11 CHAPTER

Powering "One India"

Since 2014, sweeping changes have characterized the power sector, including: record addition to generation capacity and the comprehensive initiative—Ujwal DISCOM Assurance Yojana (UDAY)—to improve the health and performance of the distribution companies. These changes provide the basis for discussing issues of longer-term interest for the states and their power regulators. These include reducing the complexity of tariff schedules that may prevent consumers from fully responding to price signals, the impact of quality-adjusted tariffs on the competitiveness of Indian industry, and the impediments to creating one market for power. Finally, using insights from the optimal income taxation literature, we provide illustrative estimates of the structure of consumer tariffs. The results suggest the possibility of achieving reasonably greater progressivity in tariff structures, with lower tariffs for the poor, while also ensuring cost recovery.

Introduction

11.1 Against the background of the many positive changes that are sweeping the power sector, this chapter attempts to make a few analytical observations that are relevant for the states, their regulators, and other stakeholders.

11.2 Since the present government came to power, the following striking developments have taken place in the power sector:-

- There has been the highest ever increase in generation capacity (in 2014-15 the addition to plant capacity in utilities was 26.5 GW, much higher than the average annual addition of around 19 GW over the previous five years). These measures have helped in bringing down the peak electricity deficit in the country to the lowest ever level of 2.4 percent.
- On 29th December, 2015, no congestion was observed in the electricity grid and a single price (₹2.3/kWh)[1] was discovered on the power exchange IEX[2]. This is the first such instance after India achieved complete grid integration on 31st December 2013.
- The Indian Railways (IR) is attempting to shift to open access (OA) for power purchase. This is not only cost efficient, but also harbingers the possibility of making India one market in power. Box 11.1 provides further details.
- Central and State governments have come together to address problems related to

[1] http://www.business-standard.com/article/economy-policy/one-nation-one-grid-now-one-price 116010100010_1.html

[2] This was repeated subsequently on 14.01.2016 and 30.01.2016 to 01.02.2016.

the health of distribution companies, and the debt overhang problem via the Ujwal DISCOM Assurance Yojana (UDAY). Box 11.2 provides details of the various programs initiated by the government to bring electricity distribution back on track.

- Renewable energy targets have been revised from 32 GW to 175 GW by 2022 moving the country towards a sustainable development model. In the latest round of auctions under the National Solar Mission, tariffs reached an all-time low of ₹4.34/kWh. Grid parity for solar generation is on its way to becoming a reality.

11.3 Notwithstanding these major successes, the complexity of the power sector is such that

Box 11.1: The Indian Railways and Open Access[1]

The Indian Railways (IR), one of the largest transportation networks in the world, consumes 17.5 billion units of energy (1.7 per cent of the country's total electricity consumption) for which it pays about ₹12,300 crore to distribution companies annually. This amounts to more than 25 per cent of total revenue budget of IR which is the second largest component of its revenue expenditure.

IR has embarked on a cost rationalisation strategy to migrate from existing arrangements with 14 state utilities/ NTPC and procure electricity through open access. These new arrangements are expected to result in an estimated cumulative saving of ₹ 742 crore in 2015-16 and ₹1600 crore in 2016-17.

To facilitate this arrangement, IR was given the status of deemed licensee by the Ministry of Power in May, 2014.

As such, the cross subsidy charges levied by states may not be applicable to it, though charges for using states' transmission and distribution networks will continue to be paid.

[1] ***Source:*** **Ministry of Railways. State governments have challenged the decision in the Appellate Tribunal for Electricity.**

Box 11.2: Salient features of policy action on distribution front

A. Ujwal DISCOM Assurance Yojana (UDAY)

1. States shall take over 75 per cent of discom debt outstanding as of September 2015.
2. Reduction of Aggregate Technical & Commercial (AT&C) losses to 15 per cent by 2018-19.
3. Reduction in difference between average cost of supply and average revenue realized (ARR) by 2018-19.
4. Increased supply of domestic coal to substitute for imported coal.
5. States shall take over future losses of discoms in a phased manner.
6. Banks/FIs not to advance short term debt to discoms for financing losses.

B. Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY)

1. Electrification of all villages.
2. Metering of unmetered connections for reducing losses.
3. Separation of feeders to ensure sufficient electricity to agriculture and continuous supply to other categories.
4. Improvement of sub-transmission and distribution network to improve the quality and reliability of supply.

C. Integrated Power Development Scheme (IPDS)

1. Strengthening of sub-transmission and distribution network in urban areas.
2. Metering of distribution transformers /feeders / consumers in urban areas.
3. IT enablement of distribution sector and strengthening of distribution network.

D. Domestic Efficient Lighting Program (DELP)

1. 77 crore LED bulbs to replace household and street light incandescent bulbs.

