

March 2017

# Understand Bihar's Energy Personality in 10 Questions

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Bihar's energy sector is defined by a large unelectrified and agriculture-dependent population, crippling debt, and electricity distribution inefficiencies. The Indian government, Bihar state government, and private sector entities are engaged in improving the state of the power sector through bailout programs and distributed energy solutions. These efforts are at odds with the problems intrinsic to Bihar: a poor consumer base that is unable to pay for power, and populist measures such as free power and low tariffs that hamper financial viability of distribution companies. As the energy-poor population gains access, it is pertinent to find financially sustainable solutions.

## Question 1: What Are the Key Drivers of the Power Sector?

*Population and spread:*<sup>1</sup> Bihar is a very populace, rural state, with a higher-than-average level of impoverished people. Bihar is the third most populous state with 9 percent of India's population and is India's 13<sup>th</sup> largest state. Bihar has a population of about 105 million (1.3 percent of the world's population) and a population density of about 2,863 people per square mile (United States' is 86 people per square mile). Only 12 percent of the state's population lives in urban areas (the average for lower-middle-income countries is 39 percent). Bihar is also among the most impoverished states<sup>2</sup> in India with 34 percent poverty (national average is 22 percent).

*Major cities and towns:*<sup>3</sup> Even though much of the population lives in rural areas because many of those people lack energy access, urban areas drive higher levels of energy consumption within the state. Patna, the capital of Bihar, holds most of the urban population. Other major metropolitan areas in the state are Gaya, Bhagalpur, and Muzaffarpur. Bihar's proximity to eastern and northern parts of India makes access to ports in Kolkata and Haldia possible. It can also access raw material and mineral reserves in its neighboring states.

*Major industries:*<sup>4</sup> Bihar's dependence on agriculture coupled with 88 percent of the population being in rural areas drives the electricity needs of the state. 80 percent of Bihar's population is dependent on agriculture. It is the largest producer of vegetables and the second-largest producer of fruits in India. Food processing, dairy, sugar, leather, and textile are some of the key industries in the state.

*Future of power:*<sup>5</sup> According to the World Bank's survey and analysis,<sup>6</sup> Bihar's power sector is financially one of the worst-performing power sectors in India—fraught with poor infrastructure in the rural areas, limited finances, an increasing gap in demand and supply of electricity, and low credit ratings and poor performance of the state-run electricity agencies. The poor performance of state electricity agencies stems from high transmission and distribution losses and low collection of revenue. However, the state's solar and biomass potential coupled with a large off-grid population makes Bihar a laboratory for micro-grid solutions. The solar-powered micro-grid supplying power to Tayabpur village in Bihar, which is run by Tata Power Delhi Distribution Ltd, is an example of one such solution.<sup>7</sup> These developments have led some parties to suggest that one pathway forward for electrification in Bihar could comprise a state-wide network of decentralized energy plants (standalone and micro-grids) developed with support from state government agencies in collaboration with private entrepreneurs.

### IMPRESSION

Power sector transformation in Bihar needs to start with rural areas with no access to electricity. Being an agricultural state, there is agro residue-based bio-energy potential that should be explored.

<sup>1</sup> Census 2011, "Bihar Population Census Data 2011," <http://www.census2011.co.in/census/state/bihar.html>.

<sup>2</sup> Reserve Bank of India, "Number and Percentage of Population below Poverty Line 2011-12," <https://www.rbi.org.in/scripts/PublicationsView.aspx?id=15283>.

<sup>3</sup> Ibid.

<sup>4</sup> Indian Brand Equity Foundation, "Information about Bihar: Agriculture, Industries, Economy Growth, Geography," <http://www.ibef.org/states/Bihar.aspx>.

<sup>5</sup> Anjula Gurtoo and D. Lahiri, *Empowering Bihar: Policy Pathway for Energy Access* (Bengaluru, India: Greenpeace India Society, April 2012), 2, 14, <http://www.greenpeace.org/india/Global/india/report/Empowering-Bihar-Policy-pathway-for-energy-access.pdf>.

<sup>6</sup> Sheoli Pargal and Sudeshna Ghosh Banerjee, *More Power to India: The Challenge of Electricity Distribution* (Washington, DC: World Bank, 2014), 61, 86, 94, 124–25.

<sup>7</sup> Tata Group, "Tata Power Delhi Distribution brings solar microgrid to rural village in Tayabpur, Bihar," January 24, 2017, <http://www.tata.com/media/releasesinside/tata-power-rural-electrification-bihar>.

