007/s12594-010-0081-1.
[10] Press Information Bureau, Government of India, "Madhya Pradesh joins 'UDAY' scheme; would derive an overall net benefit of Rs 17,515 crore through 'UDAY'" August 10, 2016.
[11] Indian Ministry of Power, *State Distribution Utilities Fourth Annual Integrated Rating* (New Delhi: Ministry of Power, June 2016), 10, http://www.pfcindia.com/writereaddata/userfiles/file/goi/4th_rating_booklet_Final_20-6-16.pdf.
[12] Government of India, Ministry of Power UDAY Dashboard, https://www.uday.gov.in/state.php?id=16&code=mp.
[13] Ministry of Health and Family Welfare, "National Family Health Survey-4, 2015–16, State Fact Sheet—Madhya Pradesh," http://rchiips.org/NFHS/pdf/NFHS4/MP_FactSheet.pdf.
[14] World Bank, "Access to electricity (% of population)," http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS.
[15] Government of India and Government of Madhya Pradesh, "24 X 7 Power for All," 8, http://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_madhya%20pradesh.pdf.
[16] Ibid., 7.

per capita consumption, including a large below-poverty-line consumption base, and consumers in tribal regions. The low per capita consumption is also attributable to small user base of industrial (25 percent) and commercial (7 percent) users and large user base of agricultural users (39 percent).

Power supply situation: Madhya Pradesh became a power surplus state for the first time in 2014, that is, the power generated in the state is higher than the power consumed in the state. Issues with the national grid, and continued distributional inefficiencies, left the state without any surplus capacity to export the following years.[17] Projection for 2016–17 shows that the state is expected to have over 8 percent power surplus.[18] An important caveat here is that agricultural power consumers in state, who receive power supply at subsidized prices, are provided only 10 hours of supply a day. After 10 hours of what the state describes as "essential supply," power supply is cut off. Therefore, the power surplus might not be true reflection of the supply situation in the state. Policies such as "Madhya Pradesh Policy for Decentralized Renewable Energy Systems 2016" may help improve power supply for agricultural users through off-grid solutions.

Power reliability:[19] Madhya Pradesh is amongst the better performing states in India when it comes to reliability of power supply, that is, consumers are provided round-the-clock power supply. Urban, commercial, and industrial consumers have steady supply, albeit per capita consumption is lackluster. Agricultural users are provided only 10 hours of supply.

Financial viability:[20] The financial viability of the Madhya Pradesh's energy sector is harmed by its record of past accumulated losses and current operational inefficiencies. In 2011, power sector debt was 15 percent of the state's domestic product. In Madhya Pradesh, fiscal transfer to the energy sector accounts for a significant share of the state's budgetary spending.[21] In 2016–17, this share stood at 12 percent. While a large budgetary allocation does not demonstrate that the sector is in poor health, the budgetary allocation to the power sector was doubled from 2015 to 2016, to absorb distribution losses under the UDAY program. Thus, a significant portion of the state's budget is being used to make up for the failings of the power sector.

IMPRESSION

As Madhya Pradesh continues to eliminate past losses under UDAY and set tariffs reflective of the cost of supply, its power sector will become financially viable.

The World Bank's 2011 ranking of Indian states by financial and operational efficiency puts Madhya Pradesh at the bottom three alongside Uttar Pradesh and Bihar. Its losses stem not only from distribution, but also from state generation.[22] However, there has been a steady improvement since 2011. The state's electricity regulatory commission, in keeping with India's main electricity law, Electricity Act, 2003, now sets consumers tariff that is reflective of the cost of supply.

[17] Ibid., 9
[18] Central Electricity Authority, Ministry of Power, Government of India, *Load Generation Balance Report 2016–17*, 28, http://www.cea.nic.in/reports/annual/lgbr/lgbr-2016.pdf.
[19] Sudeshna Ghosh Banerjee et al., *Power for All: Electricity Access Challenge in India* (Washington, DC: World Bank, 2015), 28.
[20] Pargal and Banerjee, *More Power to India*, 61, 86, 94, 124–25.
[21] PRS Legislative Research, "Madhya Pradesh Budget Analysis 2016–17," February 2016, http://www.prsindia.org/administrator/uploads/general/1456807123_Budget%20Analysis%20MP.pdf
[22] Mani Khurana and Sudeshna Ghosh Banerjee, *Beyond Crisis: The Financial Performance of India's Power Sector* (Washington, DC: World Bank, 2015), 28, doi:10.1596/978-1-4648-0392-5.

An examination of the Retail Supply Tariff Order for 2016–17[23] shows that the revenue form tariffs meets the cost of supply of power. However, the annual expenditure exceeds revenue, as the distribution companies have to offset not only the cost of supply, but also previous years' losses.

Question 3: How Did the Power Sector Evolve and Who Are the Key Players?

