

**Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur**



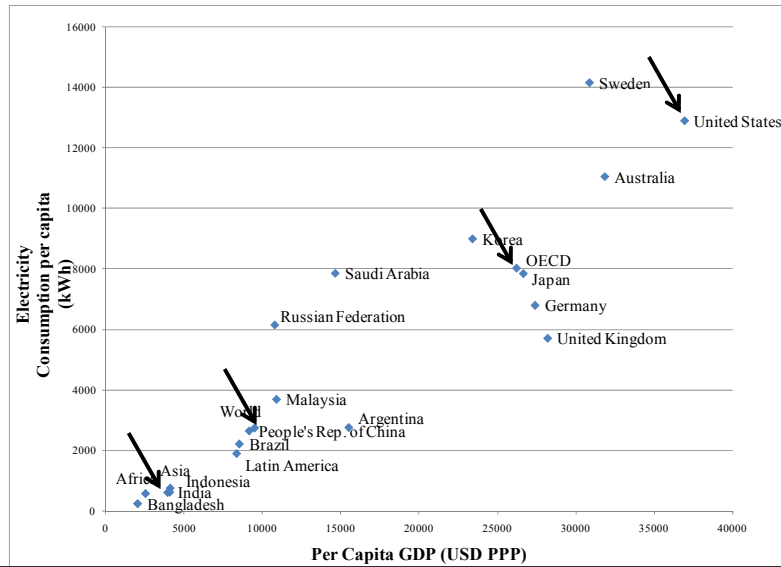
Training Programme on
“Power Procurement Strategy and Power Exchanges”
28-30 July 2014

Power Sector Reforms and Market Development

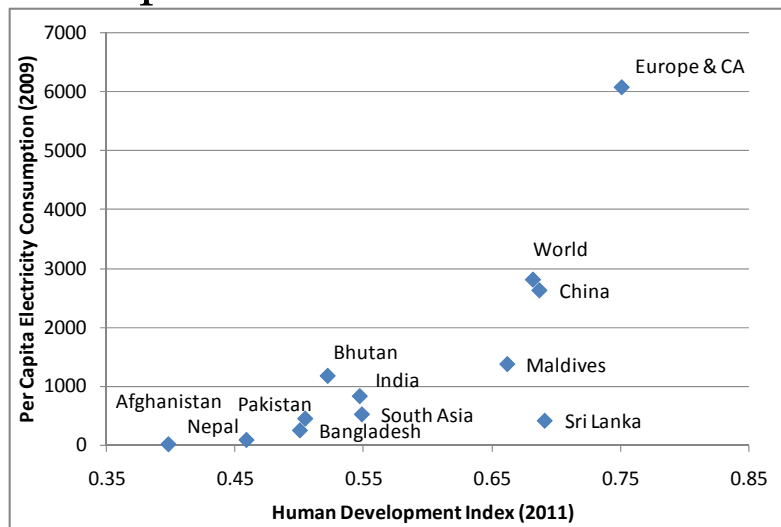
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Energy & Economic Growth

Electricity Consumption and Economic Growth



Electricity Consumption and Human Development Index



Selected Energy Indicators

| Region/Country | GDP Per Capita-PPP (US \$ 2000) | TPES Per Capita (kgoe) | TPES/GDP (kgoe/\$-2000 PPP) | Electricity Consumption Per Capita (kWh) | kWh/\$-2000 PPP |
|----------------|---------------------------------|------------------------|-----------------------------|--|-----------------|
| China | 4838 | 1090 | 0.23 | 1379 | 0.29 |
| Australia | 28295 | 5630 | 0.20 | 10640 | 0.38 |
| Brazil | 7359 | 1094 | 0.15 | 1934 | 0.26 |
| Denmark | 29082 | 3852 | 0.13 | 6599 | 0.23 |
| Germany | 25271 | 4210 | 0.17 | 6898 | 0.27 |
| India* | 2732 | 439 | 0.16 | 553 | 0.20 |
| Indonesia | 3175 | 753 | 0.24 | 440 | 0.14 |
| Netherlands | 27124 | 4983 | 0.18 | 6748 | 0.25 |
| Saudi Arabia | 12494 | 5805 | 0.46 | 6481 | 0.52 |
| Sweden | 27869 | 5751 | 0.21 | 15397 | 0.55 |
| United Kingdom | 26944 | 3906 | 0.14 | 6231 | 0.23 |
| United States | 35487 | 7835 | 0.22 | 13066 | 0.37 |
| Japan | 26636 | 4052 | 0.15 | 7816 | 0.29 |
| World | 7868 | 1688 | 0.21 | 2429 | 0.31 |

TPES – Total Primary Energy Supply; for year 2003.