*Distribution reform:* In February 2016, Bihar joined Ujwal DISCOM (distribution company) Assurance Yojana (UDAY), the central government's bailout scheme to revive state electricity distribution companies. The Bihar government will take over \$350 million (Rs. 2332 crore) of DISCOM debt, accounting for 75 percent of the total outstanding debt of \$465 million (Rs. 3110 crore). Besides helping the DISCOMs to bring about a financial turnaround, UDAY requires improvements to the operational efficiencies of the DISCOMs. Through financial and operational efficiencies, the credit rating<sup>8</sup> of the DISCOMs is likely to improve—ratings currently range between B+ and B, that is, between moderate operational and financial performance capability and below average operational and financial performance capability. This will help DISCOMs raise cheaper funds for future capital investment. As of June 2016, the Bihar government had issued bonds for 75 percent (\$260 million) of the debt it took over.<sup>9</sup>

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

*Power access:* In 2016,<sup>10</sup> less than 60 percent of the population of Bihar had access to electricity (89 percent of those in urban areas, 54 percent in rural). The global average for electricity access for lower-middle-income countries like India is 78 percent.<sup>11</sup> However, this is a significant improvement from 2011, when according to the Census of India,<sup>12</sup> only 16.4 percent of Bihar had access to power. The 2016 tariff order<sup>13</sup> indicates very low household consumption of power—the monthly household consumption of power among grid-connected consumers for 2015–16 stood at 14 percent with less than 30 kW, 58 percent with consumption between 30 kW and 60 kW, 27 percent with consumption between 60 kW and 150 kW, and less than 1 percent with consumption over 150 kW. Daily per-household consumption is 1.40 kWh for rural households and 4.30 kWh for urban households,<sup>14</sup> which is the lowest in the country (national average<sup>15</sup> is 2.5 kWh) given that only 12 percent of all households in Bihar are urban. These consumption levels are also among the lowest in the world (U.S. average daily consumption is 32 kWh).

*Power deficit:* Bihar faces a power deficit as the power generated and imported into the state is not sufficient to meet the demand of all consumers. In 2014–15, the deficit in terms of availability vis-à-vis requirement was 16 percent and peak deficit was 19 percent.<sup>16</sup> Peak deficit refers to shortage of supply when demand is at its highest. During these times, generators that produce more expensive power are run. These generators are turned off during non-peak times. The 2016–17 projections<sup>17</sup> show a deficit of 25 percent (18.4 percent during peak

<sup>8</sup> 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](http://www.pfcindia.com/writereaddata/userfiles/file/goi/4th_rating_booklet_Final_20-6-16.pdf).

<sup>9</sup> 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>.

<sup>10</sup> Ministry of Health and Family Welfare, "National Family Health Survey- 4, 2015–16, State Fact Sheet—Bihar," [http://rchiips.org/nfhs/pdf/NFHS4/BR\\_FactSheet.pdf](http://rchiips.org/nfhs/pdf/NFHS4/BR_FactSheet.pdf).

<sup>11</sup> World Bank, "Access to electricity (% of population)," <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>.

<sup>12</sup> Census 2011, "Source of Lighting," [http://www.censusindia.gov.in/2011census/hlo/Data\\_sheet/India/Source\\_Lighting.pdf](http://www.censusindia.gov.in/2011census/hlo/Data_sheet/India/Source_Lighting.pdf).

<sup>13</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17," Case No. 45 and 50 of 2015, March 21, 2016, 60, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

<sup>14</sup> Government of India and Government of Bihar, "24 X 7 Power for All," 8, [http://powermin.nic.in/sites/default/files/uploads/BIHAR\\_PFA\\_REPORT\\_15.12.2015\\_With\\_Signature\\_II.pdf](http://powermin.nic.in/sites/default/files/uploads/BIHAR_PFA_REPORT_15.12.2015_With_Signature_II.pdf).

<sup>15</sup> World Bank, "Bihar Needs to Ramp up Power Infrastructure to Provide Access for All," February 27, 2016, <http://www.worldbank.org/en/news/press-release/2015/02/27/bihar-needs-ramp-up-power-infrastructure-provide-access-all>.

<sup>16</sup> Government of India and Government of Bihar, "24 X 7 Power for All," 9.

<sup>17</sup> 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>.

demand), indicating that supply is not able to keep up with the growing production. This deficit is in addition to over 40 percent of the population of Bihar with no access to power.

*Power reliability:*<sup>18</sup> In Bihar, one in four households with electricity face an average of 20 hours of power outage every day. To cope with the power outages, these households rely on kerosene for lighting. However, they pay a required minimum charge for lighting regardless of the electricity consumed. Power outages affect adoption of electricity, that is, poor quality of power supply discourages consumers from seeking access in the first place.

*Financial viability:*<sup>19</sup> In Bihar, fiscal transfer to the power sector accounts for a significant share of the state's budgetary spending. In 2011, this share stood at 15 percent, against the national average of 1.3 percent. Close to 90 percent of domestic power consumption in the state is subsidized (the national average is 80 percent). The financial loss from serving the large rural population in Bihar, which is also subsidized, is very high. As of 2010, for every unit (kWh) of power supplied to rural customers, a loss of 11 cents (Rs. 7.5) was incurred.

### IMPRESSION

Low demand per consumer and low tariffs make the cost of service high and non-remunerative. Distributed generation is a transition solution that can ensure access and continuous supply to meet needs without investment in a large grid.

Bihar government provides subsidy support to agricultural/rural consumers. Agricultural consumers and most of the domestic and non-domestic consumers in the rural areas are not metered. Industrial high-voltage and low-voltage consumption is less than 1 percent of the total electricity consumption in the state owing to a large rural population dependent on agriculture.