Madhya Pradesh's power sector has been more progressive than most other Indian states. It was among the first few states to begin a power sector restructuring process. Faced with power shortages, Indian states took to restructuring their state electricity boards at the turn of the century. They unbundled the sector into its constituent parts—generation, distribution, and transmission—and constituted an independent electricity regulatory commission. The restructuring process for Madhya Pradesh began in 1998 and was completed in 2005.

Madhya Pradesh's power sector comprises three verticals—generation, transmission, and distribution. The restructuring of the integrated Madhya Pradesh State Electricity Board (MPSEB) led to the creation of distinct companies to conduct each of these businesses.

Transmission: Madhya Pradesh Power Transmission Co. Ltd., Jabalpur (MPPTCL) is vested with the transmission business.

Distribution: Power distribution within the state is under the ambit of three utilities: Madhya Pradesh Poorva Kshetra Vidyut Vitaran Company Ltd., Jabalpur (MPPKVVCL or East Discom), which undertakes distribution of electricity in the eastern part of Madhya Pradesh; Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Ltd., Indore (MPPKVVCL or West Discom), which undertakes distribution of electricity in the western part of Madhya Pradesh; and Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Ltd. Bhopal (MPMKVVCL or Central Discom), which undertakes distribution of electricity in the central part of the state.

IMPRESSION

State-owned companies dominate power generation in Madhya Pradesh. Some of the operational inefficiencies can be reduced by encouraging participation of private companies in the sector. The state is seeing progress in this direction, especially with renewables.

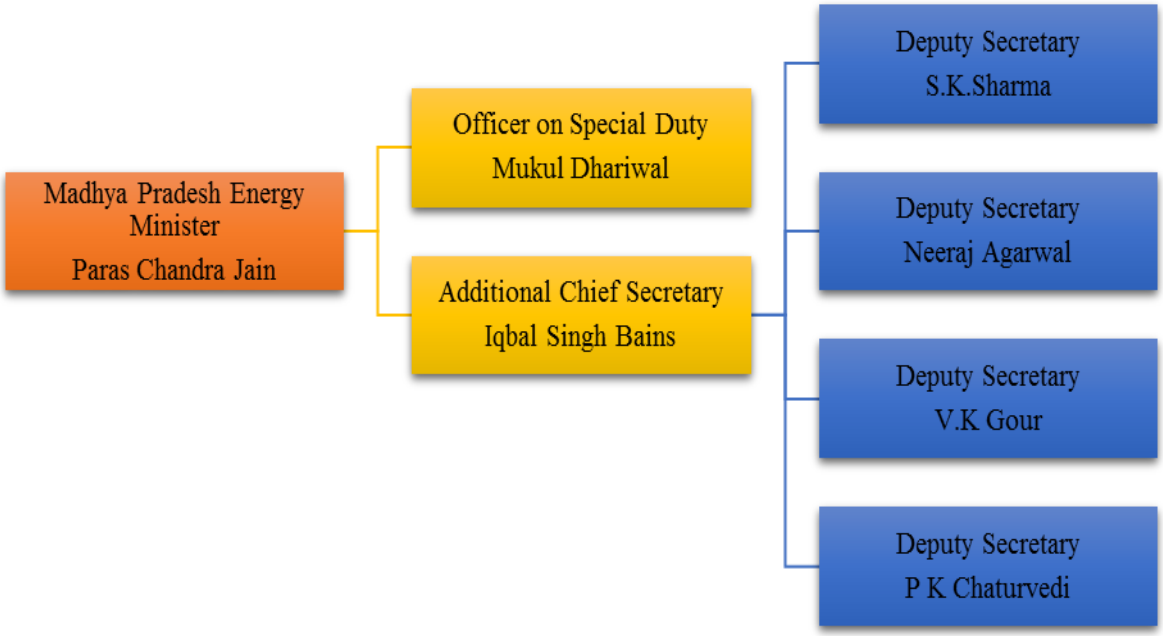
Generators:[24] Generation is undertaken by state-owned entities and private companies: Madhya Pradesh Power Generation Company Limited (MPPGCL) is the electricity generation company of the Madhya Pradesh government. It has coal and hydro-based generation. Narmada Hydroelectric Power Corporation is the major hydro-based generator in the state. National Thermal Power Corporation and National Hydel Power Corporation are two of the major state-owned generators. Reliance Infrastructure is a major private thermal power generator.

[23] Madhya Pradesh Electricity Regulatory Commission, "Retail Supply Tariff Order FY 2016–17."
[24] Government of India "List of thermal power stations in India up to 2016," http://cbrienvis.nic.in/Thermal%20Power%20Station%20in%20India%202016.pdf.

