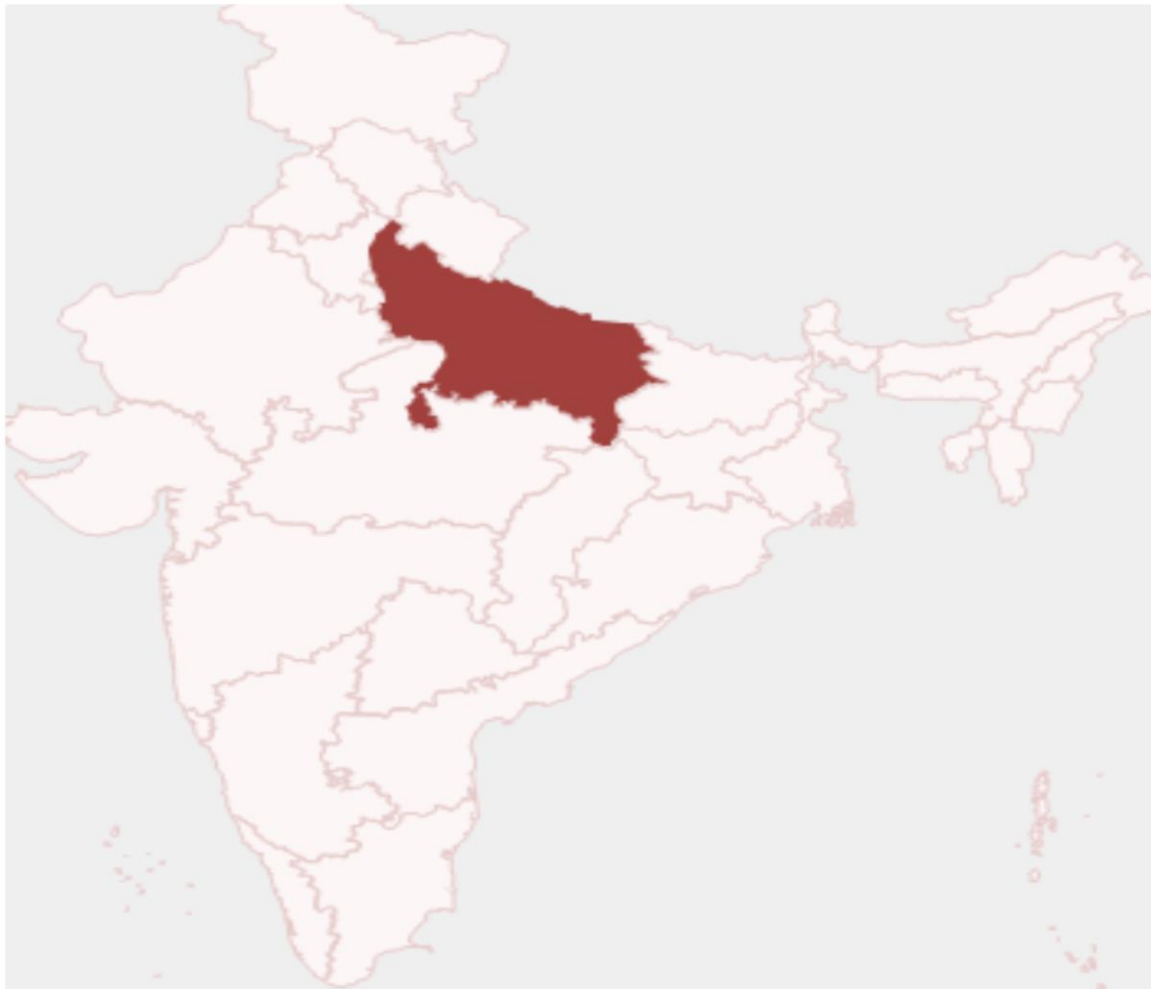


January 2017

Understand Uttar Pradesh's Energy Personality in 10 Questions

Sharmila Bellur and Sarah Ladislaw



Uttar Pradesh's energy sector is in disarray. Over half of its population does not have access to power and the electricity tariff structure is unable to meet the supply cost. Saddled with debt that has accumulated over the past seven decades, UP's distribution companies are now on the mend through the government-sponsored bailout program Ujwal Discom Assurance Yojana (UDAY). These efforts are at odds with the problems intrinsic to the state: electricity theft and politicization of the electricity. As India's most populous state, UP's energy future will have a significant impact on the country.

