



INDIAN ENERGY EXCHANGE
India's No. 1 Power Exchange

Indian Power Sector Overview



In this presentation...

- India Power Sector-
 - Structural Overview
 - Key Statistics
- Electricity Act, 2003
- System Operations
- Market Design
- Issues for discussions

India Power Sector- Structural Overview



- 1897-98 First hydro (130 kW) Darjeeling / thermal(1MW) in Calcutta by CESC.
- 1910 Indian Electricity Act 1910 enacted to regulate supply by the Licensees to the consumers.
- **1948** Indian Electricity (Supply) Act 1948' (ES Act).
Formation of State Electricity Boards with full powers to control generation, distribution and utilization of electricity within their respective states and Central Electricity Authority for planning and development of power system.
- **1964** Five Regional Electricity Boards (REBs) were formed by the Government of India with the concurrence of State Governments with a view to ensure integrated grid operation and regional cooperation on power.

- **1976** **Creation of Central Generating Companies** for development of super thermal power stations at coal pit heads and large hydroelectric stations leading to creation of NTPC, NHPC, NPC, NLC & NEEPCO.

- **1991** ES Act 1948 amended to pave the way for the formation of private Generating companies. CEA empowered to fix the norms for determining the tariff of all generating companies. RBI allows 100% foreign investment in power sector without any export obligations.
- **1992** First Gazette Notifications on the criteria for fixing the tariff for sale of electricity by the Generating companies to SEBs or any other agency.
- **1998** Electricity Regulatory Commission Act 1998 enacted paving the way for the formation of Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERC). Regulatory power of the State governments transferred to SERC. Consequently, Tariff regulatory function of CEA transferred to CERC.

- **1998** Act amended to provide for of Central Transmission Utility (CTU) and State Transmission Utilities (STU).
- **2003** Electricity Act 2003 enacted by the Parliament.
This Act repeals the following Acts.
IE Act 1910
ES Act 1948
ERC Act 1998

Institutional

- Federal Structure
- 'Power' a concurrent subject
- RLDCs (Regional System Operator) : apex bodies in regional grid operation. Supervise and control inter-regional and inter-state transmission systems.
- RLDCs can give directions to intra-state utilities for security of the grid
- SLDCs (State-level System Operator) : to supervise and control state power systems

Central Government

Ministry of power

a Public Sector Enterprises

- NTPC, NHPC, NPC- Generating Companies.
- PTC- Trading Company
- POWERGRID- Transmission company.

b Undertakings owned by Central Government

- DVC, BBMB,
- Educational institutions NPTI, CPRI etc.

c Regulators : Autonomous.

- Appellate Tribunal for Electricity
- Central Electricity Regulatory Commission

Organisational Hierarchy

State Government

State Electricity Board

A Unbundled Utilities

- Minimum Generating Co, Transmission Co and Distribution Co
- For example,
 - AP has 4 DISCOMs, TRANSCO and GENCO
 - Rajasthan has 3 DISCOMs, TRANSCO and GENCO
 - MP unbundled in 3 DISCOMs, TRANSCO and GENCO

B State Electricity Regulatory Commissions

- Members are appointed by state government. Autonomous working.

C Independent Power Producers (IPPs)

- IPPs operate under Build-Own-Operate mode. No IPPs under central government.

CEA (Central Electricity Authority)

- advises the ministry on technical, financial, and economic matters. Concurrence for hydro stations

National Hydroelectric Power Corporation (NHPC)

- plans, promotes, and integrates the development of hydroelectric, tidal and wind power in India.

National Thermal Power Corporation (NTPC)

- Operates and sets up thermal and gas-based power projects.

Rural Electrification Corporation

- provides financial assistance for rural electrification programmes.

Power Finance Corporation

- Mobilizes capital from non-budgetary sources to provide term finance for power generation projects.

Power Grid Corporation of India Limited

- Setting and operating EHV transmission network in the country. Responsible for all the existing and future transmission projects in the central sector and for the formation of the National power grid. It also functions as the central transmission utility and is currently responsible for regional grid operations as well.