Regulator: The Madhya Pradesh Electricity Regulatory Commission regulates the electricity sector. It is responsible for regulating purchases, distribution, supply and utilization of electricity, and tariff-setting, as well as ensuring quality of service, competitiveness, and participation of private players.

Consumer categories:[25] Electricity tariffs faced by consumers vary by the purpose for which electricity is used, which is often not reflective of the actual cost of power supply to them. Consumers fall into one of the following categories: Low Tension (Voltage) category, which includes domestic, nondomestic, agriculture irrigation pumps, public water works and street lighting, and industry; and High Tension (Voltage) category, which includes coal mines, shopping malls, bulk residential users, industry, and railway traction.

Key people in Madhya Pradesh's energy department[26]



Source: Energy Department, Government of Madhya Pradesh

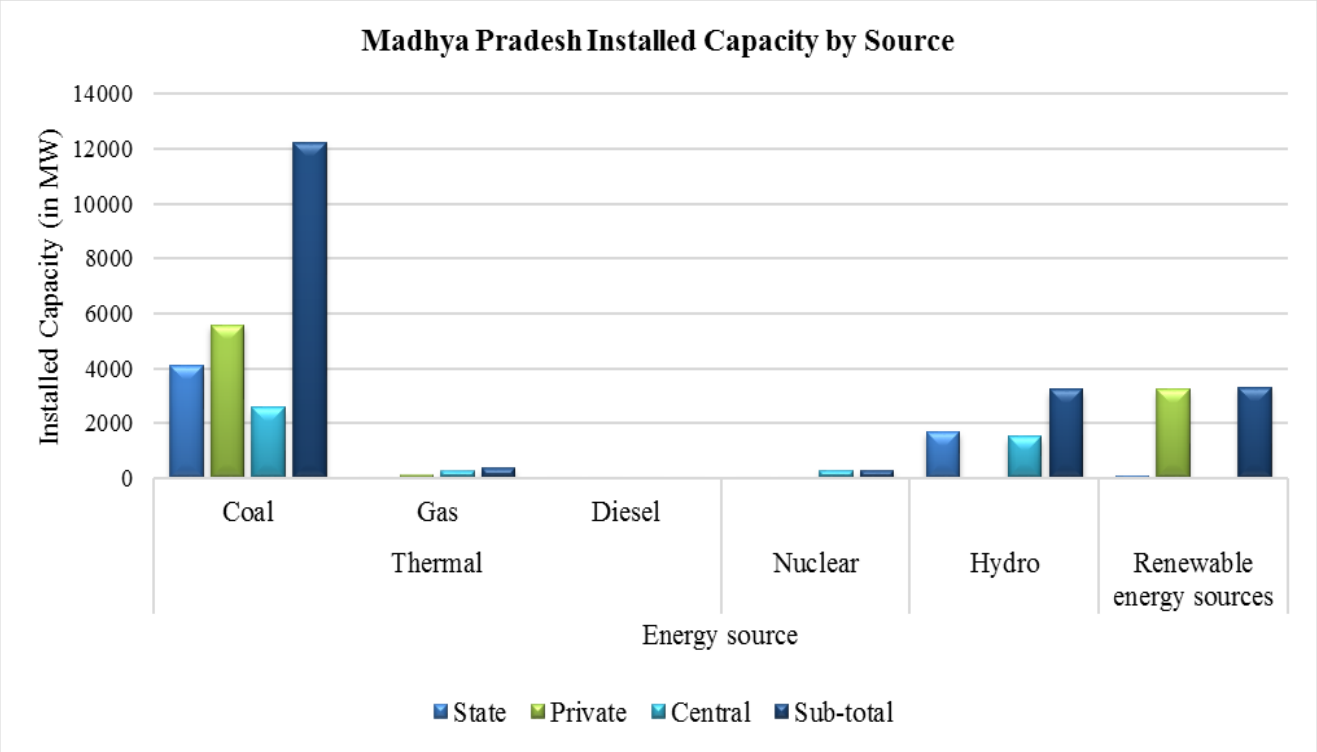
Question 4: What Kind of Power Is Generated?

Power generation mix: Sixty-three percent of the 19,400 MW installed power generating capacity in Madhya Pradesh is thermal generation from coal. Less than 2 percent of the total installed capacity is gas-based. Madhya Pradesh has significant power generation capacity for hydro-based generation (17 percent) as well as renewable sources like wind and solar power (17 percent).[27] Electricity planning in India is on a state-to-state basis. Power is availed from central generating stations, state generating stations, independent power producers, and public-private joint ventures. Allocation from these sources is made using a complex formula that considers the location of the power-generating facility, energy consumption in the preceding five years, and what is called the central plan assistance. The central plan assistance in turn depends on a state's population, per capita tax base,

[25] Madhya Pradesh Electricity Regulatory Commission, "Retail Supply Tariff Order FY 2016-17," 15–16.
[26] Energy Department, Government of Madhya Pradesh, "Who Is Who," http://mpenergy.nic.in/who_is_who.html.
[27] Central Electricity Authority, "Installed capacity (in MW) of power utilities in the states/UTs located in Western Region including allocated shares in joint & central sector utilities," 2016, 3, http://www.cea.nic.in/reports/monthly/installedcapacity/2017/installed_capacity-03.pdf.

per capita income, ongoing irrigation and power projects, as well as unique problems facing the state. State distribution companies rely on allocation from central generating stations and state projects as well as independent power producers for procuring power for sale in the state.

