

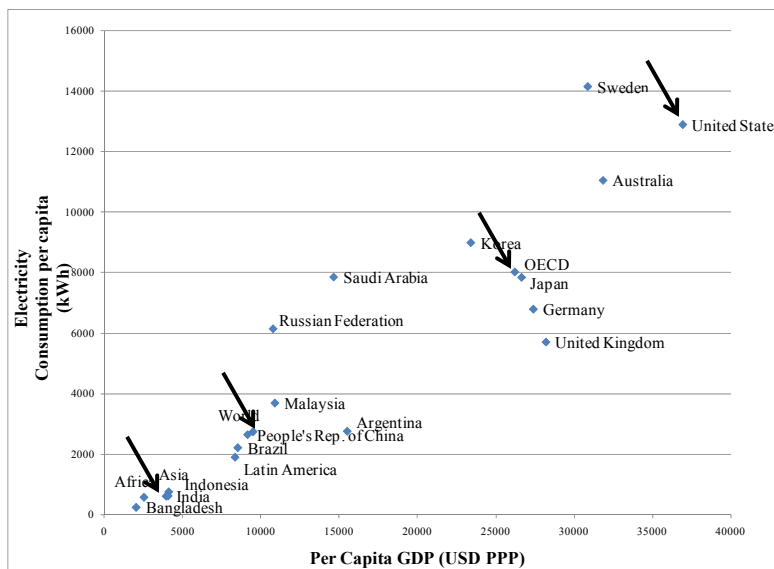
Department of Industrial and Management Engineering  
Indian Institute of Technology Kanpur

Training Programme on  
“Power Procurement Strategy and Power Exchanges”  
20-22 April 2015

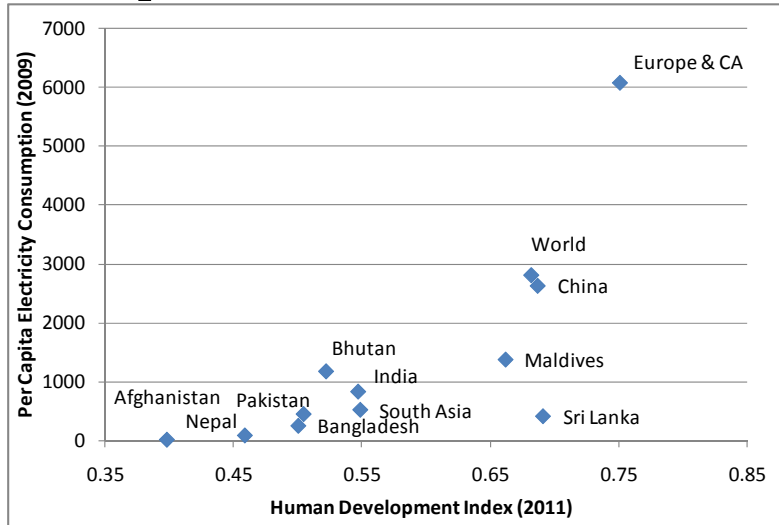
## Power Sector Reform & Regulation

Anoop Singh  
Associate Professor  
Dept of Industrial and Management Engg.  
IIT Kanpur

## Electricity Consumption and Economic Growth



## Electricity Consumption and Human Development Index

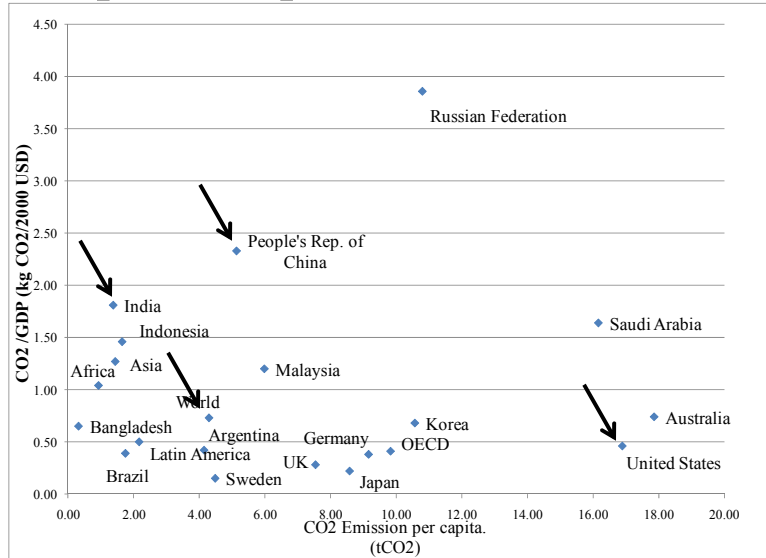


## Projections for Electricity Demand

Year	Billion kWh			
	8%	9%	8%	9%
2006-07	700	700	140	140
2011-12	1029	1077	206	215
2016-17	1511	1657	303	331
2021-22	2221	2550	445	510
2026-27	3263	3923	655	785
2031-32	4793	6036	962	1207