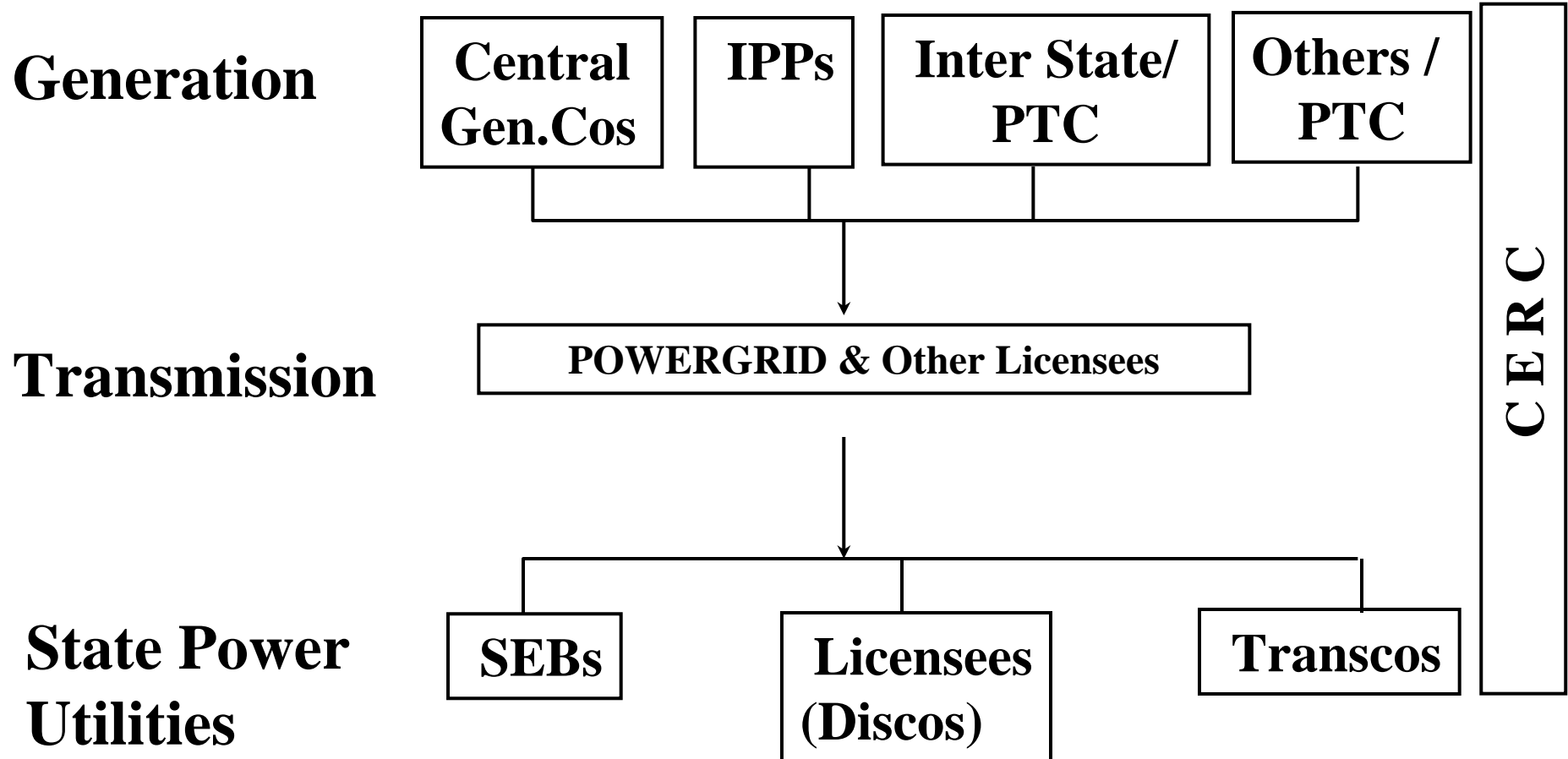
CERC (Central Electricity Regulatory Commission)

- Set up under the Electricity Regulatory Commissions Act, 1998 as an independent statutory body with quasi-judicial powers.
- CERC regulates tariff-related matters and inter-state bulk sale of power, aids and advises the central government on the formulation of a tariff policy, frames the guidelines pertaining to tariff, and promotes competition and efficiency in the electricity sector.