E. National Tariff Policy, 2016

1. Cross subsidy surcharge formula revised.
2. Regulator will devise power supply trajectory to ensure 24X7 power supply for all consumers latest by 2021-22 or earlier.

daunting challenges remain. In particular:

- Complexity of tariff schedules prevents economic actors from responding sufficiently to price signals.
- Average tariffs in some cases are set below the average cost of supplying electricity.
- High industrial tariffs and variable quality of electricity adversely affects 'Make in India'.
- Price and non-price barriers come in the way of single-nationwide electricity prices through open access.
- Determination of progressive tariff schedules for domestic consumers.

11.4 While discussing the Indian power sector it must be borne in mind that reforms in this sector are more challenging than in many others due to the clear demarcation in the roles and responsibilities of the states and centre under the constitution. Moreover, in a country with a per capita GDP that is one-seventh of the OECD average and an estimated 5 crore households without access to electricity, electricity policy, hitherto and in the future, must carefully balance economic efficiency with social benefits.

Transparency and Simplicity in Retail Electricity Tariffs

11.5 Figure 1 presents excerpts[3] from the tariff schedule of a state which is not atypical. As is evident, there are separate tariffs for poultry farms, pisciculture, wetland farms (above and below a certain size), mushroom and rabbit farms, etc. The complexity may prevent consumers from fully responding to tariffs due to the high cost of processing the price information, a behavioural effect referred to as *salience*. The basis of making such fine and numerous distinctions across end users is not immediately apparent. After all, other energy products are characterised by a single price (or at most a few prices) across-end users.

11.6 Simplification of tariffs with, perhaps no more than 2-3 tariff categories, will improve transparency and may well yield consumption and collection efficiency, along with governance benefits.[4]

Tariffs And Cost

11.7 Discoms have a key role in the power sector, acting as an interface between retail consumers and rest of the value chain. These companies act as intermediaries between generators and retail consumers, purchasing electricity from wholesale markets and marketing it to retail consumers. As with any other market intermediary, they recover returns on their equity investments (ROI) by charging a mark-up over their cost of supply. Given that these discoms are central to connecting both sides of the electricity market, their debt overhang has traditionally been a bottleneck for the sector. In what follows we briefly discuss the losses of discoms and their causes.

11.8 States with the highest losses are those where tariffs fail to cover costs on average. We compare the per unit average tariff [5] (AT) and average cost of supply[6] (ACS) for 2013-14 in Figure 2. In states such as Rajasthan, Tamil Nadu, Jharkhand, Madhya Pradesh and Uttar Pradesh (the top ranking states in loss distribution) AT is lower than the ACS. We adjust the ACS for Aggregate Technical and Commercial (AT&C) losses in these states in order to exclude these costs. Yet, AT continues to stay below this adjusted level of ACS in most states.

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3 First three pages of the tariff schedule. The complete tariff schedule is longer, containing details of other charges which different categories have to pay.