Question 1: What are the Key Drivers of the Power Sector?

*Population and spread:*¹ Uttar Pradesh (UP) is the most populous state, the third-largest economy, and the fifth-largest state (an area about half the size of California) in India. UP has a population of about 200 million (~2.7 percent of the world's population) and a population density of about 2,148 persons/miles² (United States is at about 86 persons).

*Major cities and towns:*² Close to a quarter of the state's population lives in urban areas and the rest in rural areas. Taj Mahal, one of the wonders of the world, is in the city of Agra in UP. The major metropolitan areas in the state are Kanpur, Lucknow, Ghaziabad, Agra, Varanasi, Meerut, and Allahabad.

*Major industries:*³ UP produces nearly 20 percent of food grains consumed in the country and nearly 70 percent of the sugar. It is the second-largest producer of vegetables and a major milk-producing state. The state also has cement, fertilizer, livestock, tourism, leather, and semi-conductor industries.

*Distribution reform:*⁴ In January 2016, UP joined Ujwal DISCOM [distribution company] Assurance Yojana (UDAY), the central government's bailout scheme to revive state electricity distribution companies. The UP government would take over Rs.39900 crore (~\$5.8 billion) of DISCOM debt, accounting for 75 percent of the total outstanding debt of Rs.53200 crore (~\$7.8 billion). Besides helping the DISCOMs to bring about financial turnaround, UDAY lays stress on improving operational efficiencies of the DISCOMs. With the financial turnaround through financial and operational efficiencies, the rating of the DISCOMs are likely to improve (they currently range between B–C, that is, between below average operational and financial performance capability and very low operational and financial performance capability), which will help DISCOMs raise cheaper funds for future capital investment requirement.

Impression

There is significant opportunity in electrifying and making efficiency improvements for the large rural and agriculture dependent consumer base.

*Politics of power:*⁵ The state of the power sector of UP is predominantly an outcome of its politics. Populist measures such as free power (for people below the poverty line), ad hoc concessional tariffs (for agricultural irrigation), and tendency to overlook power thefts during elections has left the power sector in poor financial health. This has in turn resulted in poor quality of supply characterized by lack of access, voltage fluctuations, and power outages.

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

*Power access:*⁶ Only 43 percent of the population of UP has access to electricity and uses electricity as the main source of lighting (32 percent rural, 80 percent urban). The global average for electricity access for lower-middle-income countries (India belongs to this category) is 78 percent.⁷ With respect to household adoption and consumption, ~55 percent of the households have no power, ~5 percent consume less than 30kW of power a

¹ Census 2011, "Uttar Pradesh Population Census data 2011," <http://www.census2011.co.in/census/state/uttar+pradesh.html>.

² Ibid.

³ Indian Brand Equity Foundation, "About Uttar Pradesh: Tourism, Agriculture, Industries, Economy & Geography," <http://www.ibef.org/states/uttar-pradesh.aspx>.

⁴ 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.

⁵ Brian Min and Miriam Golden, "Electoral cycles in electricity losses in India," *Energy Policy* 65 (February 2013): 619–25.

⁶ Sudeshna Ghosh Banerjee et al., *Power for All: Electricity Access Challenge in India* (Washington, DC: World Bank, 2015), 17–18, <http://documents.worldbank.org/curated/en/562191468041399641/pdf/922230PUB0978100Box385358B00PUBLIC0.pdf>.

⁷ World Bank, "Access to electricity (% of population)," <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>.

month, ~25 percent of the households consume between 30kW–100kW of power, and only ~15 percent consume above 100kW.

*Power deficit:*⁸ Uttar Pradesh faces a power deficit as the power generated and imported into the state is not sufficient to meet the demand of all consumers in the state. The deficit in terms of availability vis-à-vis requirement is 12.5 percent (peak deficit is 14.6 percent). This deficit is in addition to 57 percent of the population of UP that has no access to power.

Impression

One of the reasons for the power deficit in UP is the inability of the system to pay for itself. Fixing the subsidy, to make it sustainable, is important.

*Power reliability:*⁹ 30 percent of households with electricity have an average of a 15-hour 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, whether or not the households are connected to electricity at all because poor quality of power supply discourages consumers from seeking access.