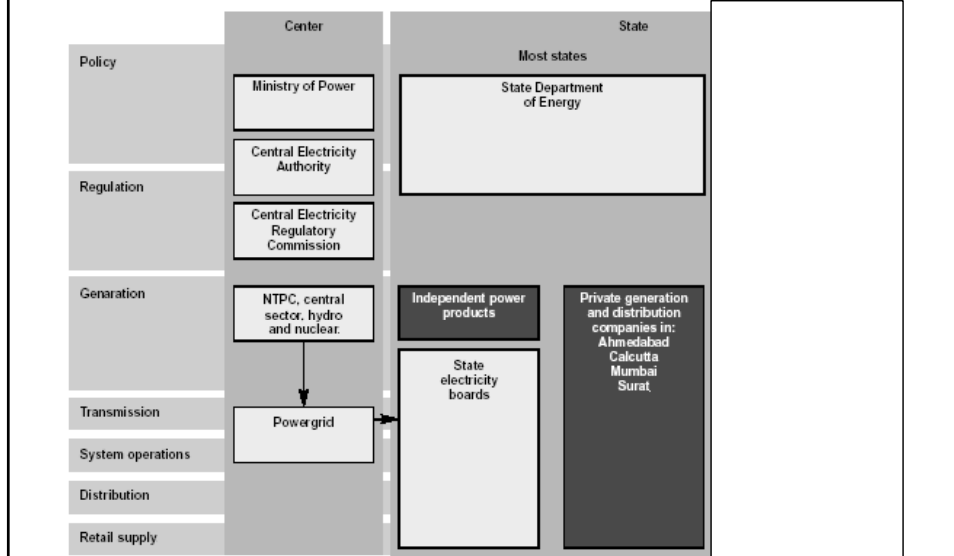
Policy and Regulatory Regime to attract investment

## CO2 Emissions – Per Capita and per GDP

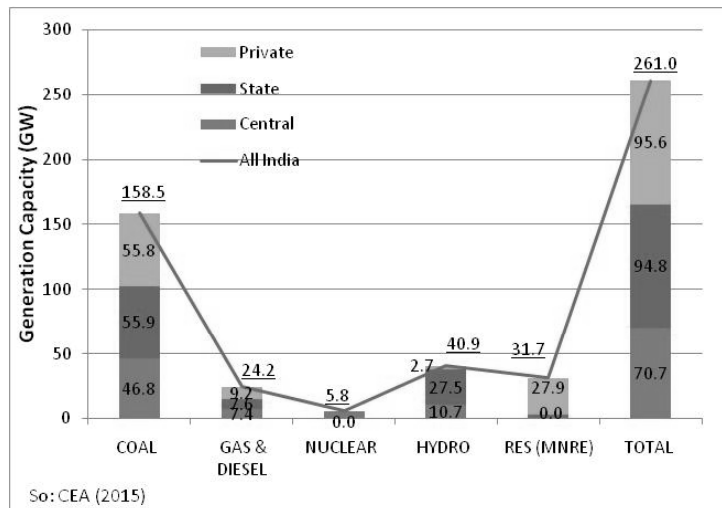


## Indian Power Sector

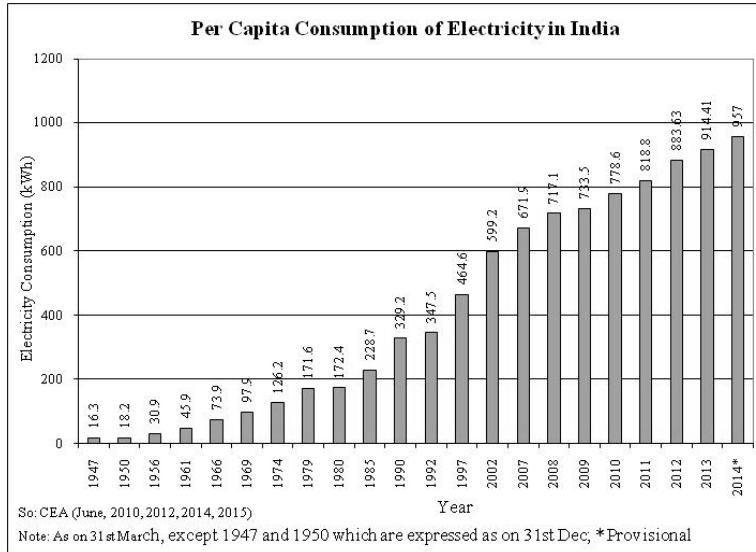
## Indian Power Sector - Institutional Framework (So: WB 2000)