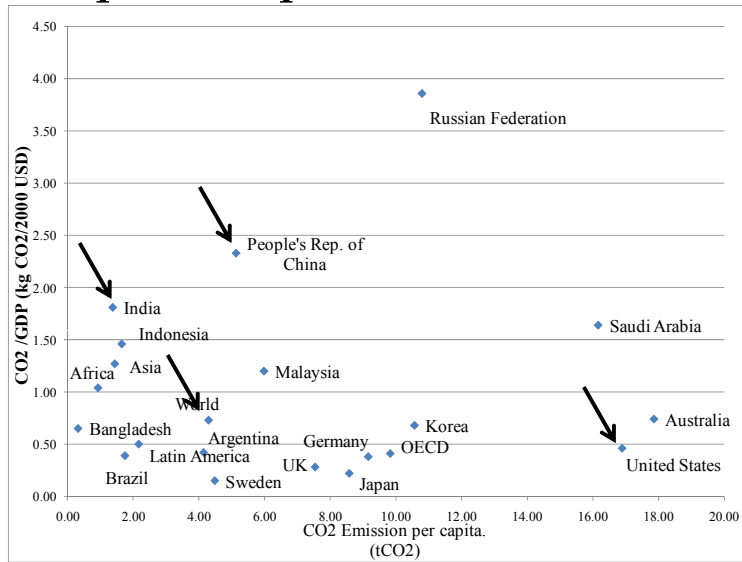
Projections for Electricity Demand

| Year | Billion kWh | | GW | |
|---------|-------------|------|-----|------|
| | 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

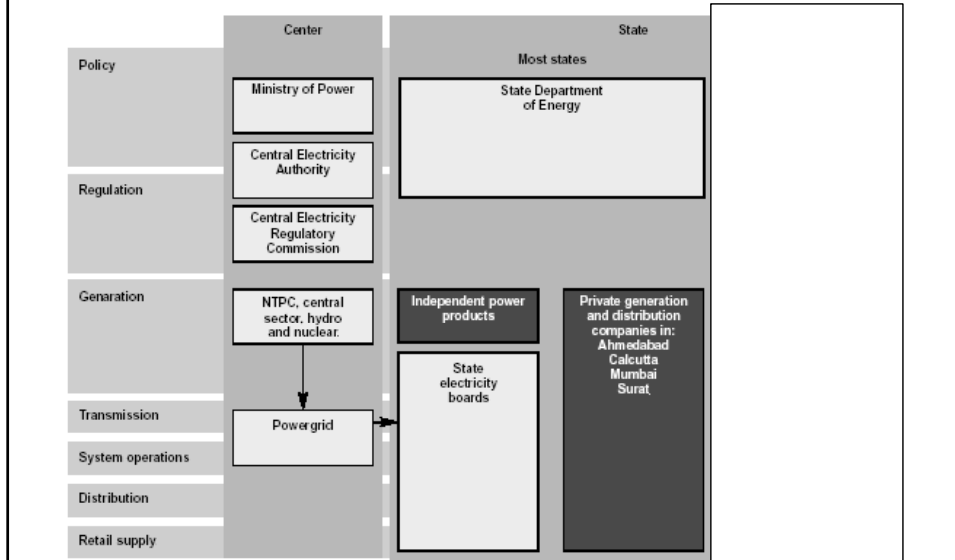
So: Integrated Energy Policy, Planning Commission