Bihar is one of the highest recipients of subsidy under a plan known as Rajiv Gandhi Grameen Vidyutikaran Yojana, which allows Indian states to receive up to a 90 percent subsidy from the Rural Electrification Corporation (REC) for the capital cost of grid extension and for decentralized distributed generation (off-grid) projects. Additionally, a 100 percent subsidy is given for new connections to households below the poverty line by REC. However, in reality, the subsidy payments are not utilized due to lack of awareness of program entitlements and misallocation at the local level.<sup>20</sup>

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

Until 2012, the Bihar State Electricity Board (BSEB) was responsible for the generation, transmission, and distribution of power within Bihar. BSEB was unbundled into five parts in 2012. Bihar State Power Holding Co. Ltd. (BSPHCL) became the apex holding company, Bihar State Power Generation Co. Ltd. (BSPGCL) was vested with the generation business, Bihar State Power Transmission Co. Ltd. (BSPTCL) with transmission, and

<sup>18</sup> Sudeshna Ghosh Banerjee et al., *Power for All: Electricity Access Challenge in India* (Washington, DC: World Bank, 2015), 28.

<sup>19</sup> Pargal and Banerjee, *More Power to India*, 61, 86, 94, 124–25.

<sup>20</sup> Greenpeace, "Rajiv Gandhi Grameen Vidyutikaran Yojana Social Survey Report," March–April 2011, <http://www.greenpeace.org/india/Global/india/report/RGGVY-Madhubani-Report%20FINAL.pdf>.

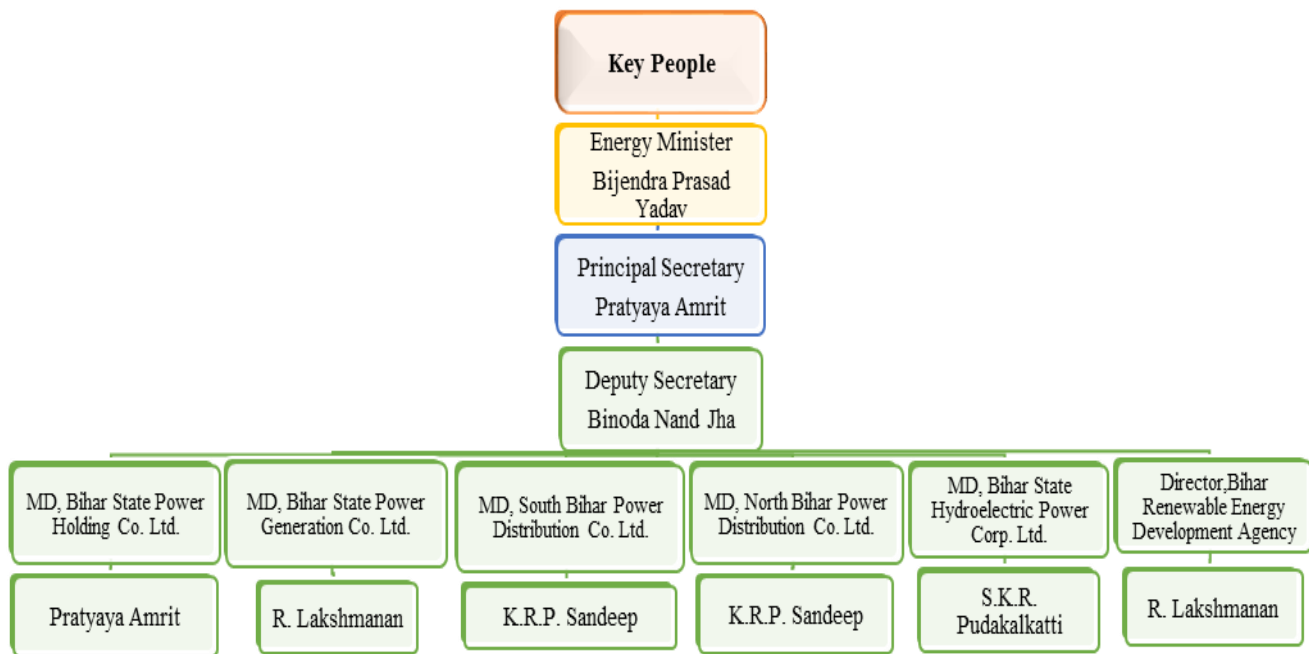
North Bihar Power Distribution Co. Ltd. (NBPDC) and South Bihar Power Distribution Company Ltd. (SBPDCL) were given the distribution over the north<sup>21</sup> and south<sup>22</sup> of the state, respectively.

**Generators:** Generation is undertaken by state-owned entities and private companies: National Thermal Power Corporation, National Hydel Power Corporation, PTC India, and BSPGCL are some of the major state-owned generators. Capital Pvt. Ltd, Nalanda Power Company (a subsidiary of CESC), Adani Power, GMR Power, and Adhunik Power and Natural Resources are some of the private thermal power generators.

