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

<table>
<thead>
<tr>
<th>Region/Country</th>
<th>GDP Per Capita-PPP (US $ 2000)</th>
<th>TPES Per Capita (kgoe)</th>
<th>TPES/GDP (kgoe/$2000 PPP)</th>
<th>Electricity Consumption Per Capita (kWh)</th>
<th>kWh/$2000 PPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>4838</td>
<td>1090</td>
<td>0.23</td>
<td>1379</td>
<td>0.29</td>
</tr>
<tr>
<td>Australia</td>
<td>28295</td>
<td>5630</td>
<td>0.20</td>
<td>10640</td>
<td>0.38</td>
</tr>
<tr>
<td>Brazil</td>
<td>7359</td>
<td>1094</td>
<td>0.15</td>
<td>1954</td>
<td>0.26</td>
</tr>
<tr>
<td>Denmark</td>
<td>29082</td>
<td>3852</td>
<td>0.13</td>
<td>6599</td>
<td>0.23</td>
</tr>
<tr>
<td>Germany</td>
<td>25271</td>
<td>4210</td>
<td>0.17</td>
<td>6898</td>
<td>0.27</td>
</tr>
<tr>
<td>India*</td>
<td>2732</td>
<td>459</td>
<td>0.16</td>
<td>553</td>
<td>0.20</td>
</tr>
<tr>
<td>Indonesia</td>
<td>3175</td>
<td>753</td>
<td>0.24</td>
<td>440</td>
<td>0.14</td>
</tr>
<tr>
<td>Netherlands</td>
<td>27124</td>
<td>4983</td>
<td>0.18</td>
<td>6748</td>
<td>0.25</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>12494</td>
<td>5825</td>
<td>0.46</td>
<td>6481</td>
<td>0.52</td>
</tr>
<tr>
<td>Sweden</td>
<td>27869</td>
<td>5751</td>
<td>0.21</td>
<td>15397</td>
<td>0.55</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>26944</td>
<td>3956</td>
<td>0.14</td>
<td>6231</td>
<td>0.23</td>
</tr>
<tr>
<td>United States</td>
<td>35487</td>
<td>7835</td>
<td>0.22</td>
<td>13066</td>
<td>0.37</td>
</tr>
<tr>
<td>Japan</td>
<td>26656</td>
<td>4025</td>
<td>0.15</td>
<td>7816</td>
<td>0.29</td>
</tr>
<tr>
<td>World</td>
<td>7868</td>
<td>1688</td>
<td>0.21</td>
<td>2429</td>
<td>0.31</td>
</tr>
</tbody>
</table>

TPES – Total Primary Energy Supply; for year 2003.

### Projections for Electricity Demand

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

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 of Electricity in India

Per Capita Electricity Consumption (kWh) in Selected Countries

Per Capita Consumption in selected countries

$\text{Indian data displayed under column, 2006 and 2007 correspond to the year 2007-08 & 2008-09 respectively.}$

$\text{The provisional figures for 2009-10 is 777.7 kWh; So: CEA (June, 2010)}$
# T&D and AT&C losses (in %)

<table>
<thead>
<tr>
<th>Year</th>
<th>T&amp;D losses (All India)</th>
<th>AT&amp;C Losses *</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-05</td>
<td>31.25</td>
<td>34.33</td>
</tr>
<tr>
<td>2005-06</td>
<td>30.42</td>
<td>33.02</td>
</tr>
<tr>
<td>2006-07</td>
<td>28.65</td>
<td>30.62</td>
</tr>
<tr>
<td>2007-08</td>
<td>27.20</td>
<td>29.45</td>
</tr>
<tr>
<td>2008-09</td>
<td>25.47</td>
<td>27.37</td>
</tr>
<tr>
<td>2009-10</td>
<td>25.39</td>
<td>26.58</td>
</tr>
<tr>
<td>2010-11</td>
<td>23.97</td>
<td>26.15</td>
</tr>
</tbody>
</table>

# All India T & D Loss (%)

![Graph showing All India T & D Loss (%) from 1947 to 2011-12](chart)

T & D Loss Across Countries

T & D Loss in Various Countries (in percentage)

- Korea: 3.57%
- Japan: 6.68%
- Germany: 6.39%
- Italy: 6.54%
- Australia: 1.98%
- South Africa: 6.57%
- France: 2.62%
- China: 0.68%
- USA: 6.48%
- Canada: 6.68%
- UK: 6.68%
- Russia: 8.58%
- Brazil: 7.84%
- India: 8.75%
- World: 6.36%

So: CEA (June, 2010)

T & D Loss Across States

2011-12 (AP)