4 Ito, Koichiro, 2014, "Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing." *American Economic Review*.

5 Data on AT from Niti Aayog, erstwhile Planning Commission Reports.

6 Data on ACS is from the Performance Report of State Power Utilities 2013-14, Power Finance Corporation (PFC).

Figure 1: Representative Tariff Schedule					
Consumer Category	**Energy Charge (₹ /Unit)**	**Consumer Category**	**Energy Charge (₹ /Unit)**	**Consumer Category**	**Energy Charge (₹ /Unit)**
LT-I:DOMESTIC (Telescopic)		LT-V:AGRICULTURE **		SEASONAL INDUSTRIES (off season Tariff)	
LT I(A):Upto 50 Units/Month	1.45	LT-V(A):AGRICULTURE WITH DSM MEASURES		11 kV	7.25
LT I(B):>50 and upto 100 Units/ Month		Corporate Farmers & IT Assesses	2.50	33 kV	6.59
First 50 Units	1.45	Wet Land Farmers (Holdings >2.5 acre)	0.50	132 kV & Above	6.33
51-100 Units	2.60	Dry Land Farmers (Connections > 3 nos.)	0.50	TIME OF DAY TARIFFS (6 PM to 10 PM)	
LT I(C):>100 and upto 200 Units/ Month		Wet Land Farmers (Holdings ≤ 2.5 acre)	0.00	11 kV	7.07
First 50	2.60	Dry Land Farmers (Connections ≤ 3 nos.)	0.00	33 kV	6.62
51-100	2.60	LT-V(B):AGRICULTURE WITHOUT DSM MEASURES		132 kV & Above	6.20
101-150	3.60	Corporate Farmers & IT Assesses	3.50	HT-I(B):FERRO ALLOY UNITS	
151-200	3.60	Wet Land Farmers (Holdings >2.5 acre)	1.00	11 kV	5.68
LT I(D):Above 20 0 Units/Month		Dry Land Farmers (Connections > 3 nos.)	1.00	33 kV	5.23
First 50	2.60	Wet Land Farmers (Holdings ≤ 2.5 acre)	0.50	132 kV & Above	4.81
51-100	3.25	Dry Land Farmers (Connections ≤ 3 nos.)	0.50	HT-II:OTHERS	
101-150	4.88	LT-V(C):OTHERS		11 kV	7.25
151-200	5.63	Salt farming units upto 15HP	3.70	33 kV	6.59
201-250	6.70	Rural Horticulture Nurseries upto 15HP	3.70	132 kV & Above	6.33
251-300	7.22	LT-VI:STREET LIGHTING AND PWS		TIME OF DAY TARIFFS (6 PM to 10 PM)	
301-400	7.75	LT-VI(A):STREET LIGHTING		11 kV	8.30
401-500	8.27	Panchayats	5.64	33 kV	7.64
Above 500	8.80	Municipalities	6.16	132 kV & Above	7.38
LT-II:NON DOMESTIC/ COMMERCIAL		Municipal Corporations	6.69	HT-III:AIRPORTS,BUS STATIONS AND RAILWAY STATIONS	
LT II(A):Upto 50 Units/Month	5.40	LT-VI(B):PWS SCHEMES		11 kV	6.91
LT II(B):Above 50 Units/Month		Panchayats	4.59	33 kV	6.31
First 50	6.63	Municipalities	5.64	132 kV & Above	6.01
51-100	7.38	Municipal Corporations	6.16	TIME OF DAY TARIFFS (6 PM to 10 PM)	
101-300	8.54	LT-VI(C):NTR Sujala Padhakam	4.00	11 kV	7.96
301-500	9.06	LT-VII:GENERAL		33 kV	7.36
Above 500	9.59	LT-VII(A):GENERAL PURPOSE	6.86	132 kV & Above	7.06
LT II(C):ADVERTISEMENT HOARDINGS	11.58	LT-VII(B):RELIGIOUS PLACES (CL ≤ 2 KW)	4.70	HT-IV: Govt., LIFT IRRIGATION, AGRICULTURE AND CPWS	
LT-III:INDUSTRY		LT-VIII: TEMPORARY SUPPLY	9.90	Govt. Lift Irrigation & Agriculture	5.64
Industry (General)	6.38	HT-I:INDUSTRY		Composite Water Supply Schemes	4.61
Seasonal Industries (off season)	7.09	HT-I(A): INDUSTRY GENERAL		HT-V:RAILWAY TRACTION	6.68
Pisciculture/Prawn culture	4.63	11 kV	6.02	HT-VI:TOWNSHIPS AND RESIDENTIAL COLONIES	5.96
Sugarcane crushing	4.63	33 kV	5.57	HT-VII:GREEN POWER	11.32
Poultry farms	5.63	132 kV & Above	5.15	HT-VIII:TEMPORARY	
Mushroom & Rabbit Farms	5.63	INDUSTRIAL COLONIES		RURAL ELECTRIC CO-OPERATIVES	
Floriculture in Green House	5.63	11 kV	5.96	Kuppam	0.24
LT-IV:COTTAGE INDUSTRIES & OTHERS		33 kV	5.96	Anakapally	1.38
a) Cottage Industries upto 10 HP	3.75	132 kV & Above	5.96	Chipurupally	0.22
b) Agro Based Activity upto 10 HP	3.75				

11.9 Tariffs reflecting costs are a necessary condition for discoms to sustain themselves over the long-run. Several states are attempting to close this gap under the UDAY Scheme.

Policies in the Power Sector: Impact on 'Make in India'

11.10 The 'Make in India' campaign is crucial to the structural transformation of the industrial sector, and the Indian economy in general. In this section, we study the impact electricity supply and its quality may have on industrial output.

1.11 High tariffs and erratic supply for industry have led to a slow but steady decline in the growth of industrial electricity purchases from utilities and a gradual transition towards captive generation.

11.12 Figure 3 shows a cross-country comparison of industrial tariffs[7] plotted against the per capita GDP taking into account the quality of power supply in different countries. The colours represent the quality of

[7] International Energy Agency, 2015 and data provided by the World Bank (2015).

Figure 2: Average tariff and average cost of supply (₹/kWh)