**Regulator:** The Bihar 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.

## IMPRESSION

Bihar's population is largely rural, with low levels of consumption per household. Energy solutions for the state can begin with distributed generation as they require lower investment and are cost-effective in meeting the consumption needs when compared with large-scale grid-connected solutions.



<sup>21</sup> North Bihar Power Distribution Company Ltd., "Overview," <http://www.nbpdc.in/Overview.aspx?GL=2&PL=2>.

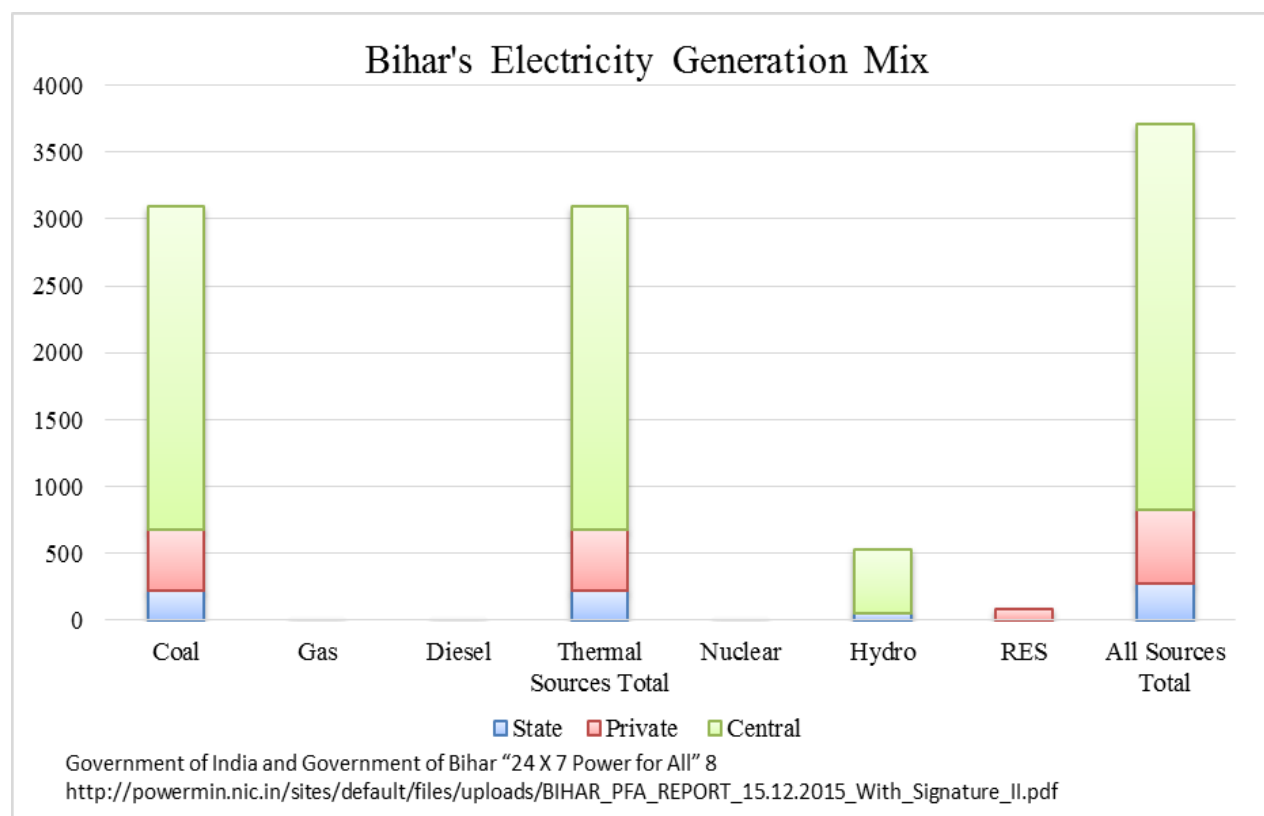
<sup>22</sup> South Bihar Power Distribution Company Ltd., "Message from MD," <http://www.sbpdc.in/MessagefromMD.aspx?GL=2&PL=3>.



*Consumer categories:*<sup>23</sup> 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, non-domestic, public lighting, irrigation, public water works, and industry; and High Tension (Voltage) category, which includes industry and railway traction.

## Question 4: What Kind of Power Is Generated?

*Power generation mix:* Most of the 3000 MW power generation in Bihar is from coal (92 percent). The only other notable source of power in Bihar is hydro-based generation (5 percent).<sup>24</sup> 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, 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.



<sup>23</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016-17," 219.

<sup>24</sup> Central Electricity Authority, "Installed capacity (in MW) of power utilities in the states/UTs located in Eastern Region including allocated shares in joint & central sector utilities," 2016, 5,  
[http://www.cea.nic.in/reports/monthly/installedcapacity/2016/installed\\_capacity-03.pdf](http://www.cea.nic.in/reports/monthly/installedcapacity/2016/installed_capacity-03.pdf).

Bihar receives coal-based power from the central National Thermal Corporation Plants and the state's Damodar Valley Corporation. Hydel power comes from central and state plants on the Teesta river.<sup>25</sup> Some of the major hydro-projects in the state are Eastern Gandak Hydroelectric Project, Kosi Hydroelectric Project, and Sone Hydroelectric Project.