CO2 Emissions – Per Capita and per GDP

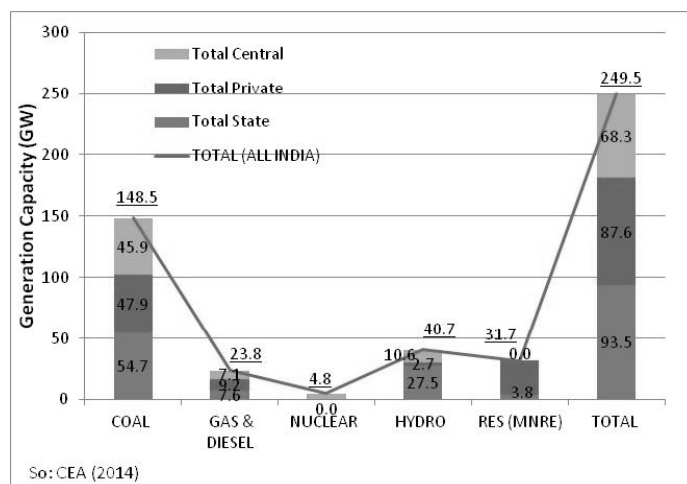


Indian Power Sector

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

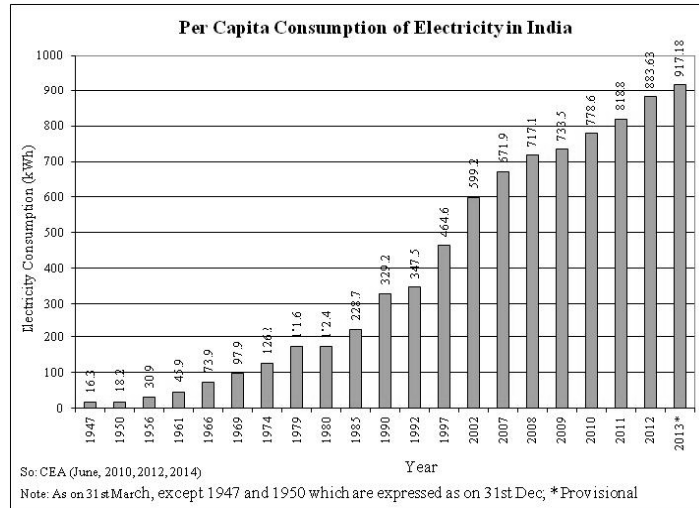


All India Generation Capacity (As on 30 June 2014)

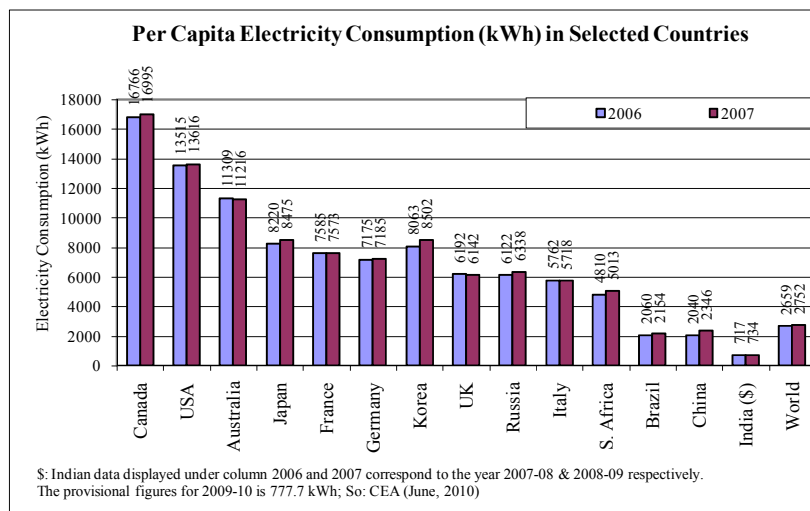


Captive Generating Capacity (MW) connected to the Grid = 39375.36 MW (as on 30-06-2014)

Growth in Per Capita Consumption



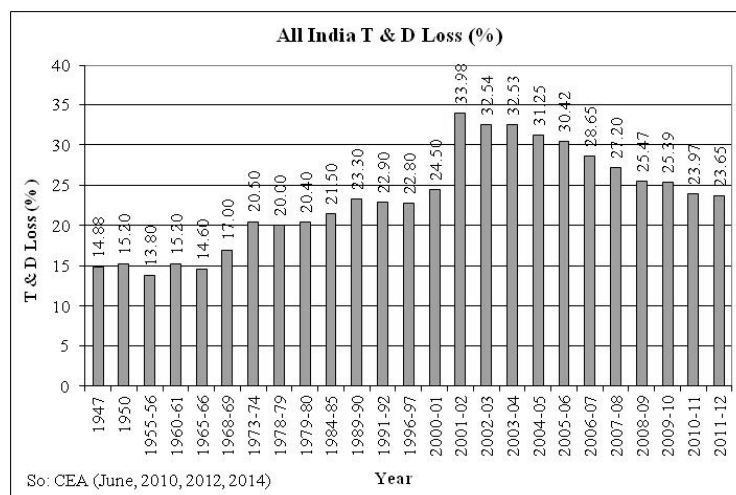
Per Capita Consumption in selected countries