*Financial viability:*¹⁰ UP is one of the largest receivers of cumulative subsidy from the central government in India. The power sector accounts for 43 percent of the state's debt and its debt exceeded 10 percent of the state's GDP in 2011 (national average was 1.5 percent of GDP). The tariffs are set at cost recovery but the state does not achieve profits even with subsidies. Mismanagement and misuse of government subsidies result in 75 percent of subsidies meant for households below poverty line to leak to households above the poverty line. Tariff increases have helped reduce the contribution of underpricing to losses.

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

Until 2000, the Uttar Pradesh State Electricity Board (UPSEB) was responsible for generation, transmission, and distribution of power within UP. The state's power sector was unbundled in 2000, and Uttar Pradesh Power Corporation Limited (UPPCL) was vested with the function of transmission and distribution. Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited (UPRVUNL) undertakes Thermal Generation and Uttar Pradesh Jal Vidyut Nigam Limited (UPJVNL) is vested with the function of hydro-generation within the state. Generation is undertaken by state-owned entities and private companies: National Thermal Power Corporation, and Neyveli Lignite Corporation, along with UPPCL, are some of major state-owned generators. Lanco, JP Power Ventures, Jaypee Group, Reliance Power, and Bajaj Hindustan are major private generators.

Impression

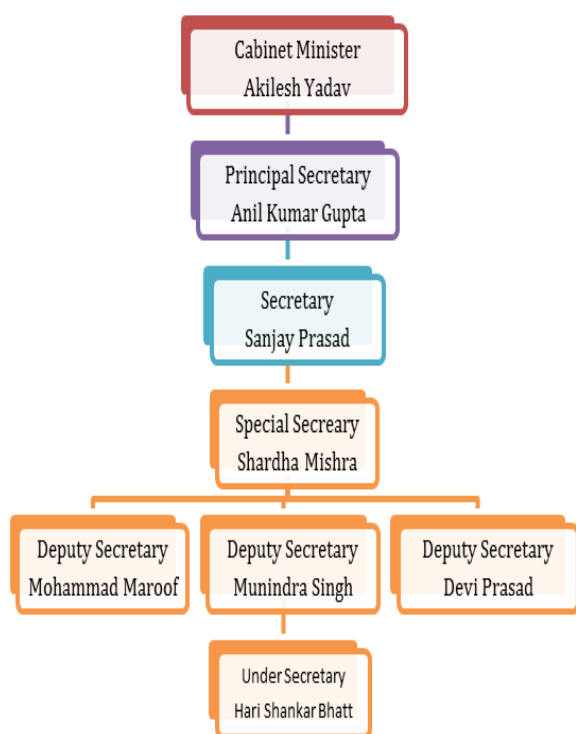
Engaging with various consumer categories, particularly consumers in lift irrigation and private tube wells, is one pathway for improving electricity efficiency within the state.

⁸ 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>.

⁹ Sudeshna Ghosh Banerjee et al., *Power for All: Electricity Access Challenge in India* (Washington, DC: World Bank, 2015), 28, doi: 10.1596/978-1-4648-0341-3.

¹⁰ Sheoli Pargal and Sudeshna Ghosh Banerjee, *More Power to India: The Challenge of Electricity Distribution* (Washington, DC: World Bank, 2014), 61, doi: 10.1596/978-1-4648-0233-1.

Key People



Source: Department of Energy, Government of Uttar Pradesh,
<http://energy.up.nic.in/org-stru.jpg>.

In 2000, the Kanpur Electricity Supply Authority (KESA) responsible for power distribution in the state was corporatized and its assets were transferred to Kanpur Electricity Supply Company (KESCO). In 2003, further unbundling created four new DISCOMs: Dakshinanchal Vidyut Vitaran Nigam Ltd, Madhyanchal Vidyut Vitaran Nigam Ltd, Pashchimanchal Vidyut Vitaran Nigam Ltd, and Poorvanchal Vidyut Vitaran Nigam Ltd.

The Uttar 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:*¹¹ 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: domestic, nondomestic, public lamps, institutions, private tube wells, small and medium power, public water works, state tube wells, temporary supply, departmental employees, nonindustrial bulk loads, large and heavy power, railway traction, and lift irrigation.

Question 4: What Kind of Power is Generated?

Power generation mix: Most of the power generation is from coal, even though the state has scanty coal reserves (~1.06 billion tons/0.35 percent of India's reserves). Some of the coal-based electricity comes from central allocation, that is, power from central generation stations located in UP or other states are allocated to the state by the Indian government.