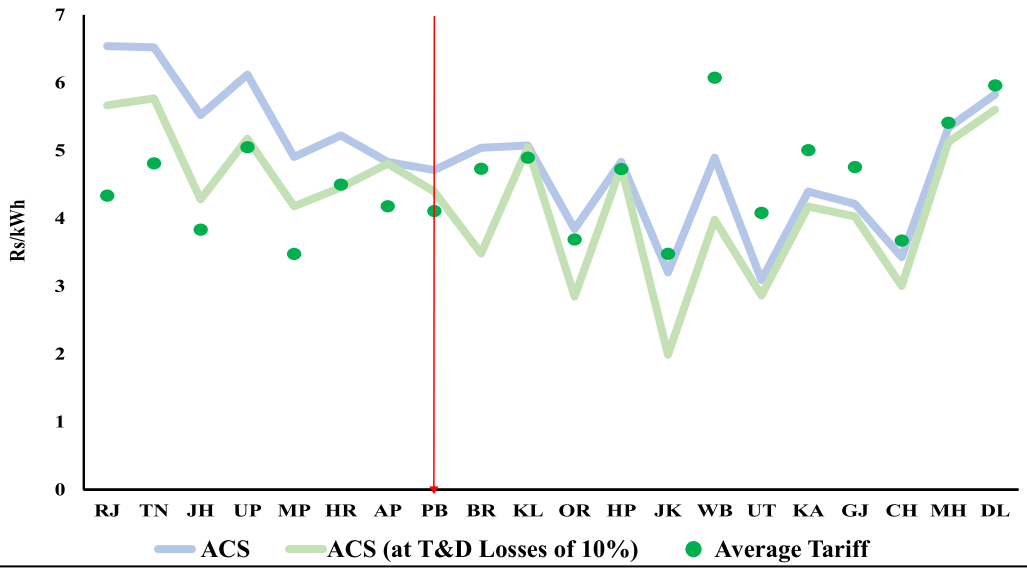
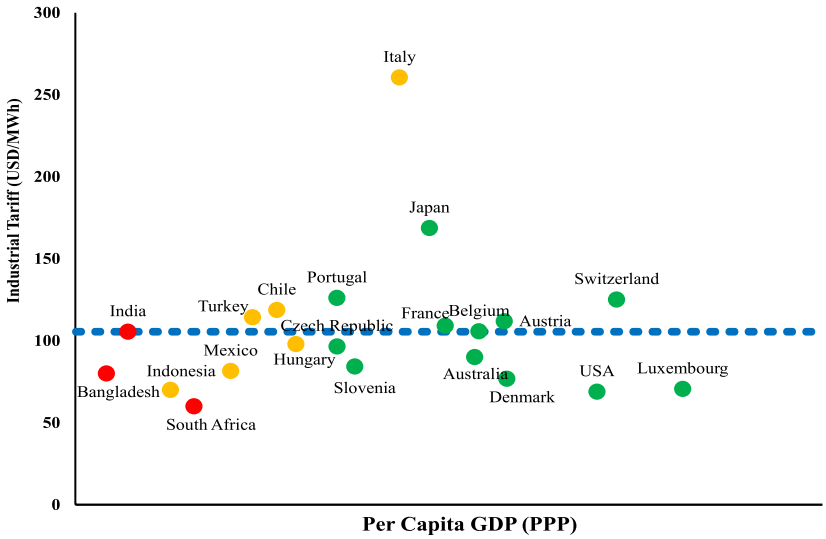


Figure 3: Industrial tariffs (USD/MWh) vs Per Capita GDP (PPP)



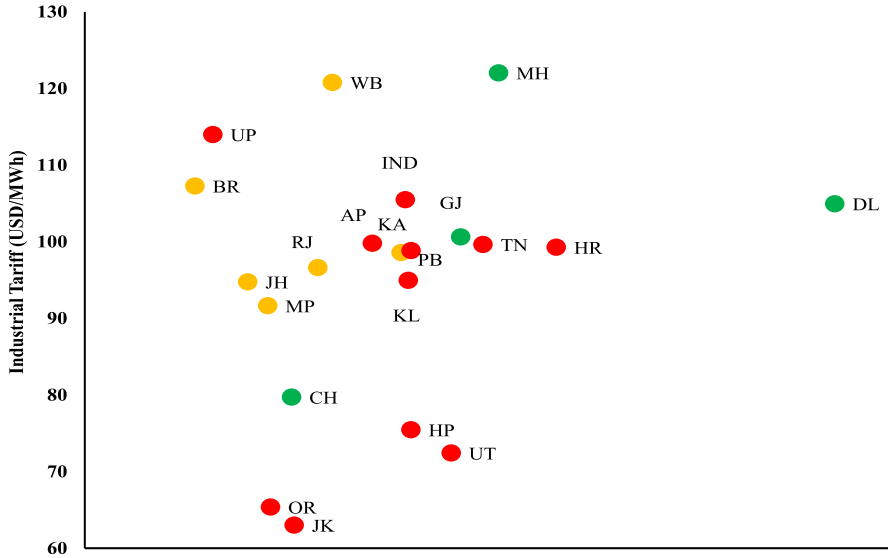
electricity supply[8] : green (score >6), orange (4< score <6) and red (score <4). It indicates that electricity tariffs are unusually high for Indian industry, especially when quality is taken into account.

11.13 Figure 4 shows that there is wide variation in industrial tariffs within India. In addition, the colours green (response<10 per cent), orange (10 per cent< response<20 per cent) and red (response >20 per cent) highlight the share of firms identifying electricity as a major constraint in their state[9]. It can be seen that for the country as a whole the share is greater than 20 percent of firms. For some states, such as Uttarakhand, Uttar Pradesh, Tamil Nadu, Andhra Pradesh, and

[9] World Bank's Enterprise Survey of Industries (2013-14). Industrial tariffs are from the Planning Commission/ Niti Aayog.

[8] In terms of quality of electricity supplied, India ranks 98 out of 140 countries in World Economic Forum-Global Competitiveness Report 2015-16. India has an overall ranking of 55 in this report. The scores are on a scale of 1 to 7.

Figure 4: Industrial tariffs (USD/MWh) vs Per Capita GSDP



Kerala, the share is higher than 40 percent.