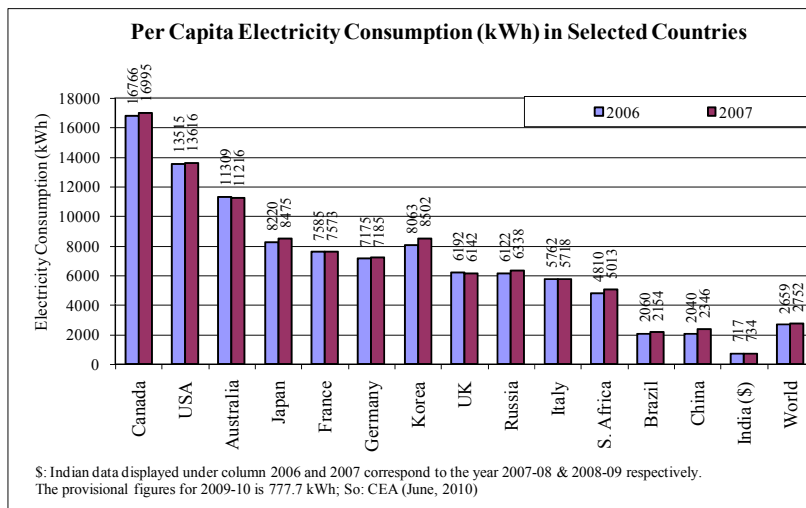
## All India Generation Capacity (As on Feb. 2015)



# Growth in Per Capita Consumption



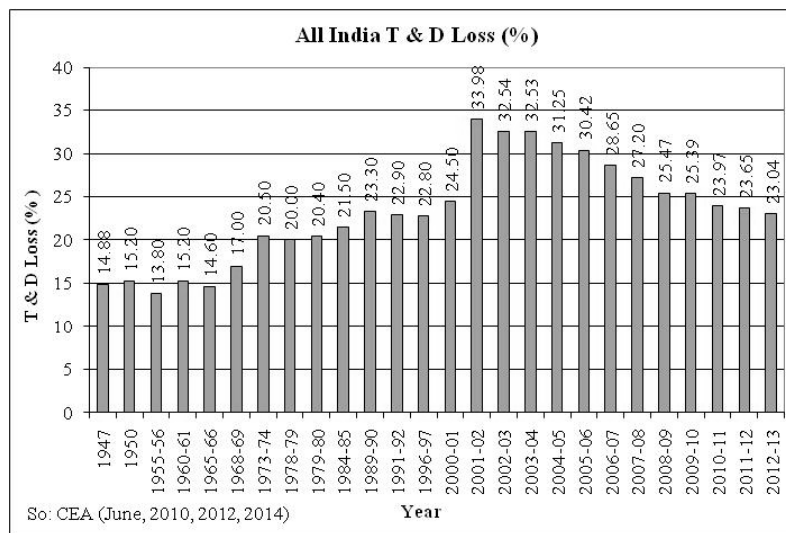
# Per Capita Consumption in selected countries



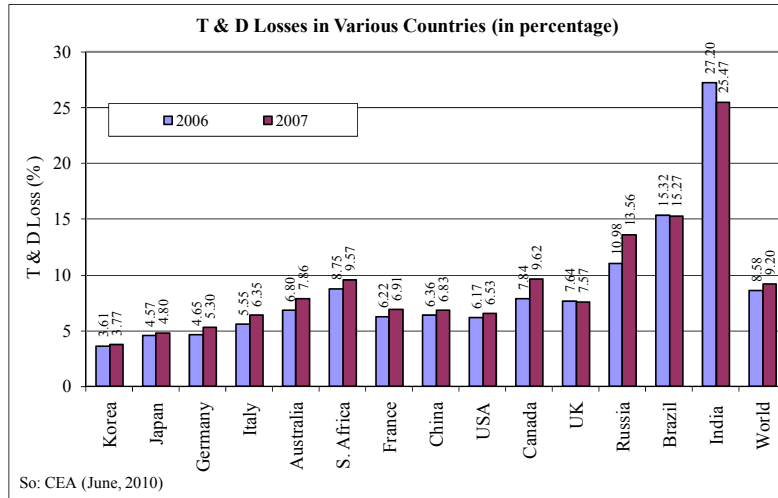
## T&D and AT&C losses (in %)

Year	T&D losses (All India)	AT&C Losses *
2004-05	31.25	34.33
2005-06	30.42	33.02
2006-07	28.65	30.62
2007-08	27.20	29.45
2008-09	25.47	27.37
2009-10	25.39	26.58
2010-11	23.97	26.15