Half of the coal-based generation comes from the public sector (state and central) while the other half is generated from the private sector. Gas contributes a small percentage to the energy mix of UP.

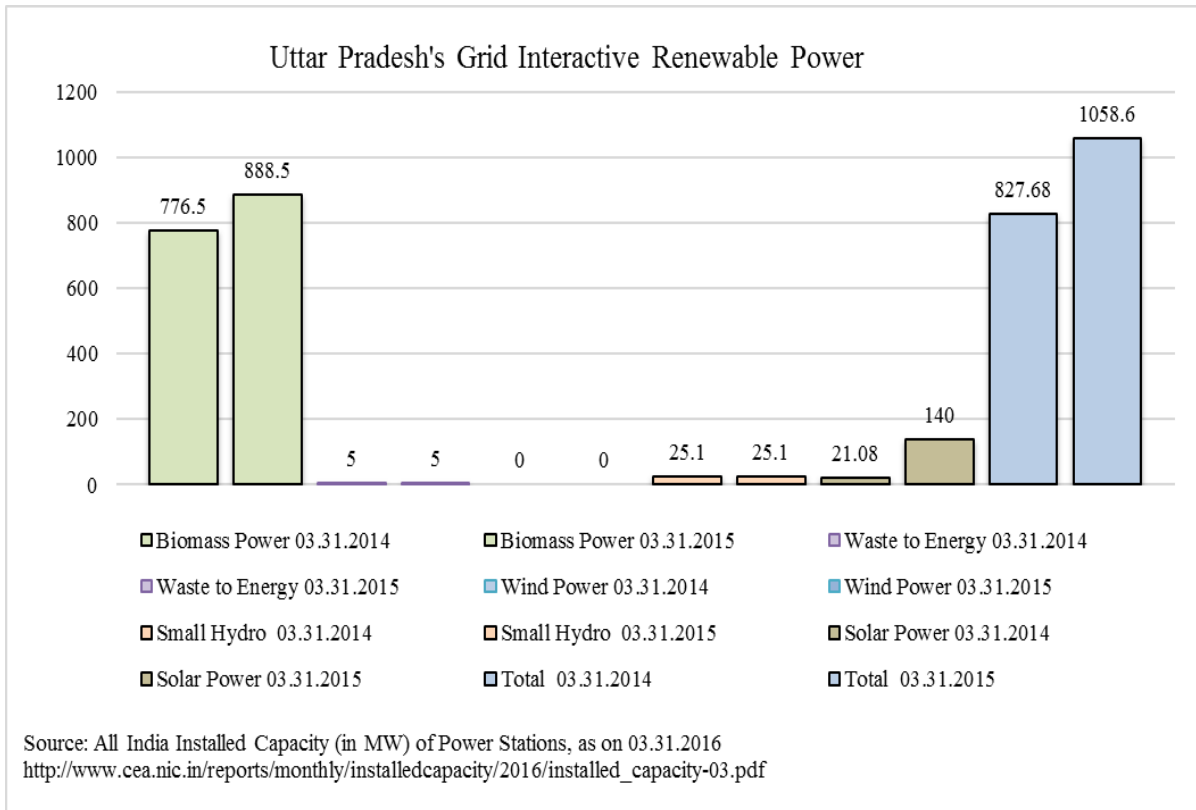
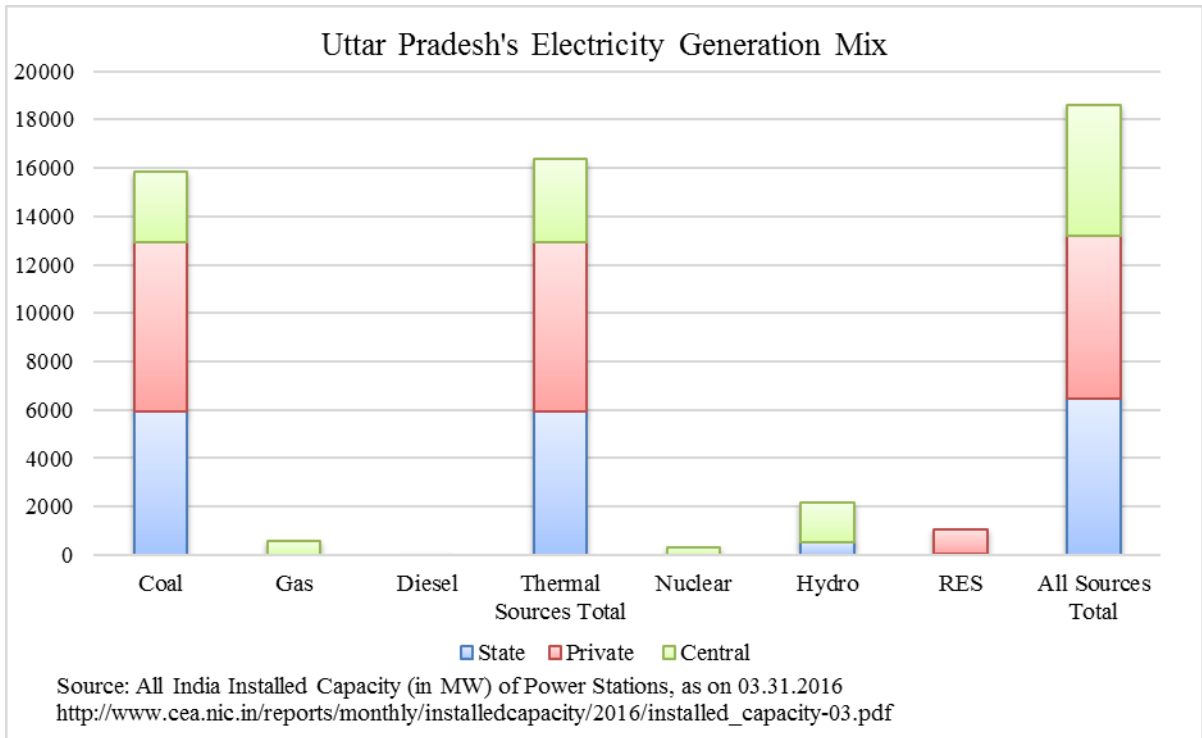
*Renewable power:*¹² Capacity addition in renewable energy has come predominantly from solar power, and a small extent from biomass power. Notably UP has an estimated solar power potential of 22.83 GW_p (which is more than the sum of UP's power deficit and electricity needs of its population without access to any power). Private companies are major players in renewable energy generation as well.