*Renewable power:* Installed power from renewable sources<sup>26</sup> is 120 MW, of which 43 MW<sup>27</sup> comes from biomass and co-generation projects and the rest from solar. Bihar has an estimated solar power potential of 11.20 GW<sub>p</sub>.<sup>28</sup> Private companies exclusively control solar-based generation in the state. The Bihar 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 for 2016–17<sup>29</sup> is 6.5 percent (solar power is 5 percent, non-solar power 1.5 percent).

### IMPRESSION

Bihar needs government investment and participation in order for the state to meet its RPO target.

According to the Bihar government's 24 X 7 Power for All<sup>30</sup> (a document submitted by all Indian states describing the state of the power sector), there is a wide chasm between the renewable installed capacity and potential in the state.

Source-wise breakup of installed capacity v. potential <sup>31</sup>

Source	Installed capacity as of March 2015 (MW)	Potential (MW)
Solar	-	11,200
Bagasse-based cogeneration	85	300
Biomass-based power generation	1	619
Wind	-	144
Total	86	12,263

<sup>25</sup> Central Electricity Authority "Allocation of power from central generating stations and Bhutan stations to eastern region," 2015, 6, [http://cea.nic.in/reports/monthly/powersupply/2015/power\\_alloc-09.pdf](http://cea.nic.in/reports/monthly/powersupply/2015/power_alloc-09.pdf).

<sup>26</sup> Ibid.

<sup>27</sup> Ministry of New and Renewable Energy, "State-wise/year-wise list of commissioned biomass power/cogeneration projects (as on 01.04.2016)."

<sup>28</sup> Government of India, Ministry of New and Renewable Energy (Solar R&D Division), "State Wise Estimated Solar Potential in the Country," 2014, 2, <http://mnre.gov.in/file-manager/UserFiles/Statewise-Solar-Potential-NISE.pdf>.

<sup>29</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17," Case No. 45 and 50 of 2015, March 21, 2016, 8, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

<sup>30</sup> Government of India and Government of Bihar, "24 X 7 Power for All," 45.

<sup>31</sup> Ibid

## Question 5: How Is the Transmission and Distribution Infrastructure?

*Transmission infrastructure:*<sup>32</sup> There is pressure on the transmission infrastructure to expand and transmit more efficiently. The transmission infrastructure in Bihar has not been built out to provide electricity access to its population, leaving over 40 percent of the population without any electricity. Bihar's transmission infrastructure is managed by Bihar Grid Company Limited (BGCL), which is a joint venture of BSPHCL and Power Grid Corporation. Electricity consumed in the state is internally generated and also received from other states through the interstate transmission network. Bihar receives 66 percent of its electricity from out of state. The transmission losses suffered by the system is 4.5 percent in state transmission losses and 2.5 percent in central transmission losses, which are higher than developed countries like the United States where transmission losses are 2 percent).

*Distribution infrastructure:* The losses for distribution companies in Bihar are among the highest in the country at 44.5 percent, 64.5 percent, and 60.8 percent, respectively, in SBPDCL, Gaya, and Bhagalpur areas. For NBPDCCL, AT&C losses were submitted<sup>33</sup> as 34.6 percent and 53.1 percent respectively in NBPDCCL and Muzaffarpur areas during 2014–15 (national average is around 21 percent; globally, lower-middle-income countries average 15 percent<sup>34</sup>).

Bihar's power distribution is managed by South Bihar Power Distribution Company Ltd and North Bihar Power Distribution Company Ltd. In the 2016–17 tariff order determination, the distribution companies submitted<sup>35</sup> a breakdown of aggregate technical and commercial (AT&C) for 2014–15.

Distribution Losses by DISCOM			
Distribution Licensee	Approved in Tariff Order dated February 28, 2014	Revised Projection in True up for FY 2014-15	Approved in Truing up for FY 2014-15
<b>SBPDCL</b> <sup>36</sup>	21.4	49.7	21.4
<b>NBPDCCL</b> <sup>37</sup>	21.4	37.9	21.4

<sup>32</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of South Bihar Power Distribution Company Limited (SBPDCL)," Case No. 45 and 50 of 2015, March 21, 2016, 132, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

<sup>33</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of North Bihar Power Distribution Company Limited (NBPDCCL)," Case No. 44 and 49 of 2015, March 21, 2016, 408, <http://berc.co.in/orders/tariff/distribution/nbpdcl/160-tariff-order-of-nbpdcl-for-fy-2016-17>.

<sup>34</sup> World Bank, "Access to electricity (% of population)."

<sup>35</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of South Bihar Power Distribution Company Limited (SBPDCL)," 408.

<sup>36</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of South Bihar Power Distribution Company Limited (SBPDCL)," Case No. 45 and 50 of 2015, March 21, 2016, 69, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

<sup>37</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of North Bihar Power Distribution Company Limited (NBPDCCL)," Case No. 44 and 49 of 2015, March 21, 2016, 72, <http://berc.co.in/orders/tariff/distribution/nbpdcl/160-tariff-order-of-nbpdcl-for-fy-2016-17>.