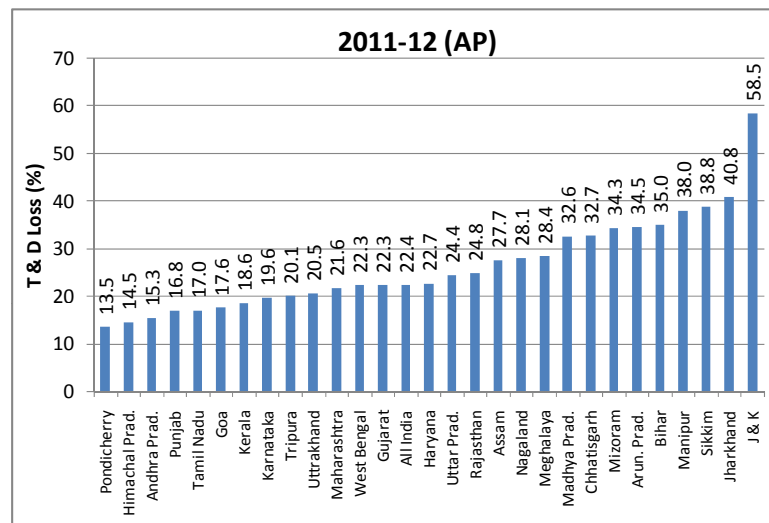
## All India T & D Loss (%)



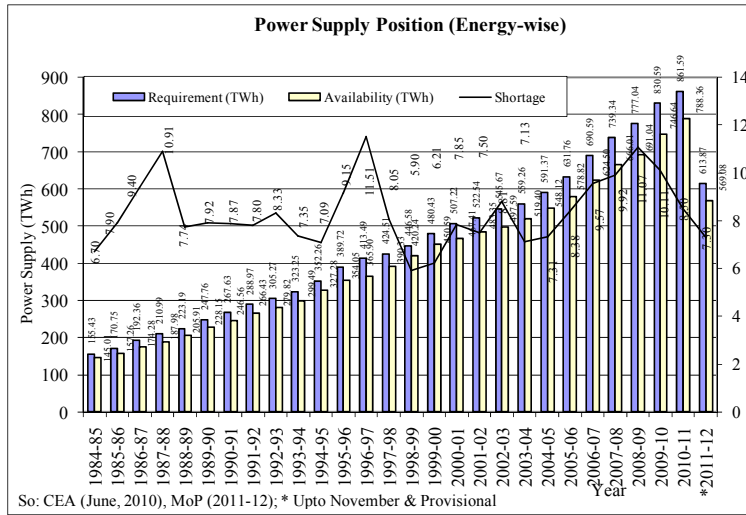
## T & D Loss Across Countries



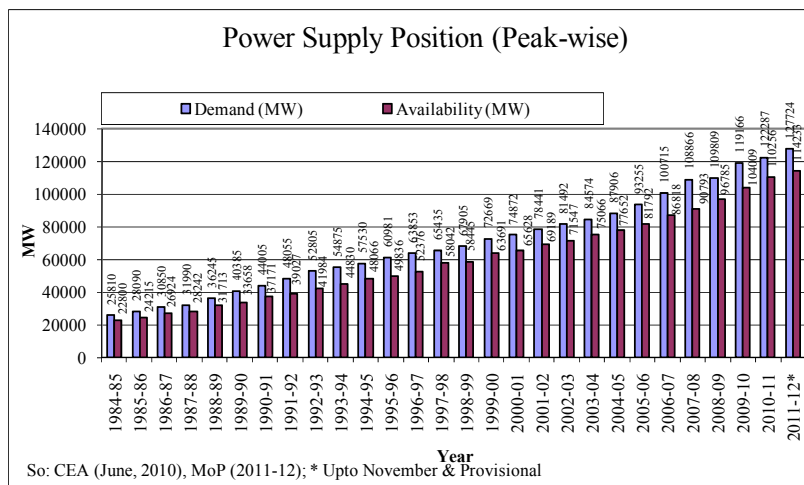
## T & D Loss Across States



# Energy Shortage



# Peak Shortage





## Power supply position in September 2012\*

Region	Energy (MU)	Deficit	Peak Demand	Deficit
	Requirement	%	(MW)	%
Northern	25,345	-8.0	42,071	-11.6
Western	21,046	-1.5	36,025	-0.7
Southern	22,828	-18.1	36,590	-19.1
Eastern	9,432	-3.7	15,166	-6.3
North Eastern	1,027	-6.6	1,998	-9.7

## Projections for Electricity Demand

Year	Billion kWh		GW	
	8%	9%	8%	9%
2006-07	700	700	140	140
2011-12	1029	1077	206	215
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2031-32	4793	6036	962	1207

Policy and Regulatory Regime to attract investment

## All India Annual per Capita consumption of Electricity

Year	Per Capita Consumption ( kWh)#
2005-06	631.4
2006-07	671.9
2007-08	717.1
2008-09	733.5
2009-10	778.6
2010-11	818.8
2011-12	879.22*

- All India Village Electrification (as on 31.05.2013): 5,60,899
- Pumpsets Energised (as on 31.05.2013): 1,88,95,341