Impression

New power plants in UP operate predominantly from renewables. The state has also made renewable energy a policy priority. Setting up new solar-based generation is a pathway to get involved in the energy business in UP.

¹¹ Uttar Pradesh Electricity Regulatory Commission, "Determination of Aggregate Revenue Requirement (ARR) and Tariff for 2016–17," Petition No. 1065/2015, August 1, 2016, 119, http://www.uperc.org/App_File/DVVNLTariffOrderFY2016-17-August1,2016-pdf81201633501PM.pdf.

¹² Government of India, Ministry of New and Renewable Energy (Solar R&D Division), "State wise Estimated Solar Potential in the Country," 2, 2014, <http://mnre.gov.in/file-manager/UserFiles/Statewise-Solar-Potential-NISE.pdf>.



Question 5: How is the Transmission and Distribution Infrastructure?

*Transmission infrastructure:*¹³ UP's transmission infrastructure is managed by UP Power Transmission Corporation Limited. Distribution losses are at 25 percent (globally, lower-middle-income countries average at 15 percent¹⁴).

Distribution infrastructure: UP's distribution sector is extremely inefficient, with high aggregate technical and commercial (AT&C) losses of 34.2 percent and daily power cuts. 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 at 6 percent and the average for lower-middle-income countries is 15 percent).¹⁵ Commercial losses 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. UP uses an unscheduled load-shedding mechanism to deal with power deficits. Losses due to poor collection are steep (\$0.7 billion in 2011).

The DISCOMs in Uttar Pradesh are well-known for their lack of financial health. The AT&C losses are compounded by a cost recovery (expenditure from buying power that is recovered from tariff paid by consumers) of 66 percent, and collection efficiency (bills paid by consumers) of 87.8 percent, which has resulted in a total outstanding debt of Rs. 53,200 crore (~\$8 billion) as of September 2015.

Impression

The DISCOMs' reform initiative UDAY enlists several banks to help the operational and financial turnaround of DISCOMs. If investors and businesses are interested in the UP electricity sector, they can engage with these financial institutions as a way to make inroads into the electricity sector.