AT&C losses comprise two components: Technical losses, with loss of power due to flow from one point to another. 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).<sup>38</sup> And, second, 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.

Due to power deficits, 25 percent of the grid-connected households suffer up to 20 hours of power outages every day. To be financially viable, DISCOMs request the regulatory commission BERC to account for the high distribution losses during the tariff-setting exercise. It is important to note that the regulatory commission, while pressuring the DISCOMs to reduce losses by improving meter reading, does not accept the actual losses suffered by the DISCOMs while setting the tariff. Thus, only a portion of such losses is accounted for in the final tariff that is determined, meaning that DISCOMs incur consistent losses in revenue and increasing debt levels. Distribution inefficiencies in Bihar can be understood from the table below:

### IMPRESSION

A large share of the distribution inefficiencies in Bihar stem from non-billing of metered customers and withdrawal of power from unmetered customers. Improving meter readings, billing efficiency, and collection efficiencies are critical to reducing distribution losses.

**Billing and revenue collection by DISCOM**

Distribution Licensee	No. of consumers	Meter Reading (in percent)	Billing (in percent)	Revenue Collection (in percent)
NBPDCL <sup>39</sup>	3,361,480	29	76	87
Muzaffarpur	211,321	51	68	69
SBPDCL <sup>40</sup>	2,523,950	63	61	91
DF Gaya	120,672	48	37	96
DF Bhagalpur	162,540	55	49	80

<sup>38</sup> 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>.

<sup>39</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of North Bihar Power Distribution Company Limited (NBPDCL)," Case No. 44 and 49 of 2015, March 21, 2016, 404, <http://berc.co.in/orders/tariff/distribution/nbpdcl/160-tariff-order-of-nbpdcl-for-fy-2016-17>.

<sup>40</sup> Bihar Electricity Regulatory Commission, "Tariff Order 2016–17 of South Bihar Power Distribution Company Limited (SBPDCL)," Case No. 45 and 50 of 2015, March 21, 2016, 408, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

## Question 6: What Is the Cost of Power?<sup>41</sup>

*Tariff:* The average cost of supply in Bihar is greater than the average revenue received. The expenditure for buying power for DISCOMs is higher than the revenue received by them from selling power to consumers. Even after a government subsidy, the revenue generated does not meet the cost of supply.

During FY 2016–17, Bihar Electricity Regulatory Commission (BERC) approved the following tariff for SBPDCL and NBPDCCL:

Particulars	SBPDCL <sup>42</sup>	NBPDCCL <sup>43</sup>
Average power purchase cost	4.25	4.25
Average cost of supply	5.85	5.62
Average revenue realization excluding subsidy	4.60	4.03
Average revenue realization including subsidy	5.60	5.38

*Tariff-setting basics:* BERC sets the power tariffs for the state of Bihar. 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.

### IMPRESSION

Policy pathways need to be prescribed for bridging the gap between revenue from tariff and expenditure to buy power.

<sup>41</sup> Bihar Electricity Regulatory Commission, “Determination of Aggregate Revenue Requirement (ARR) and Tariff for 2016–17.”

<sup>42</sup> Bihar Electricity Regulatory Commission, “Tariff Order 2016–17 of South Bihar Power Distribution Company Limited (SBPDCL),” Case No. 45 and 50 of 2015, March 21, 2016, 8, <http://berc.co.in/orders/tariff/distribution/sbpdcl/157-tariff-order-of-sbpdcl-for-fy-2016-17>.

<sup>43</sup> Bihar Electricity Regulatory Commission, “Tariff Order 2016–17 of North Bihar Power Distribution Company Limited (NBPDCCL),” Case No. 44 and 49 of 2015, March 21, 2016, 9, <http://berc.co.in/orders/tariff/distribution/nbpdcl/160-tariff-order-of-nbpdcl-for-fy-2016-17>.

## Question 7: What Is the Energy Landscape?

Bihar's energy landscape is defined by large amounts of central government resources that are purposed for coal-fired power plants alongside policy incentives that tend toward renewable energy. Therefore, there is an effort to produce the least-expensive electricity from coal-based plants to alleviate energy poverty in the state while at the same time ensuring that the state's energy plans are in line with India's renewable energy plans. By adopting this path, access can improve, consumption per capita can increase, and the state can receive fund allocation from the central government's renewables-based program.

*New power plants:* Bihar's 2016–17 state budget saw a 44 percent increase in proposed budget with an emphasis on creation of new power-generation infrastructure. Some of the major coal-fired projects under construction include Barh power project (1980 MW), Banka power project (2640 MW), Muzaffarpur power project (390 MW), and New Nabi Nagar project (1980 MW). It is common for new power projects to face issues in acquiring land.

*Bihar New and Renewable Energy Development Agency (BREDA):*<sup>44</sup> BREDA was established to promote development of schemes on non-conventional energy sources in Bihar. It is the nodal agency to carry out the remote village electrification program. The Bihar government provides plan funds to BREDA for expenditure on various programs. BREDA liaises with the Ministry of New & Renewable Energy Sources (MNRE). BREDA has also been appointed as a State Designated Agency for Bureau of Energy Efficiency (BEE).