Madhya Pradesh receives coal-based power from the state's Madhya Pradesh Power Generation Corporation Ltd, and the Damodar Valley Corporation. Hydel power comes from the Narmada Hydroelectric Development Corporation on the Narmada.[28]



Source: Central Electricity Authority of India, Ministry of Power, Government of India

Renewable power: Madhya Pradesh's share in India's national renewable energy target of 175 GW by 2022 is 5,675 MW of solar, 6,200 MW of wind, 118 MW of biomass, and 25 MW of small hydro power.[29] This requires exponential growth in solar and wind capacity over the next five years from the current planned capacity of 1055 MW for solar and 2485 MW for wind. The targets for biomass and small hydro hav already been reached. Continued engagement of the private players by creating a policy apparatus that encourages investment will be critical for Madhya Pradesh's renewables plans. The Madhya Pradesh Electricity Regulatory Commission imposes a renewable purchase obligation (RPO) under which a certain minimum percentage of the total power requirement will come from renewable energy sources at a preferential tariff. The RPO

IMPRESSION

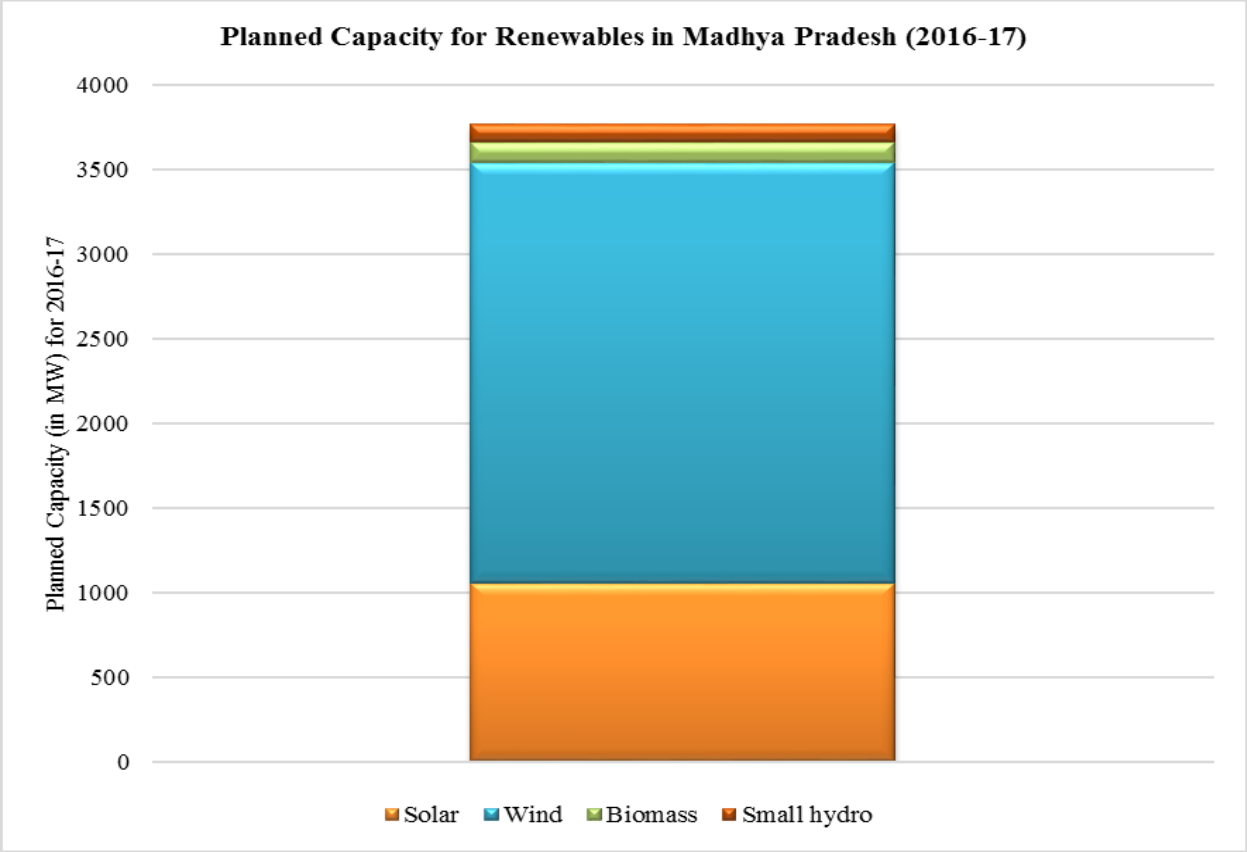
Madhya Pradesh needs greater incentives, investment, and participation at the state level to augment renewables-based generation. Replication of success seen with projects like Rewa Ultra Mega Solar project could be a viable way forward.