Distribution Losses by DISCOM¹⁶

Distribution Licensee	Actual FY 2013–14 (percent)	Provisional FY 2014–15 (percent)	Approved by the Commission for FY 2015–16 (percent)	Projected by Licensees for FY 2016–17 (percent)
DVVNL	28.7	29.5	29.0	26.0
MVVNL	24.9	22.9	21.0	19.0
PVVNL	23.0	19.7	19.5	19.0
PuVNNL	24.8	23.9	20.9	19.2
KesCO	30.9	26.0	23.5	22.0

¹³ Government of India, Government of Uttar Pradesh, and UP Power Corporation Limited, "Tripartite Memorandum of Understanding amongst Ministry of Power," January 30, 2016, 7, http://powermin.nic.in/pdf/MoU_Uttarpradesh.pdf.

¹⁴ World Bank, "Access to electricity (% of population)."

¹⁵ 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>.

¹⁶ Uttar Pradesh Electricity Regulatory Commission, "Determination of Aggregate Revenue Requirement (ARR) and Tariff for 2016–17."

Question 6: What is the Cost of Power?¹⁷

Tariff-setting basics: Uttar Pradesh Electricity Regulatory Commission sets the power tariffs for the state of UP. 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.

Tariff: During FY 2016–17, the average billing rate, ABR (consolidated for distribution licensees' DVVNL, MVVNL, PVVNL and PuVVNL) at existing tariff is Rs. 5.29 / kWh (8¢). ABR is the weighted average of tariff billed to different categories of consumers. It is the average cost recovered from consumers for every unit of power supplied to them. Average cost of supply is Rs. 6.35/kWh (9¢)—this is the tariff approved by UP's Electricity Regulatory Commission as the cost that the DISCOMs incur per unit of electricity purchased. Average cost of supply of Rs. 6.71/kWh

(10¢) projected by the licensees—this is the cost projected by DISCOMs for every unit of electricity purchased from generators. The fact that the average cost of supply is greater than ABR shows that expenditure for buying power for DISCOMs is higher than the revenue received by them from selling power to consumers.

Impression

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

Revenue-expenditure gap: For FY 2015–16, revenue from tariff will meet 87.3 percent of the supply cost.

Cost of Power in Uttar Pradesh by Distribution Company¹⁸ (in Rs and \$)

Details	PVVNL	DVVNL	MVVNL	PuVVNL	KesCo
Bulk Supply Tariff for DISCOMs (Rs./kWh)	4.26 (7¢)	4.26 (7¢)	4.26 (7¢)	4.26 (7¢)	4.26 (7¢)
Average Cost of Supply (Rs./kWh)	6.35 (9¢)	6.35 (9¢)	6.35 (9¢)	6.35 (9¢)	6.50 (10¢)

Question 7: What is the Energy Policy Landscape?

Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA): the primary agency for coordinating and implementing various energy programs in the state.

UP Energy Policy 2009: 19 the overarching energy policy for the state, laying down broad goals for capacity addition, improvement of existing plants, cogeneration, open access, and rural electrification.

¹⁷ Uttar Pradesh Electricity Regulatory Commission, "Determination of Aggregate Revenue Requirement (ARR) and Tariff for 2016–17."

¹⁸ Salient features of Tariff Order for FY2016–17, 1, http://www.uppcl.org/pdf/english_060816.pdf

¹⁹ Government of Uttar Pradesh, "Energy Policy 2009," http://udyogbandhu.com/DataFiles/CMS/file/energy_policy_2009.pdf.

*Solar:*²⁰

- Solar Energy Policy 2013, effective until March 2017, sets a 500 MW solar target.
- Grid-connected solar have PPAs. Off-grid solar is connected through programs like the Lohia Rural Housing Program for electrifying homes below the poverty line, solar street lighting, solar RO (reverse osmosis) water plant project, solar pump, mini-grid scheme, solar home light plant, and solar city program.
- Installation of total 20 MW grid connected solar power plants is targeted until March 2017. Net metering is used in UP.
- 25 percent of chair area of government office buildings to be used for installation of rooftop solar PV and certain percentage of annual energy consumption must be from solar-based energy.