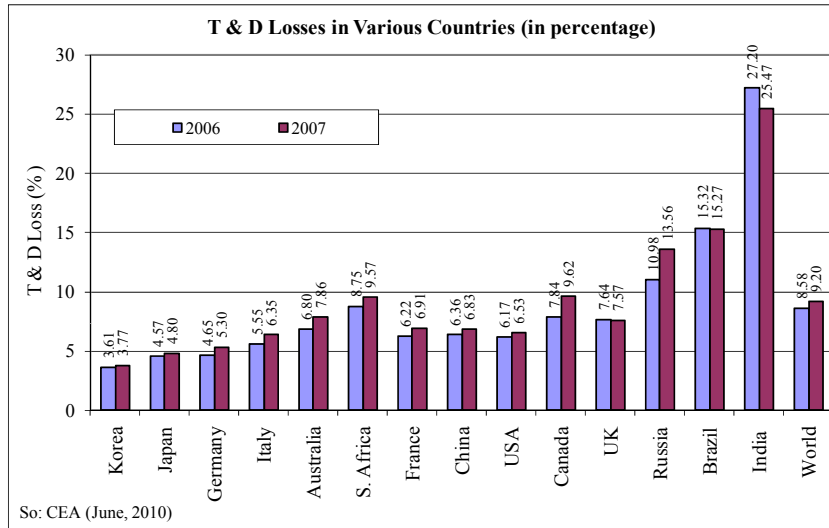
T&D and AT&C losses (in %)

| 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 |

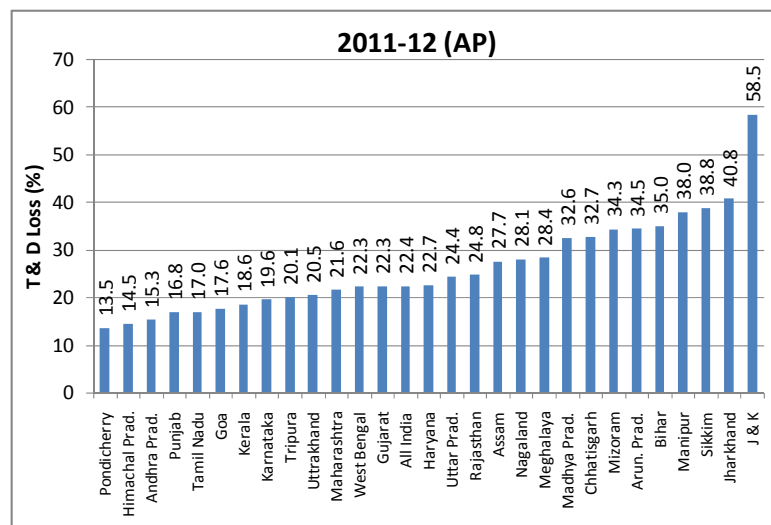
All India T & D Loss (%)



T & D Loss Across Countries



T & D Loss Across States



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 31.05.2014): 5,71,482
- 95.65 % villages electrified
- Pumpsets Energised (as on 31.05.2014): 1,91,28,200

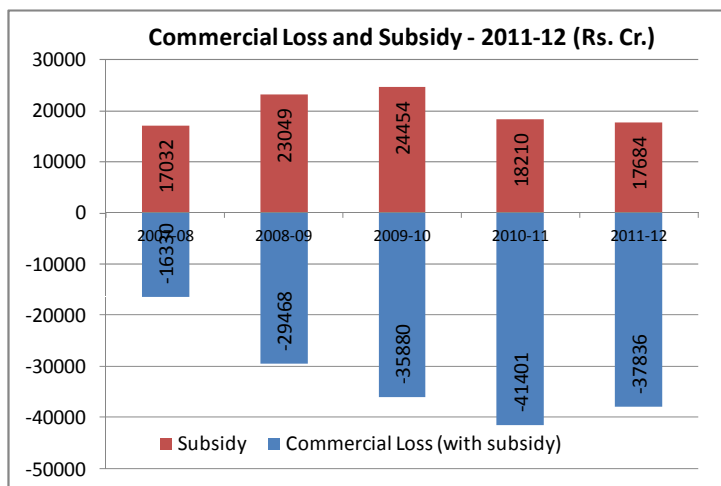
But performance is?