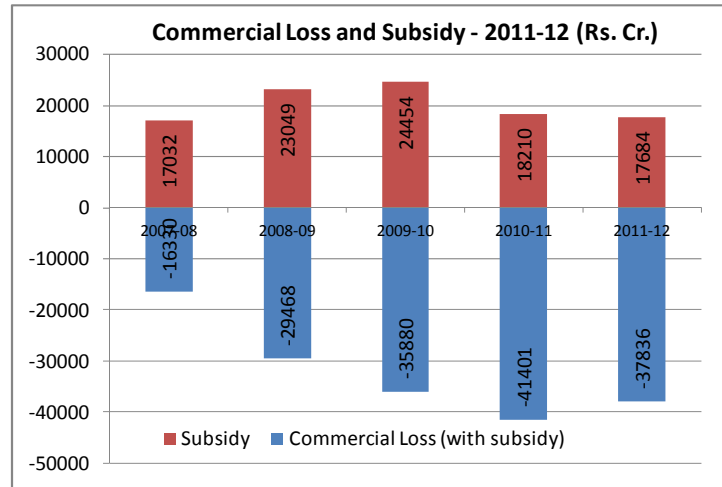
But performance is .....?

### All India Plant Load Factor (PLF)

2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13 #
								upto September 12
74.8	73.6	76.8	78.6	77.2	77.50	75.07	73.32	68.51

# - Provisional; \* - For utilities selling directly to consumers (So: PFC)

## Commercial Loss and Subsidy - 2011-12 (Rs. Cr.)



## Average cost of power supply & average realization (paise/kWh )

Year	cost of supply (paise/unit)	Realization(paise/unit)	
		Including Agriculture	Only Agriculture
2004-05	254	209	75.68
2005-06	260	221	76.36
2006-07	276	227	74.23
2007-08	293	239	77.27
2008-09	340	263	87.13
2009-10	355	268	88.70
2010-11	378	301	115.12

Source:- PFC Reports on the performance of State Power Utilities

## Investment in Infrastructure as a % of GDP (Rs. Crore in 2006-07 prices)

Years	Tenth Plan (Actual)	Base Year of XI Plan (2006-07) (Actual)	2007-08 (Actual)	2008-09 (Actual)	2009-10 (Actual)	2010-11 (Actual)	2011-12 (RE)	Total Eleventh Plan
GDPmp	1,82,46,267	42,94,706	47,15,645	48,99,129	53,02,731	58,09,293	62,07,574	2,69,34,373
Public Investment	7,14,203	1,79,246	202,517	234,788	241,060	266,565	270,022	1,214,953
Private Investment	2,01,873	61,580	91,006	122,390	118,892	216,574	180,981	729,844
Total Investment	9,16,076	2,40,826	293,523	357,179	359,952	483,140	451,003	1,944,796
<b>Investment as per cent of GDP</b>								
Public Investment	3.91	4.17	4.29	4.79	4.55	4.59	4.35	4.51
Private Investment	1.11	1.43	1.93	2.50	2.24	3.73	2.92	2.71
Total Investment	5.02	5.61	6.22	7.29	6.79	8.32	7.27	7.22

Sectors	Total Eleventh Plan	Twelfth Plan Projections					Total 12th Plan
		2012-13	2013-14	2014-15	2015-16	2016-17	
<b>Electricity</b>	<b>8,04,361</b>	<b>2,45,901</b>	<b>2,70,335</b>	<b>2,97,246</b>	<b>3,26,888</b>	<b>3,59,545</b>	<b>14,99,914</b>
Centre	2,60,561 (32.39)	76,794	86,009	96,330	1,07,889	1,20,836	4,87,858 (32.53)
States	1,99,992 (24.86)	52,505	57,230	62,381	67,995	74,115	3,14,226 (20.95)
Private	3,43,808 (42.74)	1,16,602	1,27,096	1,38,535	1,51,003	1,64,594	6,97,831 (46.52)
<b>Non Conventional Energy</b>	<b>1,00,986</b>	<b>33,413</b>	<b>39,987</b>	<b>47,881</b>	<b>57,365</b>	<b>68,763</b>	<b>2,47,409</b>
Centre	10,823 (10.72)	3,384	3,790	4,245	4,754	5,325	21,497 (8.69)
States	1,143 (1.13)	693	776	869	974	1,090	4,402 (1.78)
Private	89,020 (88.15)	29,336	35,421	42,767	51,638	62,348	2,21,510 (89.53)
<b>Roads &amp; Bridges</b>	<b>5,16,180</b>	<b>142,154</b>	<b>160,265</b>	<b>180,979</b>	<b>204,713</b>	<b>231,960</b>	<b>920,071</b>
Centre	2,21,649 (42.85)	57,707	64,000	70,990	78,758	87,390	3,58,845 (39.0)
States	1,91,517 (37.02)	44,589	48,602	52,976	57,744	62,941	2,66,851 (29.0)
Private	1,03,014 (20.13)	39,858	47,664	57,012	68,211	81,629	2,94,374 (32.0)