*Bio Energy:*²¹

- National biogas fertilizer management program sets out policy for installation of prefabricated biogas plants for domestic fuel supply, lighting, and production of organic fertilizer.
- Biogas power generation program provides financial grants to incentivize installation of biogas plants of 250kv capacity. Incentives for bagasse-based cogeneration in sugar mills.
- UP biomass energy policy 2015 targets 1,000 MW of biomass energy by 2025. Biomass energy policy proposes 100 percent stamp duty on acquiring private land for biomass power plant.

Impression

Policy supporting solar rooftop for government buildings can be implemented using the Energy Service Company (ESCO) model.

*Mini-grid policy:*²² Mini-grid projects of maximum capacity 500 kW to be installed to electrify the households of villages/ habitations/ hamlets that are not electrified or lack power in peak demand hours. Up to 30 percent subsidy to be provided by states.

*Small Hydro Power program:*²³ UPNEDA is implementing small hydropower projects up to 3 MW capacity; above 3 MW, the U.P. Hydro Power Corporation is implementing the projects.

Question 8: What is the Role of Energy Efficiency?²⁴

Agriculture DSM: framework for market-based interventions in the agriculture pumping sector through projects to upgrade pump-set efficiency using public-private partnerships (PPP).

Municipal DSM: The Bureau of Energy Efficiency (BEE) has identified energy-saving potential in the municipal sector. The objective is to improve the overall energy efficiency of the urban local bodies (ULBs),

²⁰ Government of Uttar Pradesh, "Solar Energy Policy 2013," <http://upneda.org.in/solar-energy-policy-2013>.

²¹ Government of Uttar Pradesh, "Bio Energy Program," <http://upneda.org.in/bio-energy-program>.

²² Government of Uttar Pradesh, "Mini-Grid Policy 2016," <http://upneda.org.in/sites/default/files/all/section/Mini%20Grid%20Policy%202016.pdf>.

²³ Government of Uttar Pradesh, "Micro Hydel: Small Hydro Power Program," <http://upneda.org.in/micro-hydel>.

²⁴ Government of Uttar Pradesh, "[Energy Efficiency] Schemes," <http://upneda.org.in/scheme>.

which could lead to substantial savings in the electricity consumption, thereby resulting in cost reduction/savings for the ULBs.

Domestic Efficient Lighting Program (DELP) - LED distribution under DELP program: focuses on promoting efficient use of energy and mitigates climate change by increasing the use of energy-efficient LED home lighting. The aim is to enhance the awareness of consumers about the efficacy of using efficient appliances. Aggregating demand, reducing the high initial costs, and facilitating higher uptake of LED lights by residential users are key takeaways of this program.

Energy Conservation Building Code (ECBC): provides minimum requirements for 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.

Energy Audit for Government Buildings: undertaken to reveal options available for reducing energy waste, the costs involved, and the benefits achievable from implementing energy-conservation measures.

PAT (Perform Achieve & Trade Scheme): market-based trading scheme, which aims to improve energy efficiency in industries by trading in energy efficiency certificates in energy-intensive sectors. The second phase runs from 2015–2018 covering 621 facilities from 11 intensive sectors: aluminum, cement, chlor-alkali, DISCOMs, fertilizer, iron and steel, pulp and paper, railway, refinery, textiles, and thermal power plants.

Impression

The scope for energy-efficiency improvements in 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

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.