11.14 To protect against uneven power supply, about 47 percent of firms report using a diesel generator.[10] The total capacity of the diesel generators[11] (DG) in the country may be as high as 72 GW and growing at the rate of 5 GW per year. Central Electricity Agency[12] (CEA) data suggests that DG capacity for industrial loads greater than 1 MW is 14 GW. A substantial portion of the rest (58 GW) may be contributed by micro and small industries, with load capacities of less than 1 MW.

11.15 Figure 5 shows electricity generation from captive power plants and electricity procured from the utilities. The compound annual growth rate (CAGR) of captive power generation between 2006-07 and 2014-15 is 9.3 percent, compared to 4.6 percent for electricity procured from utilities. These trends could be exacerbated in the coming years, as the decline in oil prices and the cost of renewable energy alternatives may prompt a further shift to captive power.

'Make in India' by 'Making One India': The Open Access Issue

Status of Open Access in India

11.16 The Open Access (OA) policy introduced under Electricity Act 2003, allows consumers with electricity load above 1 MW to procure electricity directly from electricity markets. At its core, OA provides an aggregation of the country-wide supply and demand on the same platform. Therefore, this constitutes a first step towards discovering a single market price for power around the country.

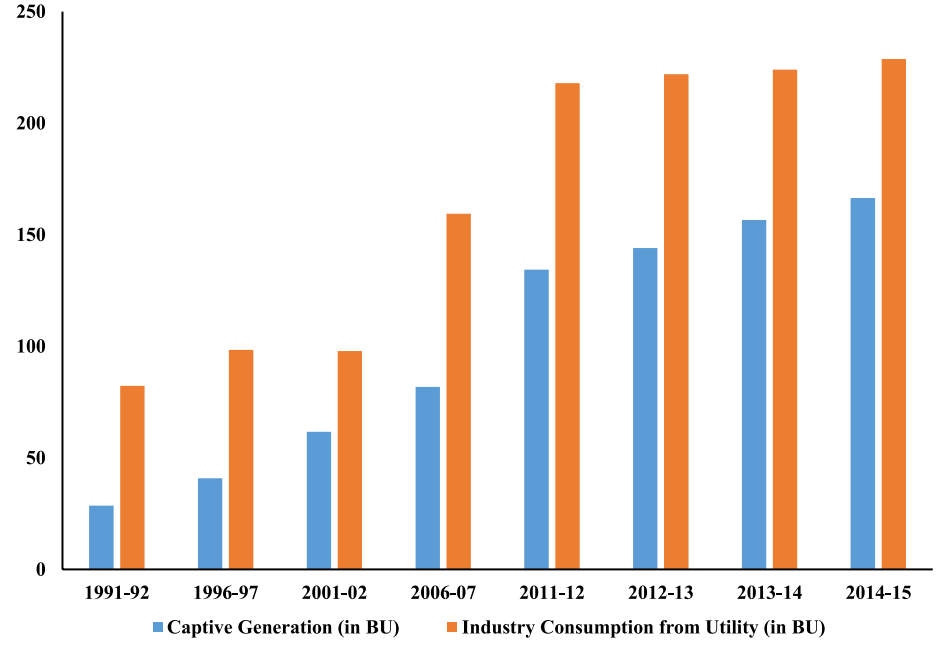
11.17 In 2008, power exchanges were set up to operationalize OA and create a national electricity market where price discovery occurs through competitive bidding. The initial response to OA was strongly positive, evident in the growth trajectory of power exchanges shown in Figure 6. Prices recorded on these exchanges provide a daily signal of the demand, supply and congestion in the transmission network across the country.

[10] World Bank's Enterprise Survey of Industries (2013-14).

[11] http://www.cercind.gov.in/2014/advisor_commette/19.pdf.

[12] http://www.indiaenvironmentportal.org.in/files/file/growth_2015.pdf.

Figure 5: Electricity generation in CPPs vs electricity procured from utilities



11.18 Some states, however, have imposed significant barriers to OA. Figure 7 shows the cross-subsidy surcharge and additional surcharge for purchasing electricity from the power exchanges (PX) in 2015-16. This problem was meant to be addressed by the National Tariff Policy (2006), which established a methodology for determining the cross-subsidy surcharge to be levied on OA consumers, with the goal of reducing it over time. Nonetheless, cross-subsidy surcharges over the years have gone up.

11.19 Significant non-price barriers exist in states that do not cross-subsidise to a great extent but where discoms derive the bulk of their revenues from industry.