## PPP Projects in Central and State Sectors (31 March 2011)

S. N.	Sector	Completed Projects		Projects under Implementation		Projects in Pipeline		Total	
		No. of Projects	Project Cost (₹ crore)	No. of Projects	Project Cost (₹ crore)	No. of Projects	Project Cost (₹ crore)	No. of Projects	Project Cost (₹ crore)
<b>(A) Central Sector</b>									
1	National Highways	39	13,699	64	41,913	81	76,341	184	1,31,953
2	Major Ports	23	5,762	13	10,509	29	18,465	65	34,736
3	Airports	3	5,883	2	18,777			5	24,660
4	Railways			4	4,717	50	90,000	54	94,717
	Total (A)	65	25,344	83	75,916	160	1,84,806	308	286,066
<b>(B) State Sector</b>									
1	Roads	96	6,387	69	60,866.5	86	40,205	251	107,458.5
2	Ports	20	19,704	37	51,548	18	17,436	75	88,688
3	Airports			1	500	13	4,120	14	4,620
4	Railways			1	500	3	312	4	812
5	Power	8	9,073	15	28,392	34	62,032	57	99,497
6	Urban Infra.	51	6,105	74	19,738	68	47,141	193	72,984
7	Other Sectors	1	18	17	3,575	19	21,701	37	25,294
	Total (B)	176	41,287	214	1,65,119.5	241	1,92,947	631	3,99,353.5
	<b>(C) Grand (A+B)</b>	<b>241</b>	<b>66,631</b>	<b>297</b>	<b>2,41,035.5</b>	<b>401</b>	<b>3,77,753</b>	<b>939</b>	<b>6,85,419.5</b>



## Progress towards Reforms

### Power Sector: transition towards reforms

- The decade of 80's witnessed accelerated reforms and restructuring of the sector in the U.K. and the USA.
- Taking lead from the U.K and USA model developing countries like Argentina, Chile, Brazil and Philippines also initiated the reforms process.
- In 1991, India also adopted the path to reform.
  - IEA and ESA Acts were amended to create a new legal, administrative & financial environment.
  - Initial focus was confined to Generation.

## Power Sector: Transition towards reforms (contd.)

- The reform models adopted in the developed countries were oriented towards introducing competition and developing a market mechanism for trading in power.
- In India, the initial reform model was designed for functional unbundling of the vertically integrated utilities.
- Beginning with Orissa, Haryana and Andhra Pradesh, reforms have been carried out in many states. Orissa & Delhi have privatised distribution business in the state.

## What does Reform mean in Indian Context?

Motivated by the success of power sector restructuring in UK, Chile & Argentina, The World Bank initiated power sector reform in India.

Usually, two main components of power sector restructuring at the state level.

- Unbundling of SEBs.
- Setting up of Regulatory Commissions.  
(Privatisation?)

## Legal and Policy Developments

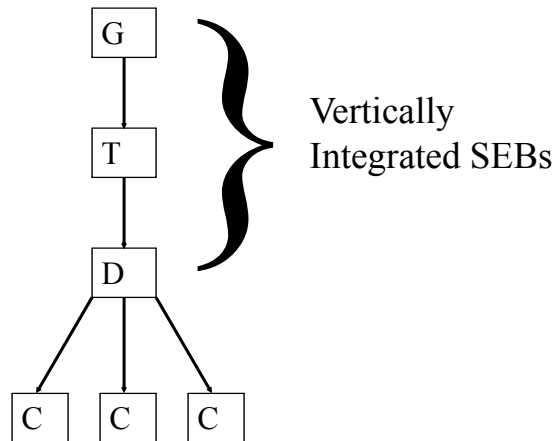
### Indian Power Sector Reform Timeline

- 1991- Opening up of Power Sector for IPPs (Private Power Policy & Mega Power Policy)
- 8 Fast Track Projects
- Unbundling & Privatisation of Orissa SEB; followed by unbundling & regulatory reforms in Haryana & AP
- 1998 – Elec. Reform Act; setting up of CERC & SERCs
- Conference of Chief Ministers / Power Ministers (2001)
- 2001 - Electricity Bill Introduced
- 2001 - Ahluwalia Committee report on SEB dues
- 2002 - Privatisation of DVB (Delhi)
- 2003 – Electricity Act 2003
- 2005 – National Electricity Policy
- 2006 – National Tariff Policy