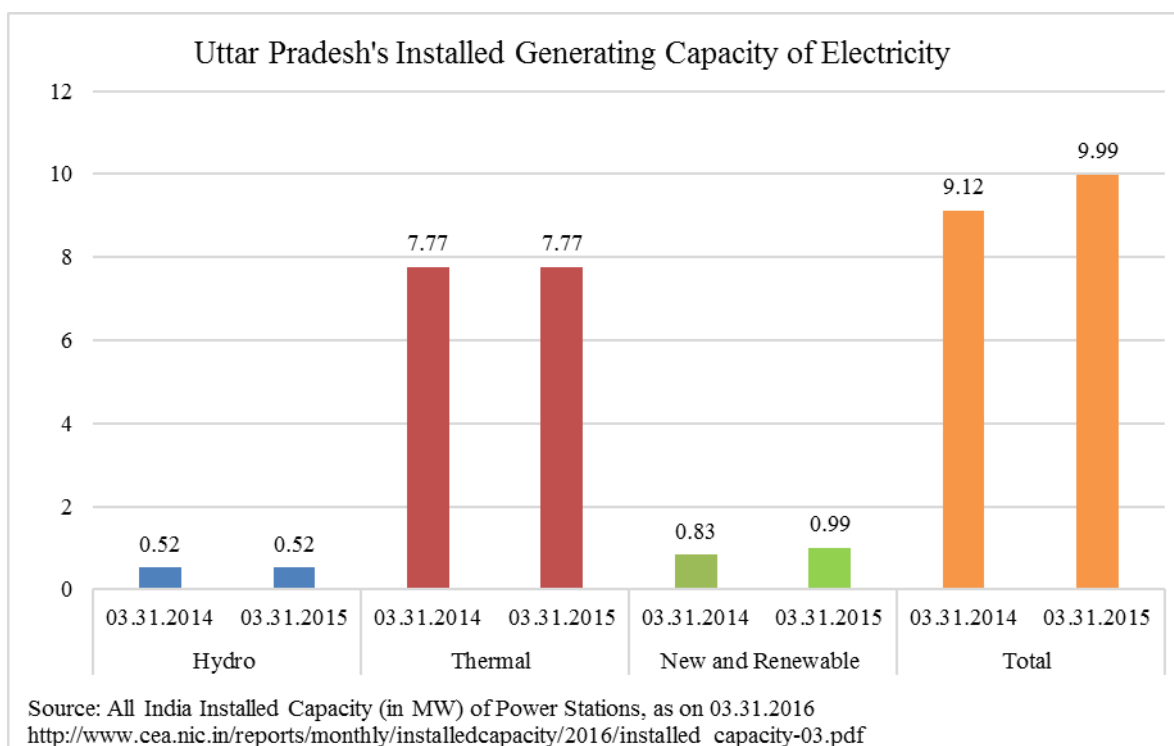
Question 9: What are the Latest Developments?

Power generation trend: UP added an additional 0.16 GW of power from March 2014 to March 2015. All of the additional capacity was in new and renewable sources of energy.

Capacity addition plan: Under the 12th five-year plan (April 2012–March 2017), the government of UP has planned for an additional capacity of 25,000 MW.

Rural electrification: As of November 2016,²⁵ over 17 million rural households in Uttar Pradesh were unelectrified. Government data on electrified villages was contested, as in some cases only 10 percent of the homes in a village were electrified. Government focus has now shifted to ensuring that every household is electrified.

²⁵ Government of Uttar Pradesh, "Status of Electrification [Village and Household] in Uttar Pradesh," <http://garv.gov.in/assets/uploads/reports/statesnaps/Uttar%20Pradesh.pdf>.



*UP joined UDAY:*²⁶ During the period of financial turnaround under UDAY, UP 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, smart and metering of high-end consumers, thereby reducing transmission losses and AT&C losses, besides eliminating the gap between cost of supply of power and realization. The reduction in AT&C losses and transmission losses to 15 percent and ~4 percent, respectively, is likely to generate an additional revenue of around Rs.17,700 crore (~\$2 billion) during the period of turnaround. UDAY provides for the balance debt of Rs.13,300 crore (~\$2billion) to be repriced or issued as state-guaranteed DISCOM bonds, at coupon rates around 3 percent less than the average existing interest rate. The annual saving in the interest cost to the DISCOMs would be close to Rs.1,600 crore (~\$230 million) on account of the state government taking over the debt as well as the reduction in interest rates on the balance debt.

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 to engage with the UP's DISCOMs.

Electric vehicles: Uttar Pradesh is one of only four other states in India that does not have preferential VAT rate for both electric and hybrid vehicles.

²⁶ Government of India, Ministry of Power, "Uttar Pradesh Joins 'Uday' Scheme, Would Derive an Overall Net Benefit of Rs.33000 Crore Through 'UDAY,'" January 2016, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=135939>.

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

Strengths	Weaknesses
<ul style="list-style-type: none"> Central and state governments are invested in overhauling the power sector in UP through UDAY There are private players 	<ul style="list-style-type: none"> A large proportion of consumers are unmetered Administrative incompetency due to poor collection Lack of political will to carry out sectoral reform
Opportunities	Threats
<ul style="list-style-type: none"> There is a large consumer base that has no access to power Under UDAY, the DISCOMs are required to undertake specific steps that render themselves as business avenues 	<ul style="list-style-type: none"> Power theft has been ingrained into the system DISCOMs are in cyclical debt Politicization of power has resulted in political incentives to leave the energy sector in a state of disarray

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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