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

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?)

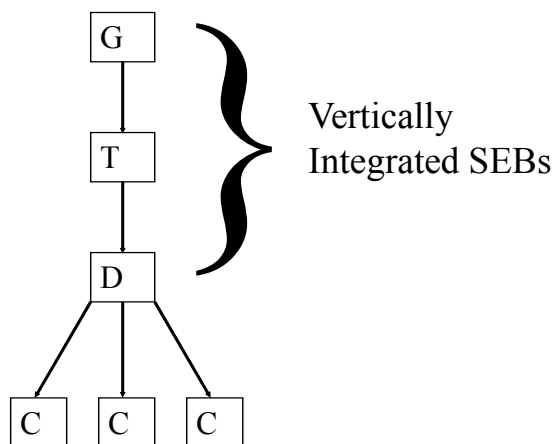
Legal and Policy Developments

Indian Power Sector Reform Timeline

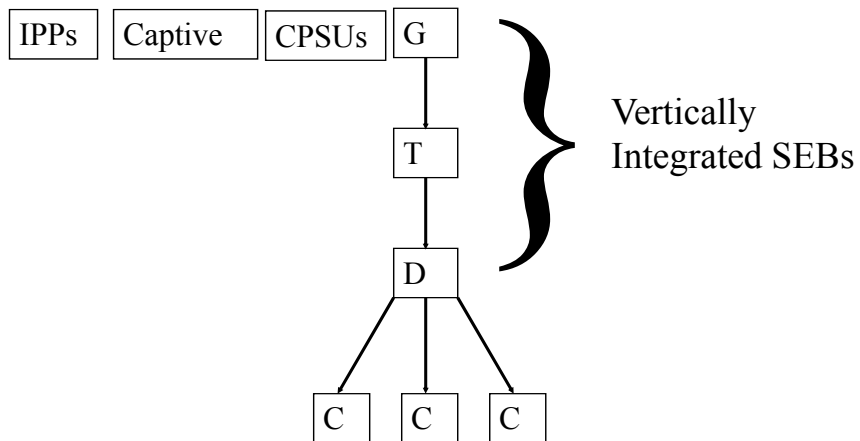
- 1991- Opening up of Power Sector for IPPs (Private Power Policy & Mega Power Policy)
- 8 Fast Track Projects
- Unbundling & Privatisation of Orissa SEB; followed by unbundling & regulatory reforms in Haryana & AP
- 1998 – Elec. Reform Act; setting up of CERC & SERCs
- Conference of Chief Ministers / 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

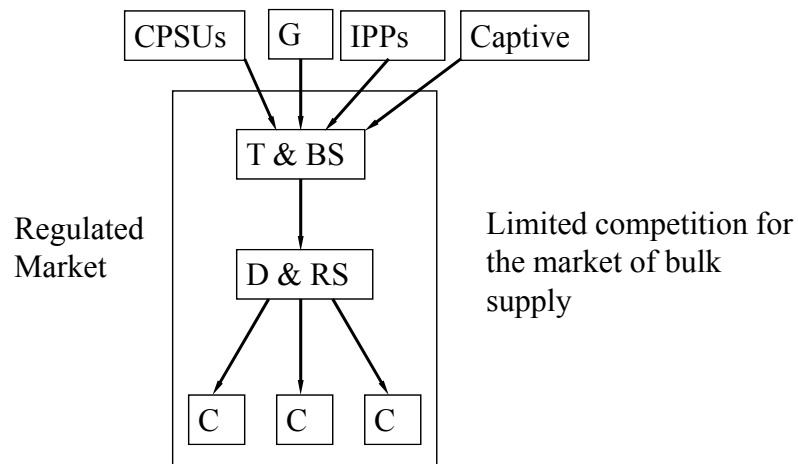


Segments of the Electricity Markets

Main segments of the power sector are,

- Generation Genco
- Transmission } T & BS Transco
- Bulk Supply } Discos
- Distribution } Discos
- Retail Supply } 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.