### IMPRESSION

Bihar has solar potential, with fallow agriculture land and policy support to set up solar farms on such lands.

*Bihar Policy for promotion of New and Renewable Energy Source 2011:*<sup>45</sup> This policy provides for exemption of duty on energy produced from renewable sources, rules for issue of loans by MNRE, lease of government land for renewable projects, use of agriculture land for non-agriculture purposes, concession for biomass-based projects rules for captive generation of less than 1 MW of power, and third-party sale of power generated for captive use under open access.

*BERC (Rooftop Solar Grid Interactive Systems Based on Net-Metering) Regulations 2015:*<sup>46</sup> Issued by Bihar's electricity regulatory authority, this regulation provides for DISCOMs to allow a net-metering arrangement for consumers who install grid-connected rooftop solar system in its area of supply on a non-discriminatory and first-come, first-served basis. Up to 10MW of installed capacity will be allowed to eligible consumers under net metering, on a yearly basis, in the area of supply of the distribution licensee, provided that the cumulative capacity to be allowed at a particular distribution transformer does not exceed 15 percent of the capacity of the distribution transformer.

*Solar water pumping program:*<sup>47</sup> This is a program formulated by MNRE and is being implemented by BREDA since FY 2013–14. A subsidy of 90 percent (30 percent from MNRE and 60 percent from Bihar government) of the cost of the pump is provided. The balance of the cost—10 percent—is borne by the beneficiary. Some 1560

<sup>44</sup> Bihar Renewable Energy Development Agency, "About BREDA," [http://breda.in/about\\_us.html](http://breda.in/about_us.html).

<sup>45</sup> Compendium of State Government Policies on Renewable Energy Sector in India, "Bihar Renewable Energy Development Agency Policy for Promotion of New and Renewable Energy Sources, 2011," <http://www.ireda.gov.in/writereaddata/CompendiumStatePolicyRE/Data/Bihar.pdf>.

<sup>46</sup> Bihar Electricity Regulatory Commission, "Bihar Electricity Regulatory Commission (Rooftop Solar Grid Interactive Systems Based on Net Metering) Regulations, 2015," <http://mnre.gov.in/file-manager/Compendium/Final/BIHAR%203.PDF>.

<sup>47</sup> Government of India and Government of Bihar, "24 X 7 Power for All," 48.

2HP solar water pumps were installed in the state during 2014–15; 3300 2HP/3HP solar water pumps for irrigation were installed in 2015–16.

*Solar off-grid systems:*<sup>48</sup> There is an ongoing MNRE scheme to provide domestic lighting system (DLS) / home lighting system (HLS- Model-II) to the beneficiaries in rural and urban areas having one solar module of 12 W, two LEDs each of 9 W, and one battery of 12V, 12Ah capacity. This scheme also provides a 90 percent subsidy (30 percent from MNRE and 60 percent from Bihar government). As of 2015, 8500 systems have been installed in Bihar.

*Solar for Municipal University Schools and Hospitals (MUSH) market:*<sup>49</sup> Off-grid rooftop solar at government buildings is implemented in the state by BREDA government buildings, hospitals, public health centers (PHCs), block offices in rural and semi-urban areas, to be provided with solar off-grid systems with battery support.

## Question 8: What Is the Role of Energy Efficiency?<sup>50</sup>

Energy efficiency programs and policies in Bihar are still in a nascent stage. 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.

*Time of Day (ToD) metering:* Bihar provides ToD tariff for certain categories of consumers. It provides peak and off-peak rates to consumers that allow consumers flexibility to manage their energy bills better.

*Demand Side Management Regulations, 2015:* These regulations mandate that DISCOMs in Bihar carry out assessment of potential for DSM in the state every year, conduct load and market research to devise DSM policies, and set DSM targets for approval by BERC. DSM measures adopted by the state include a ToD tariff, surcharges, and capacitor charges.

*Unnat Jyoti by Affordable LEDs for All (UJALA):* UJALA seeks to promote high-quality LED lighting in the domestic sector by overcoming the high first-cost barrier. UJALA will enable the sale of LED bulbs from designated places at a cost that is much less than the market price of Rs. 350–450 as replacements of incandescent lamps (ICLs). The program is supposed to reduce the installed load by 505 MW and lead to an annual energy-consumption reduction of the state by more than 531 million KWh. The objective is to sell the saved energy to better-paying consumers like industry and commercial users, and create an additional revenue stream to the DISCOMs. As of January 2017, 10 million LEDs had been distributed by the

### 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.

<sup>48</sup> Ibid., 49.

<sup>49</sup> Ibid.

<sup>50</sup> Ibid., 51–55.

state's two distribution companies resulting in energy savings of 35,58,000 kWh, with cost savings of Rs 1,42,32,000 per day.<sup>51</sup>

*Energy Conservation Building Code (ECBC):* ECBC provides minimum requirements for the energy-efficient design and construction of buildings and their systems without compromising on the comfort of the occupants. It sets minimum energy standards for commercial buildings with a connected load of 100kW or contract demand of 120kVA and above. Although there is evidence of ECBC in Bihar, very little information is available about its performance.