Figure 6: Total volume traded in power exchange (Billion Units)

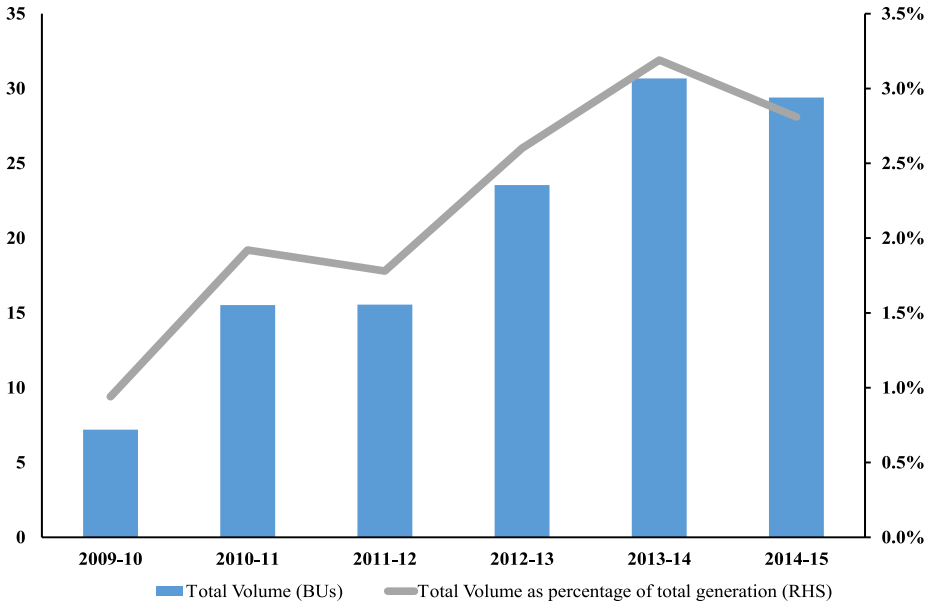


Figure 7: Cross subsidy surcharge for purchasing electricity from PX, 2015 -16

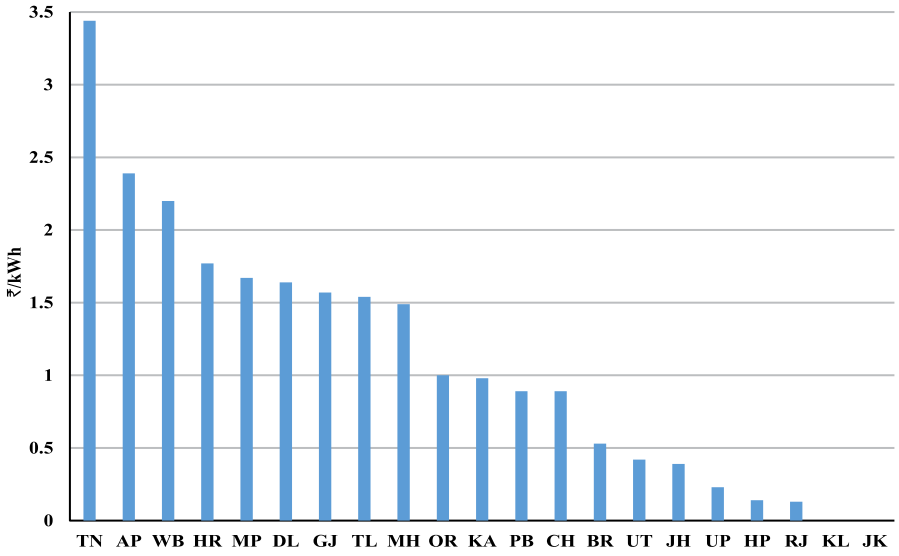
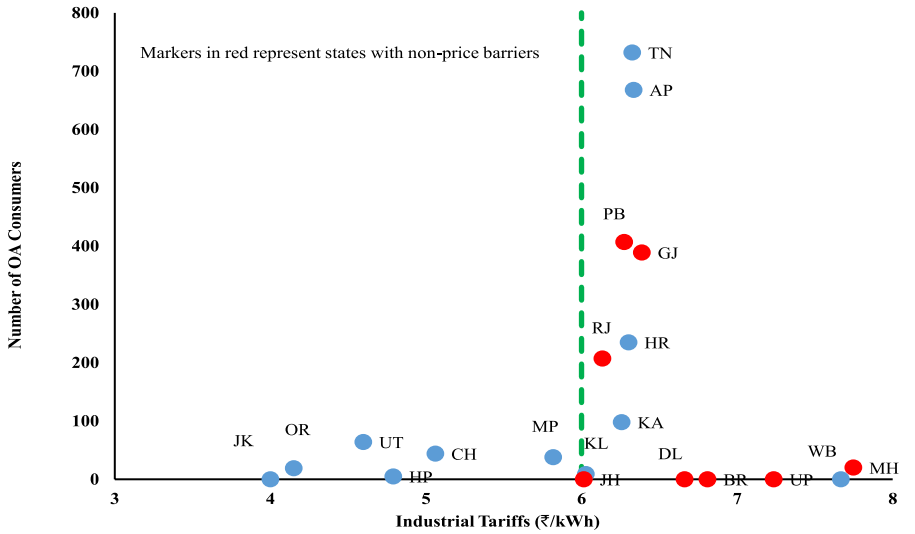


Figure 8: Number of Open Access consumers and industrial tariffs (₹/kWh)