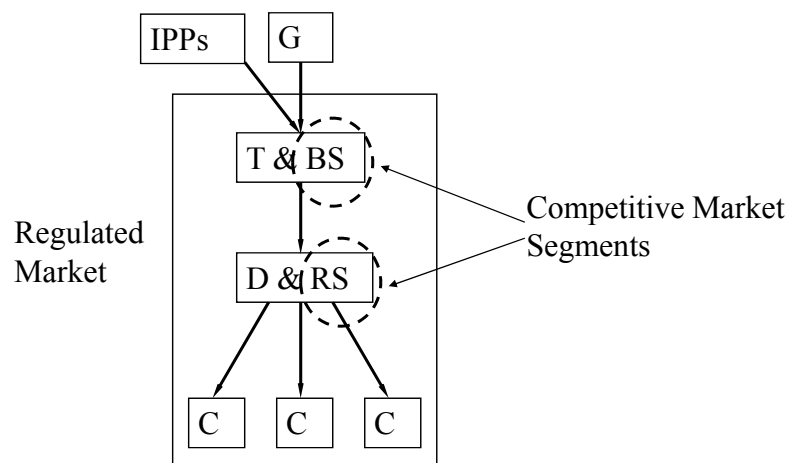
Electricity Act 2003 – Main Provisions (Contd.)

- 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.)

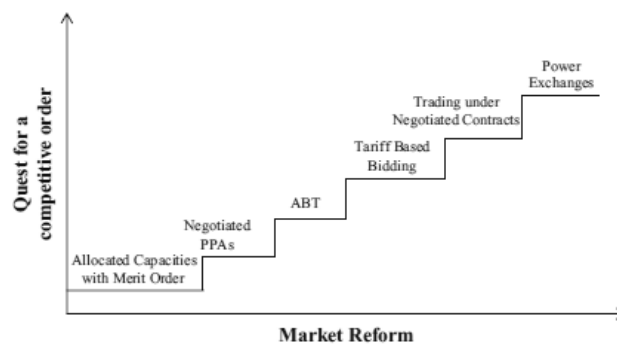
- Provision for payment of subsidy through budget and gradual elimination of cross-subsidy.
- Setting up of an Appellate Tribunal to hear appeals against the decisions of the CERC and SERCs.
- Mandatory metering of all electricity supplies.

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



Wholesale Competition - Post Electricity Act 2003

Evolving competition in the bulk power market



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

Status of Market Development

- ST, MT and LT Open access regulations issued by the CERC
- Two Power Exchanges (PXs) operational
- Proposed Amendments to the EA 2003 aim to bring retail competition by unbundling 'distribution' and 'retail supply'

Thank You

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Further Readings

- “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).
- “Economics, Regulation and Implementation Strategy for Renewable Energy Certificates in India” in India Infrastructure Report 2010, Oxford Univ. Press.
- “Towards a Competitive Market for Electricity and Consumer Choice in Indian Power Sector”, Energy Policy Vol. 38 4196-4208, 2010. (Elsevier)
- “A Market for Renewable Energy Credits in the Indian Power Sector”, Renewable and Sustainable Energy Review journal, Elsevier, 2009.
- “Economics of Iran-Pakistan-India Natural Gas Pipeline: Implications for Energy Security in India”, Economic and Political Weekly, Vol. XLIII, No. 7 2008.
- “Power Sector Reform in India: Current Issues and Prospects”, Energy Policy, Elsevier, Volume 34, Issue 16, November 2006.

Courses, Workshops and Conferences

- Short Term Course “Challenges and Implementation Issues post Electricity Act 2003: Regulatory, Policy & Technical Solutions”, 10-14 April, 2004
- International Conference on “Power Market Development in India: Reflections from International Experience”, 19-21 April, 2005
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- Capacity Building Programme for Officers of Electricity Regulatory Commissions, 30th June - 5th July, 2008

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- 2nd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 3-8 August, 2009
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- 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 Oct., 2012

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Selected Papers on Power/RE

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- 6th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 9-15 Feb., 2014

For ppts of above programs, visit www.iitk.ac.in/ime/anoops