[28] Government of India and Government of Madhya Pradesh, "24 X 7 Power for All," 27, http://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_madhya%20pradesh.pdf.
[29] Climate Scope 2016, "Madhya Pradesh," http://global-climatescope.org/en/country/india/madhya-pradesh/.

for 2016–17[30] is 7.75 percent (solar power is 6.5 percent, non-solar power 1.25 percent). The table below compares the installed capacity in 2016, with the targeted installation for 2019 under the "24 X 7 Power for All"[31] and Madhya Pradesh's share under the national target of 175 GW from renewables by 2022.

Installed capacity v. Targeted installation for 2019 v. Share under national target[32]

Renewable resource	Installed capacity in 2016 (MW)	Planned capacity for 2019 (MW)	Share under national target of 175 GW by 2022 (MW)
Solar	1055	2105	5675
Wind	2845	3485	6200
Biomass	121	141	118
Small hydro	105	155	25



Source: Central Electricity Authority of India, Ministry of Power, Government of India

[30] Madhya Pradesh Electricity Regulatory Commission, "Retail Supply Tariff Order FY 2016-17," 27.
[31] Government of India and Government of Madhya Pradesh, "24 X 7 Power for All," 35.
[32] Ibid

Question 5: How Is the Transmission and Distribution Infrastructure?

Transmission infrastructure: Madhya Pradesh is part of the western regional grid for interstate transmission, which connects its neighboring states of Maharashtra, Gujarat, Rajasthan, and Chhattisgarh. As a power exporting state, there is pressure on Madhya Pradesh's transmission system to expand so that it can evacuate power from new power generation installations. At the same time, the intrastate transmission system, which caters to internal demand, is under pressure to provide access to unelectrified regions in the state. As the state's transmission network grows in size and complexity, adding more capacity in various generation pockets and increasing the number of players, there will be increased pressure on the system for real-time monitoring and control. The state has a Supervisory Control and Data Acquisition (SCADA) system, with control centers in Jabalpur, Bhopal, and Indore.[33] The proper use of this system in the planning and transmission process will be critical for steady and reliable power supply within and outside Madhya Pradesh. Therefore, plans to improve the transmission infrastructure in the state have to accommodate the twin objectives of grid expansion and real-time grid monitoring.

Madhya Pradesh's intrastate transmission infrastructure is managed by Madhya Pradesh Power Transmission Co. Ltd., Jabalpur (MPPTCL). MPPTCL, which aids the central grid planning authority Power Grid Corporation of India Ltd. (PGCIL), is planning an expansion of the interstate transmission system. Electricity consumed in the state is internally generated in state and central thermal and hydro plants. The state produces 120 percent of its needs, and exports the excess power generated.[34] The transmission losses suffered by the system is 2.88 percent in intrastate transmission losses and 3.7 percent and 2 percent for interstate transmission in the western and eastern regional grid, respectively. These losses are close to the levels seen in developed countries like the United States where transmission losses are 2 percent.

IMPRESSION

Proper energy accounting and energy audit at various levels such as sub-stations, distribution feeders, and distribution transformers, as well as at the consumer end, must be done to collect data about the actual level of distribution losses. This will help fix distribution inefficiencies in Madhya Pradesh.

Distribution infrastructure: Madhya Pradesh's distribution companies Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited, Jabalpur, Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited, Indore, and Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited, Bhopal, are otherwise referred to as East DISCOM, West DISCOM, and Central DISCOM, respectively These companies supply power to 12 million households, with 10 percent of all households still remaining unelectrified, and only 10 hours of daily supply being provided to agricultural users.