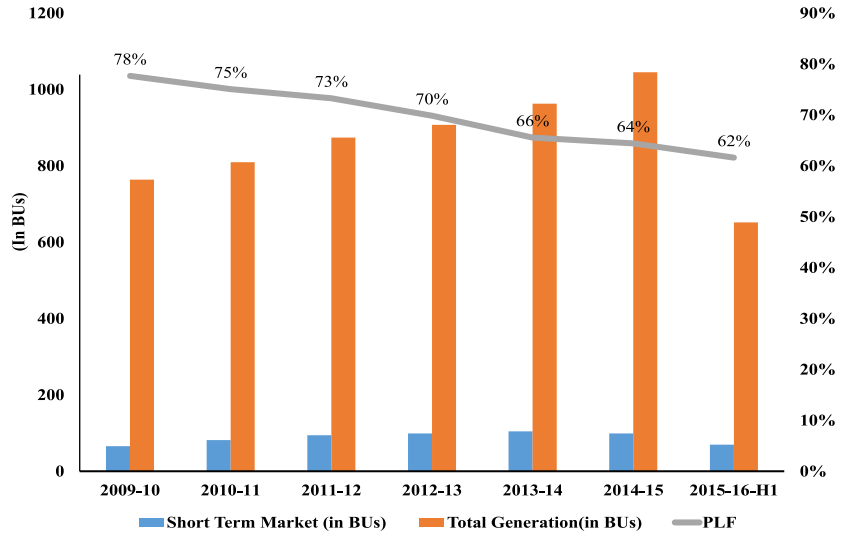
11.20 Figure 8 shows the number of consumers availing OA in different states against the average industrial tariff in a state. We observe that the trigger point for availing open access is tariff exceeding ₹6/kWh (US$ 98/MWh). The number of consumers beyond this threshold in states viz. Maharashtra, Bihar, Uttar Pradesh, Delhi and Maharashtra (in red) is low because of non-price barriers.

11.21 Currently, power plant load factors are at their lowest ebb (about 60 percent), as generation capacity has increased while the financial ability of discoms to purchase electricity has diminished (Figure 9). The time is thus ripe to allow industry, which has a high demand for power, to absorb the excess generation capacity through OA, providing a stimulus to industrial production under 'Make in India'.

Exploiting Progressivity to Lower Tariffs for the Poor

11.22 There is, at present, no specific policy guidelines on the intra-category cross subsidisation or subsidy provisioning. Figure 10 show the average billing rates

Figure 9: Total generation, short term market size and PLFs



(ABR) (light green) for domestic category for a representative Indian state (one for which we have collected detailed data). The tariff schedule is progressive as the consumption increases, although, ABR for all the consumption categories lies below the average cost of supply (ACS) implying that costs are not be fully recovered.

11.23 Countries such as Bangladesh, Sri Lanka, South Korea, Vietnam and Brazil (Figure 11) appear to better exploit the progressivity of electricity tariffs in the domestic category (reflected in higher ratio of tariffs charged to the rich relative to poor). In contrast, the state that we have studied appears to discriminate much less between rich and poor, leaving scope for greater exploitation of progressivity.

11.24 The power regulator, while deciding on the tariff schedules and cross-subsidisation rate for different categories, has to undertake a broad welfare analysis. There is a rich literature in public finance which tries balancing exactly the same constraints: greater revenue collection with greater welfare allocations. This literature, starting with James Mirrlees and more recently, Gruber and Saez (*The elasticity of taxable income: evidence and implications*," Journal of Public Economics, 2002), offers a methodology to arrive at an optimal tax and transfer policy based on consumers' behaviour. Given the parallels between the two problems, a similar approach can be adopted in electricity tariffs.

11.25 The question can be posed as follows: *Given the differential response of consumers to prices, and given that governments may wish to provide greater relief to the poorest sections, what should be the best structure of tariffs while also ensuring that power supply costs are recovered?* The differential responses are reflected in the price elasticities of demand (about which we make assumptions based on estimates from the literature[13]). Governments' preferences are captured by social welfare weights for different categories (about which we make assumptions). The results of these optimality exercise[14] undertaken for the particular Indian

[13] Filippini, M & S. Pachauri, 2004, "Elasticities of Electricity Demand in Urban Indian Households", Energy Policy. http://tinyurl.com/jmhrqhl

[14] We have assumed that this optimization exercise should be accompanied by a simplification of the tariff schedule, reflected in the fact that there are only three rates in the final optimal structure. Time of Day Tariffs proposed in new National Tariff Policy provide a new degree of freedom in tariff design to the regulators.

state are shown in Figure 10 (dark green bars) and Figure 11. The results suggest that in fact tariffs for the poorest can be reduced while covering costs and without unduly burdening richer consumers.

11.26 It is also clear from Figure 11 that progressivity in tariff rates suggested by the model, remains less than that of Brazil. This is an illustrative exercise but it shows that state regulators can make greater use of economic theory and its application to design more effective and politically palatable policies.