*Energy Audit for Government Buildings:* Audits are undertaken to reveal options available for reducing energy waste, the costs involved, and the benefits achievable from implementing energy-conservation measures. There is some evidence of energy audits of government buildings in Bihar.<sup>52</sup>

*PAT (Perform Achieve & Trade Scheme):* PAT is a market-based trading scheme that aims to improve energy efficiency in industries by trading in energy-efficiency certificates in energy-intensive sectors.

*Star Labeled Appliances:* BEE initiated the Standards & Labeling program for equipment and appliances in 2006 to allow consumers to make informed choices about energy savings. The program is intended to reduce the energy consumption of appliances without diminishing the services they provide to consumers. The most recent additions to the list of labeled products are variable-capacity air conditioners and LED lamps.

## Question 9: What Are the Latest Developments?

*Bihar's energy budget:*<sup>53</sup> In the 2016–17 budget, the Bihar government proposed to spend \$1.27 billion (Rs. 8,582 crores) on creating assets related to power projects. This includes construction of four new coal-based thermal power units in Katti thermal plant and Barauni thermal power project. The proposed increase in expenditure outlay for the energy sector is 44 percent.

*Innovation lab:* The presence of energy poverty, a large off-grid population, and low household energy consumption has led to many social and technology experiments in Bihar over the past few years.

- In June 2011, Patna-based Husk Power Systems (HPS) installed two off-grid biomass gasification plants of 32 kW capacity each in the village. These plants convert solid biomass into gas used to generate electricity. Each plant uses 300 kg of rice husk a day to power 40 percent of the households in Sahebganj.<sup>54</sup>
- Greenpeace's solar-powered micro-grid was commissioned in July 2014.<sup>55</sup> The 100 kW micro-grid provides electricity to a population of more than 2200 in Dharnai village of Jehanabad district in Bihar, including 400 households and 50 commercial establishments. The installed micro-grid has experienced

<sup>51</sup> "Over 1 crore LED bulbs distributed in Bihar under UJALA," *Economic Times*, January 18, 2017, <http://economictimes.indiatimes.com/industry/energy/power/over-1-crore-led-bulbs-distributed-in-bihar-under-ujala/articleshow/56834111.cms>.

<sup>52</sup> "Audits aim to save energy in govt buildings," *Times of India*, August 24, 2011, <http://timesofindia.indiatimes.com/city/patna/Audits-aim-to-save-energy-in-govt-buildings/articleshow/9715074.cms>.

<sup>53</sup> PRS Legislative Research, "Bihar Budget Analysis 2017," <http://www.prsindia.org/administrator/uploads/general/1457088027~~Bihar%20Budget%20Analysis%202016-17.pdf>.

<sup>54</sup> Center for Science and Environment, "Mini-grid, Electricity for All," 56, <http://www.cseindia.org/userfiles/mini-grids.pdf>.

<sup>55</sup> Guest Blogger, "Solar energy microgrid powers India village in Bihar," Greenpeace, July 17, 2014, <http://www.greenpeace.org/usa/solar-energy-microgrid-powers-india-village-bihar/>.



some setbacks, with varying claims about residents rejecting it in favor of grid-based electricity. Local politics has also complicated perceptions of the microgrid and its value to the community.

- In 2016, Tata Power Delhi Distribution Ltd (TTPDL) along with researchers at MIT used a Reference Electrification Model (REM) model to devise an electrification plan for Vaishali, a district of 3.5 million people in Bihar. TPDDL has been supported by partners such as Tata Trusts, Prayas Juvenile Aid Centre, and GE to set up a self-managed solar micro-grid.

*Bihar joined UDAY:* During the period of financial turnaround under UDAY, Bihar and its DISCOMs will bring about operational efficiency through compulsory feeder and distribution transformer metering, consumer indexing and GIS mapping of losses, upgrade/change 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.

### IMPRESSION

Action items under UDAY for demand-side management and energy efficiency like installation of smart meters for a category of consumers are specific avenues for private players and foreign investors to engage with Bihar's DISCOMs.

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

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Central and state governments are invested in overhauling the power sector in Bihar through UDAY</li> <li>• There are private players and universities that are engaged in implementing distributed energy resources in Bihar</li> </ul>	<ul style="list-style-type: none"> <li>• A large proportion of population is not grid-connected</li> <li>• AT&amp;C losses are the highest in the country</li> <li>• Collection efficiency is poor and a large unmetered consumer base</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Large off-grid rural population</li> <li>• Under UDAY, the DISCOMs are required to undertake specific steps that render themselves as business avenues</li> </ul>	<ul style="list-style-type: none"> <li>• Consumers are too poor to pay for power</li> <li>• Power theft has been ingrained into the system</li> <li>• DISCOMs are in cyclical debt</li> <li>• Politicization of electric power and use of populist measures like free power and low-cost power</li> </ul>

## Acknowledgments

This report is made possible by the support from the U.S. Department of State and general support to CSIS.

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