The quality of the distribution infrastructure in India is captured in Aggregate Technical and Commercial (AT&C) Losses. AT&C losses comprise two components. The first is technical losses, with loss of power due to flow from one point to another. They stem from energy dissipation in conductors, equipment used for transmission line, transformer, and distribution line, and magnetic losses in transformers. This is common across countries and is between 10 and 12 percent in India (North America is 6 percent and the average for lower-middle-income countries is 15 percent).[35] The second component commercial losses, which are avoidable losses and flow from theft of electricity, deficiencies in metering, and use of low-tariff power by consumers who do not belong to that category. In 2016, the distribution losses in Madhya Pradesh were at 17.8 percent and AT&C

[33] Ibid., 24.
[34] Ibid., 18.
[35] Delhi Electricity Regulatory Commission, "What Are Aggregate Technical and Commercial (AT&C) Losses?," http://www.derc.gov.in/Consumer/Press%20Note/DERCE%20AD%20ENGLISH.pdf.

losses were at 23.15 percent, indicating a transmission loss of about 6 percent. These distribution losses, unmetered consumers, and distribution transformer metering vary across DISCOMs, as can be seen in the table below:

Distribution losses, unmetered consumers and distribution transformer metering[36]

Distribution Company	Distribution losses (%)	Rural unmetered consumers (%)	Metered distribution transformers (%)
East DISCOM	18	15	5.3
West DISCOM	16	0.12	21.8
Central DISCOM	19	10.6	23

It is important to note that the regulatory commission, while pressuring the DISCOMs to reduce losses by improving meter reading, does not account for the actual losses suffered by the DISCOMs while setting the tariff. The regulatory commission has emphasized the need for proper energy accounting and energy audit at various levels such as sub-stations, distribution feeders, and distribution transformers, as well as at the consumer end so that reliable data about the actual level of distribution losses—technical and other.[37] This affects the financially viability of DISCOMs as only a portion of such losses is accounted for in the final tariff. This means that the DISCOMs incur losses in revenue and increasing debt levels from day-to-day operation.

Question 6: What Is the Cost of Power?[38]

Tariff-setting basics: MPERC sets the power tariffs for the state of Madhya Pradesh. It is a two-part tariff, comprising fixed and variable charges, and varies for each DISCOM. The tariff for all categories of consumers is defined and differentiated according to the consumer category, load factor, power factor, voltage, total consumption of energy during any specified period, time of supply, geographical location, and purpose for which the supply is required. The average revenue received is the weighted average of tariff billed to different categories of consumers for power supplied to them. Average cost of supply is the average cost that DISCOMs incur per unit of electricity purchased.

Tariff: The cost of supply to the consumer is calculated on the basis of the weighted average cost of power purchase from various generators by the DISCOMs, including their expenditure for meeting purchase of power from renewable sources under the Renewable Purchase Obligation (RPO). An RPO mandates that a certain percentage of the power bought by DISCOMs come from renewable sources. As renewables-based power is more expensive than power generated from thermal sources, there is an additional cost to DISCOMs for meeting

IMPRESSION

Tariff-setting in Madhya Pradesh allows the state's DISCOMs to meet the cost of supply. The financial status of the DISCOMs can be improved further by increasing tariffs to reflect the value to the consumers and by improving operation efficiencies.

[36] Madhya Pradesh Electricity Regulatory Commission, "Retail Supply Tariff Order FY 2016–17"
[37] Ibid., 27.
[38] Ibid

their RPO obligation. The cost of supply to consumers varies by consumer category based on the voltage at which power is supplied. Political imperatives cause the government, and by extension DISCOMs and the regulatory commission to subsidize power for certain category of consumers. Madhya Pradesh has a tariff policy that allows for cross-subsidization, that is, certain consumers are charged a tariff higher than the actual cost of supply to them, and the excess revenue is utilized to offset supply to consumers who are undercharged.

Thus, the tariff-setting exercise has two objectives: the explicit objective is that the consumer tariffs should reflect the cost of supply, and tariffs are in keeping with the political imperatives of the state government. To meet the explicit objective, the average revenue from tariffs for the various consumer categories is set equal to the voltage-wise average cost of supply. This rate is 9 cents (Rs. 5.83) for the state of Madhya Pradesh. To meet the second implicit objective, there is cross-subsidization between the consumer categories, as can be seen in the table below, to ensure the revenue from tariffs meet the expenditure on supply:

Cross subsidization among consumer categories[39]

Category	Voltage-wise Cost of Supply (cents/kWH)	Average Billing Rate (cents/kWH)	Average Billing Rate to Voltage-wise Cost of Supply (%)
LV-1: Domestic Consumers	9	9	92
LV-2: Non Domestic	9	12	130
LV-3.1: Public Water Works	9	8	83
LV-3.2: Street light	9	8	90
LV-4: Industrial	9	11	121
LV-5. Agriculture	9	7	79
HV-1: Railway Traction	8	10	130
HV-2: Coal Mines	8	12	142
HV-3.1: Industrial	8	11	135
HV-3.2: Nonindustrial	8	12	141
HV-3.3 :Shopping Malls	8	12	146
HV-3.4:Power intensive Ind.	8	10	119
HV-4: Seasonal	8	11	135
HV-5.1: Irrigation, PWW and other than Agriculture	8	8	101
HV-6: Bulk Residential Users	8	9	106
HV-7: Start-up Power to Generators	8	10	126
Total	9	9	100

[39] Ibid

Question 7: What Is the Energy Landscape?