11.27 A major advantage of this procedure is that cross-subsidisation occurs within the residential consumers itself– i.e. rich and consumers with high consumption intensity within the residential sectors subsidise prices for consumers with lower consumption. Given their relatively inelastic price elasticity, rich consumers will continue to maintain their consumption even after price increase. The net effect is that the residential revenue collection becomes cost neutral for the discom and generates more revenues as compared to the current situation. Back of the envelope calculations show that the extra revenue of approximately ₹14400 crore (annually) for the state considered can be used by the distribution companies to reduce losses or rationalize cross-subsidies.

Figure 10: Actual vs suggested ABRs for the representative state (₹/kWh)

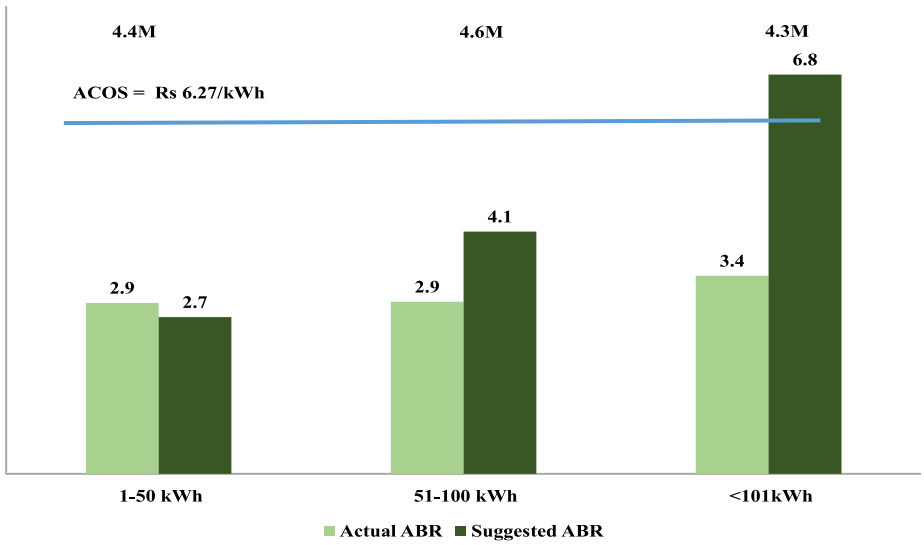


Figure 11: Progressivity of domestic category tariffs (Initial Tariff =100)

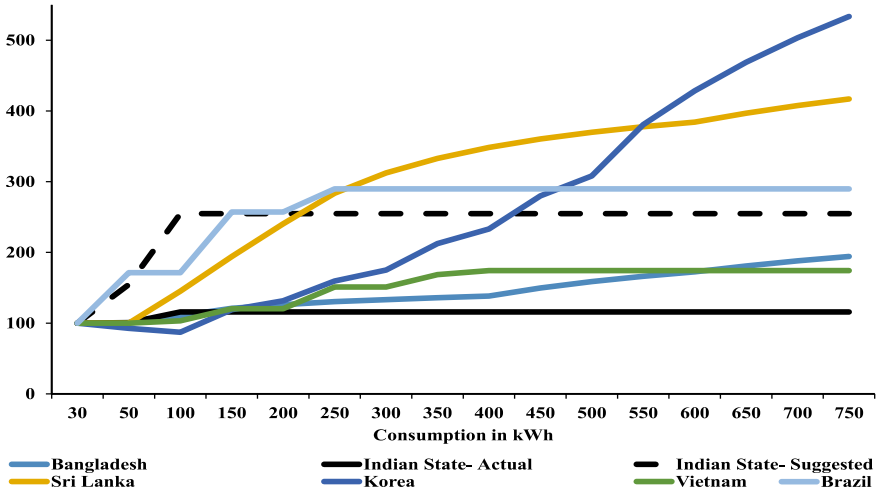


Table 1: Lowest tariff rates and ratio of highest to lowest tariff rates (USD cents/kWh)

	Ratio (H:L)	ABR (for 30 units in US Cent/kWh)
Bangladesh	1.9	4.5
Indian State (Actual)	1.2	4.8
Indian State (Suggested)	2.5	4.4
Sri Lanka	4.2	4.2
Korea	5.3	7.1
Vietnam	1.7	7.0
Brazil	2.9	6.4

Conclusion

11.28 Impressive strides have been made in the power sector over the last two years including: The addition of record generation capacity; moves to create 'one market' in power; long overdue reforms of discoms; and energizing the development of the renewables sector.

11.29 The new paradigm of surplus power sets the stage for continuing these reforms so that India can become 'one market' in power; the burden on industry can be relieved, allowing it to become internationally competitive as envisaged in 'Make in India'; tariffs can be made simple and transparent, avoiding proliferating end-use charges; and by taking advantage of the possibility of greater progressivity in rate-setting, charges for the poor could be reduced while generating more revenues.

11.30 In all of this, state governments and state regulators will have a key role to play, with helpful facilitation from the centre. The power sector is a perfect crucible for making effective the cooperative-competitive federalism experiment that is now India.