- Pondicherry: 13.5%
- Haryana: 15.3%
- Rajasthan: 16.8%
- Tamil Nadu: 17.0%
- Kerala: 18.6%
- Karnataka: 19.6%
- Tripura: 20.4%
- Maharashtra: 21.6%
- West Bengal: 21.6%
- Gujarat: 22.3%
- Andhra Prad.: 22.3%
- Madhya Prad.: 22.7%
- Himachal: 24.4%
- Meghalaya: 24.8%
- Manipur: 24.8%
- Nagaland: 25.7%
- Chhattisgarh: 26.6%
- Assam: 26.7%
- Jharkhand: 27.7%
- Bihar: 28.4%
- M.P.: 28.4%
- Uttar Pradesh: 28.4%
- Uttar Pradesh: 30.6%
- J & K: 35.0%
- Madhya Prad.: 38.0%
- M.P.: 38.0%
- Jharkhand: 40.8%
- J & K: 58.5%
All India Annual per Capita consumption of Electricity

<table>
<thead>
<tr>
<th>Year</th>
<th>Per Capita Consumption (kWh)#</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-06</td>
<td>631.4</td>
</tr>
<tr>
<td>2006-07</td>
<td>671.9</td>
</tr>
<tr>
<td>2007-08</td>
<td>717.1</td>
</tr>
<tr>
<td>2008-09</td>
<td>733.5</td>
</tr>
<tr>
<td>2009-10</td>
<td>778.6</td>
</tr>
<tr>
<td>2010-11</td>
<td>818.8</td>
</tr>
<tr>
<td>2011-12</td>
<td>819.22</td>
</tr>
</tbody>
</table>

- 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)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>74.8</td>
<td>73.6</td>
<td>76.8</td>
<td>78.6</td>
<td>77.2</td>
<td>77.50</td>
<td>75.07</td>
<td>73.32</td>
<td>68.51</td>
</tr>
</tbody>
</table>

# - Provisional; * - For utilities selling directly to consumers (So: PFC)
### Commercial Loss and Subsidy - 2011-12 (Rs. Cr.)

![Bar chart showing commercial loss and subsidy for 2011-12](chart.png)

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost of supply (paise/unit)</th>
<th>Realization (paise/unit) Including Agriculture</th>
<th>Only Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-05</td>
<td>254</td>
<td>209</td>
<td>75.08</td>
</tr>
<tr>
<td>2005-06</td>
<td>260</td>
<td>221</td>
<td>76.36</td>
</tr>
<tr>
<td>2006-07</td>
<td>276</td>
<td>227</td>
<td>74.23</td>
</tr>
<tr>
<td>2007-08</td>
<td>293</td>
<td>239</td>
<td>77.27</td>
</tr>
<tr>
<td>2008-09</td>
<td>340</td>
<td>263</td>
<td>87.13</td>
</tr>
<tr>
<td>2009-10</td>
<td>355</td>
<td>268</td>
<td>88.70</td>
</tr>
<tr>
<td>2010-11</td>
<td>378</td>
<td>301</td>
<td>115.12</td>
</tr>
</tbody>
</table>

*Source:* PPC 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)
- 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
- Transmission
- Bulk Supply
- Distribution
- Retail Supply
- Trading

Genco
Transco
Discos
Restructured Power Sector – Pre Electricity Act 2003

- CPSUs
- IPPs
- Captive

T & BS

D & RS

Captive

Limited competition for the market of bulk supply

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

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)
  – \textit{Intra}-state transmission of electricity i.e. transmission within the state’s boundaries.
  – \textit{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

Courses, Workshops and Conferences (contd.)

• 2nd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 3-8 August, 2009
• 3rd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 23-28 August, 2010
• Energy Conclave 2010, 8-15 Jan. 2010
• 4th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 July, 2011
• 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 Oct., 2012

Thank You

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Selected Papers on Power/RE


Courses, Workshops and Conferences

- International Conference on “Power Market Development in India: Reflections from International Experience”, 19-21 April, 2005
- 2nd National Workshop on “Project Financing for Energy and Infrastructure Sector”, April 24-27, 2008
- Capacity Building Programme for Officers of Electricity Regulatory Commissions, 30th June - 5th July, 2008
Courses, Workshops and Conferences (contd.)

- 2nd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 3-8 August, 2009
- 3rd Capacity Building Programme for Officers of Electricity Regulatory Commissions, 23-28 August, 2010
- Energy Conclave 2010, 8-15 Jan. 2010
- 4th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 July, 2011
- 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 Oct., 2012
- 6th Capacity Building Programme for Officers of Electricity Regulatory Commissions, 9-15 Feb., 2014

For ppt's of above programs, visit www.iitk.ac.in/ime/anoops