Madhya Pradesh's energy landscape is defined by large amounts of resources purposed for coal-fired power plants, as well as some of the country's richest hydro-based generation and a push for renewables-based energy. Therefore, there is an effort to produce the least-expensive electricity from coal-based plants for continued power export from the state while ensuring that the state's energy plans are in line with India's rural electrification and renewable energy plans. By adopting this path, access can improve, consumption per capita can increase, and the state can receive more revenue from power export, as well as benefit from the central government's electrification and renewables-based generation programs.

Generation and transmission plans:[40] Madhya Pradesh's 2016–17 state budget saw a 105 percent increase from the previous year. Although more than half of that budget has been allotted for offsetting commitments to purchase DISCOM debt under the UDAY program, there is an overall emphasis in the state to augment generation capacity and strengthen the transmission network.

Madhya Pradesh has a two-pronged approach to thermal power generation: retirement of old and inefficient thermal and its replacement with super critical technology-based new plants; and removal of inefficiencies in sourcing coal through coal linkages and use of higher grade coal. Additionally, the state has enacted the Madhya Pradesh (Investment in Power Generation Projects) Policy 2012 to streamline implementation of thermal power plants by independent power producers.

Private players dominate the renewables-based power generation. Projects like the 750 MW solar park Rewa Ultra Mega Solar is gaining traction, especially in light of the Rewa project entering a long-term contract with Delhi Metro Railways Corporation and the Madhya Pradesh Power Management Company for off-take of power generated by it. There is a thrust toward projects of this nature that allow for economies of scale, and create a safe investment environment by lowering off-taker risk.

On the transmission side, Madhya Pradesh is looking to invest in emergency restoration systems to protect the system from technical and weather-related downtime. The central transmission planning authority, PGCIL, is undertaking grid expansion in the state.

IMPRESSION

Madhya Pradesh is seeing a lot of traction for increased generation, which will help meet growing demand within and outside the state. Better resource planning can be facilitated by better data collection at the point of generation and at demand centers.

Green Corridor:[41] Madhya Pradesh is part of the power evacuation corridor dedicated to renewables-based electricity. The construction of this transmission corridor is set to be completed by the end of 2018. Madhya Pradesh has received loans from German bank KfW for the intrastate construction of this corridor.

Incentives for renewables-based generation:[42] Implementation of solar power-based projects in Madhya Pradesh 2012 (Policy 2012) was designed to encourage private participation in the development of solar projects. Solar projects that fall under the ambit of this policy include projects offered competitive bidding by the state's DISCOMs, projects constructed to captive use, those constructed for renewable energy certificate compliance, and those under the National Solar Mission.

[40] Government of India and Government of Madhya Pradesh, "24 X 7 Power for All," 21–32.
[41] Ibid.
[42] Ibid., 33–35.

Wind-based generation is incentivized under Wind Power Project Policy of Madhya Pradesh-2012 and central renewable energy ministry's wind resource assessment program. Small hydro-based projects of up to 25 MW are covered under the Policy for Implementation of Small Hydel-Power-based electricity projects in Madhya Pradesh 2011, which provides for development of projects identified by the Water Resources Department, Narmada Valley Development Authority, or Madhya Pradesh Power Generation Company. Electricity from biomass is covered under the Madhya Pradesh Biomass-based Electricity (Power) Project Implementation Policy 2011.

Question 8: What Is the Role of Energy Efficiency?[43]

Energy efficiency programs and policies in Madhya Pradesh are better developed than in other parts of the country. DISCOMs provide tariff incentives to consumers with flexible demand to reduce consumption during peak demand, pursuant to the mandate of the state's regulatory commission and to balance load and provide electricity to consumers when demand peaks. Other energy-efficiency programs are state-level implementation of central plans for street lighting, energy efficiency in buildings, and appliance efficiency.

The state has adopted various demand-side management (DSM) measures. DSM allows control and management of consumption so the DISCOMs can anticipate demand. This helps in power planning in that it helps to schedule power supply and optimize power purchase cost by reducing unscheduled power surplus and deficit.

Lighting efficiency: Madhya Pradesh has a plan to provide LED bulbs to 8.2 million domestic consumers in the state. The project was initially to be undertaken by Energy Efficiency Services Limited (EESL), which is the country's public energy services company. The implementation of the program in the state is undertaken by Madhya Pradesh Urja Vikas Nigam Limited under the Energy Conservation Act 2001.

Agricultural efficiency: Madhya Pradesh's DISCOMs offer rebates on tariffs of up to 10 percent to metered agricultural users who use efficient agricultural pump sets and related equipment.

Time of Day (ToD) metering: Madhya Pradesh provides ToD tariff for certain categories of consumers. It provides peak (5 percent surcharge) and off-peak (15 percent rebate) rates to consumers that allow consumers flexibility to manage their energy bills better.