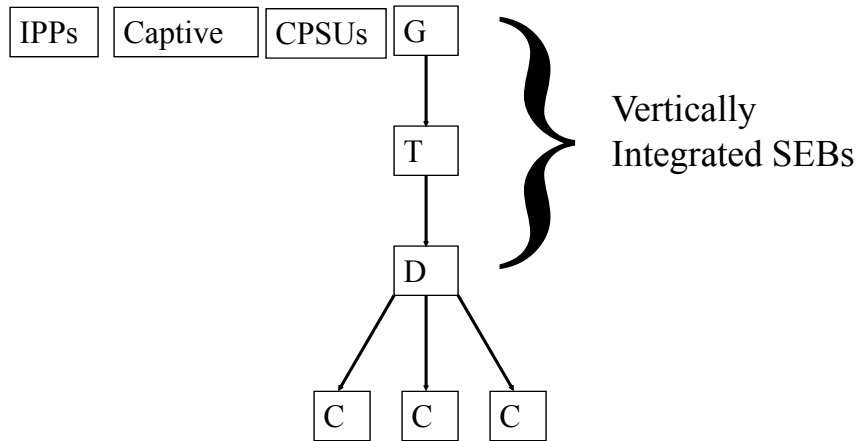


## Emerging Market Structure

## Vertically Integrated SEBs



## Vertically Integrated SEBs

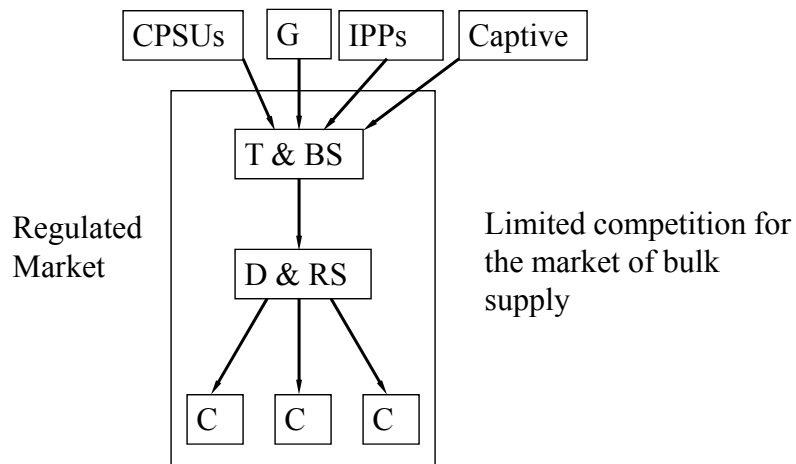


## Segments of the Electricity Markets

Main segments of the power sector are,

- Generation Genco
- Transmission }
- Bulk Supply } T & BS Transco
- Distribution }
- Retail Supply } D & RS Discos
- Trading

## Restructured Power Sector – Pre Electricity Act 2003



## Restructuring of SEBs

- Orissa – 1 Genco, 1 Transco and 3 Discoms
- Haryana – 1 Genco, 1 Transco and 3 Discoms
- AP – 1 Genco, 1 Transco and 3 Discoms
- UP – 2 Genco, 1 Transco and 4 Discoms (+KESCO, NPCL – Pvt.)
- Maharashtra – 1 Genco, 1 Transco and 1 Discoms (+BSES - REL)

# Electricity Act 2003

## Electricity Act 2003

After a number of drafts and amendments in Lok Sabha and Rajya Sabha, Electricity Act 2003 came into effect from 10th June 2003. It replaced the existing three legislations governing the power sector,

- Indian Electricity Act, 1910
- Electricity (Supply) Act, 1948
- Electricity Regulatory Commissions Act, 1998.

## Electricity Act 2003 – Main Provisions

Main provisions of the Act are,

- Thermal generation delicensed and captive generation freely permitted.
- Provision for license free generation and distribution in the rural areas and provision for management of rural distribution by Panchayats, Cooperative Societies, NGOs, franchisees etc.

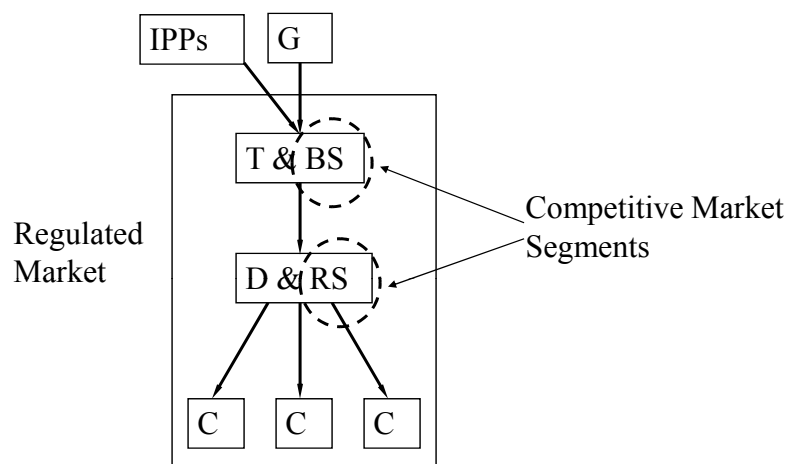
## Electricity Act 2003 – Main Provisions (Contd.)

- Open access in transmission from the outset.
- Open access in distribution to be introduced in phases. Provision for surcharge till for current level of cross subsidy to be gradually phased out.
- Trading recognised as a distinct activity with ceilings on trading margins to be fixed by the Regulatory Commissions.