IMPRESSION

The scope for energy-efficiency improvements in the energy management of existing buildings is immense. From targeting urban local bodies as a segment to undertaking energy audit and energy efficiency measures could help target a large market with centralized decision-making.

Madhya Pradesh Energy Efficiency Improvement Investment Program: Under this program, which runs from 2011 to 2018, the Asian Development Bank is supporting 32 districts in rural Madhya Pradesh to improve the power distribution infrastructure and the quality of power supply. The program encompasses installation of separate feeders for agricultural and household use, installation of high-voltage distribution systems and new power meters, and strengthening of the 33 kV network.

[43] Ibid., 51–55.

Question 9: What Are the Latest Developments?

Madhya Pradesh's energy budget:[44] In the 2016–17 budget, the Madhya Pradesh government proposed to spend $3.23 billion (Rs. 20940 crores) in the energy sector. This includes $1.17 billion (Rs 7,568 crore) of electricity distribution company debt being converted to equity. An equivalent amount is budgeted in capital receipts (debt recoveries).

Madhya Pradesh Policy for Decentralized Renewable Energy Systems, 2016: This policy was issued October 2016 to promote captive energy generation and consumption, and third-party sale of energy generated from renewables-based resources at decentralized locations. The policy serves the dual purpose of reducing the pressure on base-load conventional energy and reducing distribution losses by moving generation outside the purview of distribution licensees. The emphasis of the policy is on off-grid rooftop and ground-mounted solar.

Renewables: The state has transitioned from feed-in-tariffs for renewables to reverse auction; the 750 MW solar park Rewa Ultra Mega Solar, in Rewa district of Madhya Pradesh, achieved the lowest tariff seen until that point in a reverse bidding process. The project is expected to be completed by the end of 2018. Power purchase agreements for the power generated here were signed in April 2017. The power will be bought by the Delhi Metro Railways Corporation and the Madhya Pradesh Power Management Company. The first-year tariff has been set at 5 cents (Rs. 2.97) per kWh of power and the levelized tariff will increase to a little over 5 cents (Rs. 3.3) over the 25 years of the contract.

Coal reform under UDAY: Under UDAY, the central government is supporting the Madhya Pradesh government with additional coal supply under preset rates. This will favor higher-capacity utilization of coal plants in the state. Other benefits—coal swapping under which power plants are supplied with coal from the closest plant, thereby bringing in operational efficiency, coal rationalization, correction in coal grade slippage, availability of 100 percent washed coal—could help the state. Madhya Pradesh is projected to gain around $653 million (Rs.4225 crore) due to these coal reforms.

IMPRESSION

Action items under UDAY for coal reform, demand-side management, and energy efficiency provide specific avenues for private players and foreign investors to engage with Madhya Pradesh's DISCOMs

Distribution reform under UDAY: During the period of financial turnaround under UDAY, Madhya Pradesh and its DISCOMs will bring about operational efficiency through compulsory feeder and distribution transformer metering, consumer indexing and GIS mapping of losses, upgrade/change of transformers, and smart metering of high-end consumers. This will help reduce transmission losses and AT&C losses, besides eliminating the gap between cost of supply of power and revenue. The reduction in AT&C losses and transmission losses to 15 percent and 4 percent, respectively, is likely to generate an additional revenue. UDAY provides for the balance of debt to be repriced or issued as state-guaranteed DISCOM bonds, at coupon rates around 3 percent less than the average existing interest rate.

[44] PRS Legislative Research, "Madhya Pradesh Budget Analysis 2017."

Question 10: What Are the Strengths, Weaknesses, Opportunities, and Threats in the Madhya Pradesh's Energy Sector?

Strengths	Weaknesses
• Abundant resources for thermal, hydro, and renewables-based generation • Locational advantage • Long-term supply contracts • Current management of DISCOMs is efficient relative to other DISCOMs in the country • Tariff meets the cost of supply • Round-the-clock supply to nonagricultural users	• 10 percent of the population and 5.25 million homes are unelectrified. • Share of industrial and commercial consumption as a share of the total is low* • AT&C losses, while lower than some of the other Indian states, are still unsustainable • Lack of data
Opportunities	**Threats**
• Surplus power generation • Potential of thermal and renewables-based generation • Potential for power savings through demand-side management	• Continued cross-subsidization by high-paying consumers might cause them to exit the DISCOMs and generate captively • Past debt of the DISCOMs • Politicization of power

* Industrial and commercial users consume larger amounts of power at a given location. Usually the voltage at which they are served is high, reducing the cost of power transmission. The return on providing power to these users is higher when compared to domestic and agricultural users. Therefore, when there is a smaller share of industrial and commercial users in the power consumption base, it results in lower profits for distribution companies.

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