## Electricity Act 2003 – Main Provisions (Contd.)

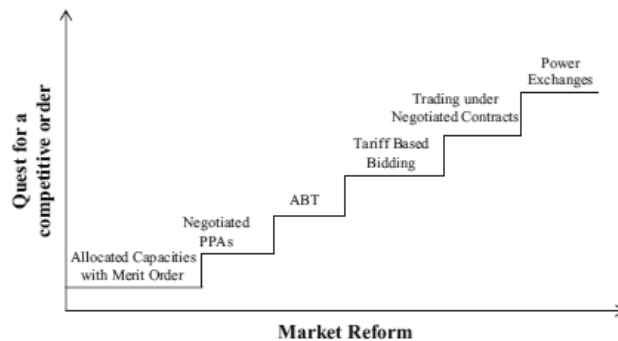
- Provision for payment of subsidy through budget and gradual elimination of cross-subsidy.
- Setting up of an Appellate Tribunal to hear appeals against the decisions of the CERC and SERCs.
- Mandatory metering of all electricity supplies.

## Restructured Power Sector – Emerging Scenario (Post Electricity Act 2003)

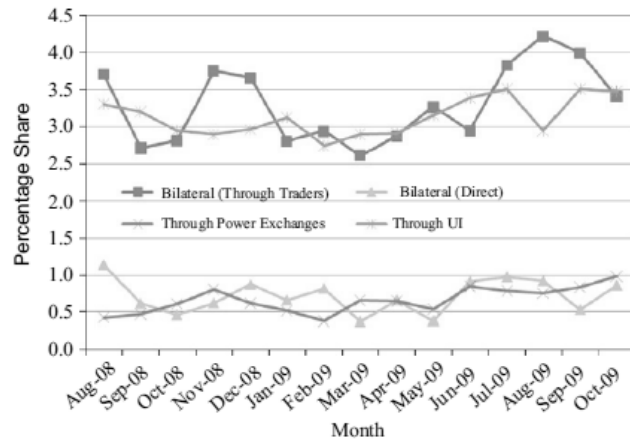


## Wholesale Competition - Post Electricity Act 2003

## Evolving competition in the bulk power market



## Exploratory space for competition for traders and PXs



## Regulatory Structure



## 'Independent' Regulators

- Central Electricity Regulatory Commission (CERC) established under the Electricity Regulatory Commissions Act, 1998.
- State Electricity Regulatory Commissions (SERCs) established under respective reform acts of the states (Orissa, Haryana, AP, etc.) and the Electricity Regulatory Commissions Act, 1998.

## Regulatory Jurisdictions - CERC

- Matters related to generation, transmission and trading of electricity involving more than one state.
  - generations assets catering to the need of more than one state (includes all plants of NTPC, NHPC and IPPs serving more than one state)
  - Inter-state transmission of electricity i.e. transmission from one state to the other.
  - Inter-state trading of electricity i.e. trading of electricity from one state to the other.

## Regulatory Purview - CERC

- Tariff for generation and transmission
- Issuing licenses for inter-state transmission
- Issuing licenses for inter-state trading
- Trading Regulations including margin for trading
- Open access regulation
- Power market development

## Regulatory Jurisdictions - SERC

- Matters related to generation, transmission and trading of electricity within a particular state.
  - generations assets catering to the particular state (includes all plants of SEB/Gencos and IPPs serving the particular state)
  - Intra-state transmission of electricity i.e. transmission within the state's boundaries.
  - Intra-state trading of electricity i.e. trading of electricity within the state's boundaries.

## Regulatory Purview - SERCs

- Tariff for generation and transmission
- Issuing licenses for intra-state transmission
- Issuing licenses for intra-state trading
- Trading Regulations including margin for trading
- Open access regulation for intra-state transmission and distribution access
- Distribution and Retail tariff for consumers

## Further Readings

- “Power Sector Reform in India: Current Issues and Prospects”, Energy Policy, Elsevier, Volume 34, Issue 16, November 2006.
- <http://dx.doi.org> enter the following doi:10.1016/j.enpol.2004.08.013
- “Towards a Competitive Market for Electricity and Consumer Choice in Indian Power Sector”, Energy Policy Vol. 38 4196-4208, 2010. (Elsevier)
- <http://dx.doi.org> enter the following doi:10.1016/j.enpol.2010.03.047

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- “Analysing Efficiency of Electric Distribution Utilities in India: a Data Envelopment Analysis” (with Dilip Kumar Pandey), IAEE International Conference, Stockholm 19-23 June, 2011.
- “Modelling Economic Efficiency of Renewable Energy Policies: A Multi-State Model For India”, Accepted for World Renewable Energy Congress, 17-19 Oct. 2011, Bali, Indonesia. (with Sundeep Chowdary).
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For ppts of above programs, visit  
[www.iitk.ac.in/ime/anoops](http://www.iitk.ac.in/ime/anoops)