Other organizations

North-Eastern Electric Power Corporation, The Nathpa Jhakri Power Corporation, The Tehri Hydro Development Corporation, and two statutory bodies- the Damodar Valley Corporation and the Bhakra Beas Management Board

Structure at Central Level



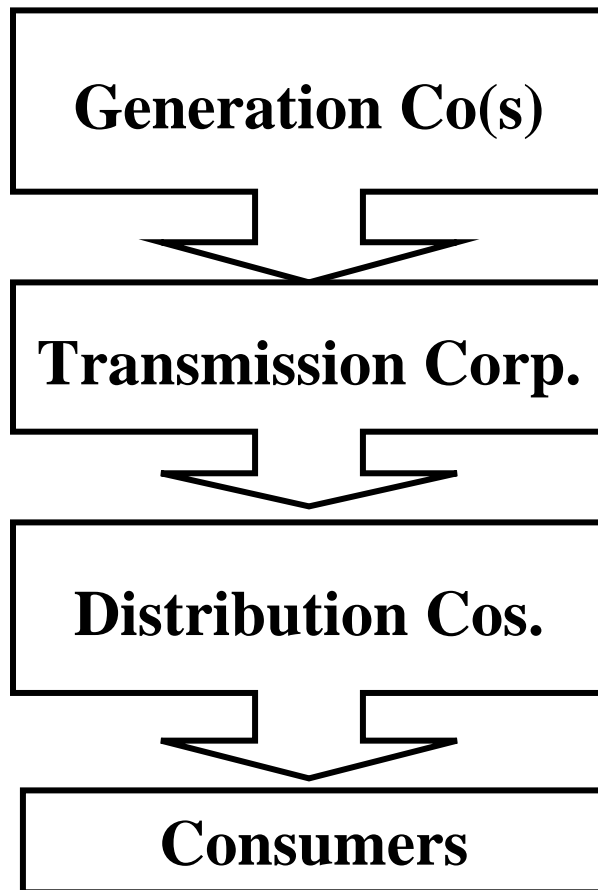
State Electricity Boards -Vertically Integrated utilities

- SEBs constituted by the state government, were responsible for ensuring generation, transmission , and distribution of electricity in the most economical and efficient manner. For this they are required to co-ordinate with the generating companies, if any, operating in the state and with the central government or any other boards or agency that has control over a power system.
- Still 5 State are unbundled (HP, Kerala, Tamil Nadu, Chhattisgarh, Punjab)

State Electricity Regulatory Commissions (23 Nos)

- regulating the purchase, distribution, supply and utilization of electricity, the quality of service, the tariff and charges payable considering the interests of both the consumer and the electricity industry in the state. Responsible for promoting competition, efficiency, and economy in the activities of the industry, the SERCs also aid and advise on matters concerning generation, transmission, distribution, and supply of electricity in the state.
- Electricity Act,2003 mandates compulsory establishment of SERCs.

Restructuring: Functional Unbundling



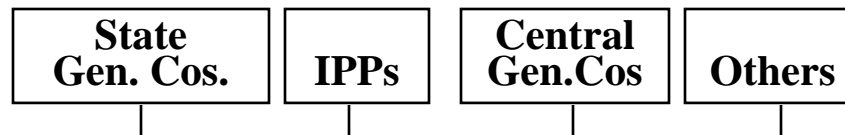
- **Responsible for Power Generation.**
- **Setting up new Generating Stations.**

- **Management of entire Transmission System.**
- **Purchase and bulk supply and wheeling.**
- **Grid Operation.**

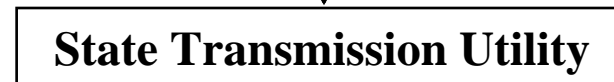
- **Management of distribution system.**
- **Extension of supply to new consumers.**
- **Bulk purchase and retail sales.**

Structure at State Level

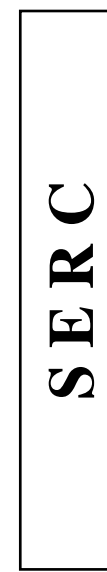
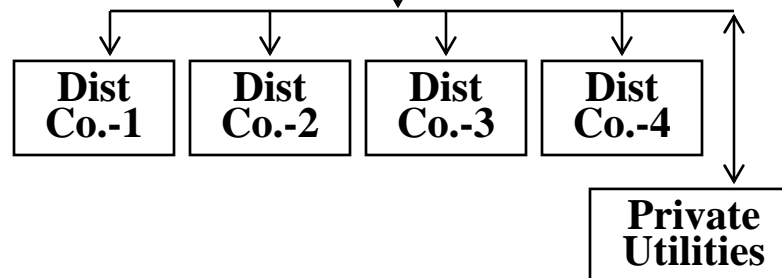
Generation



Transmission



Distribution



Private Distribution Licensees

- Mostly old-legacy
- Tata Power Company, Reliance Infrastructure, and BEST in Maharashtra, CESC in West Bengal and Torrent Power in Gujarat.
- NDPL, BRPL and BYPL in Delhi

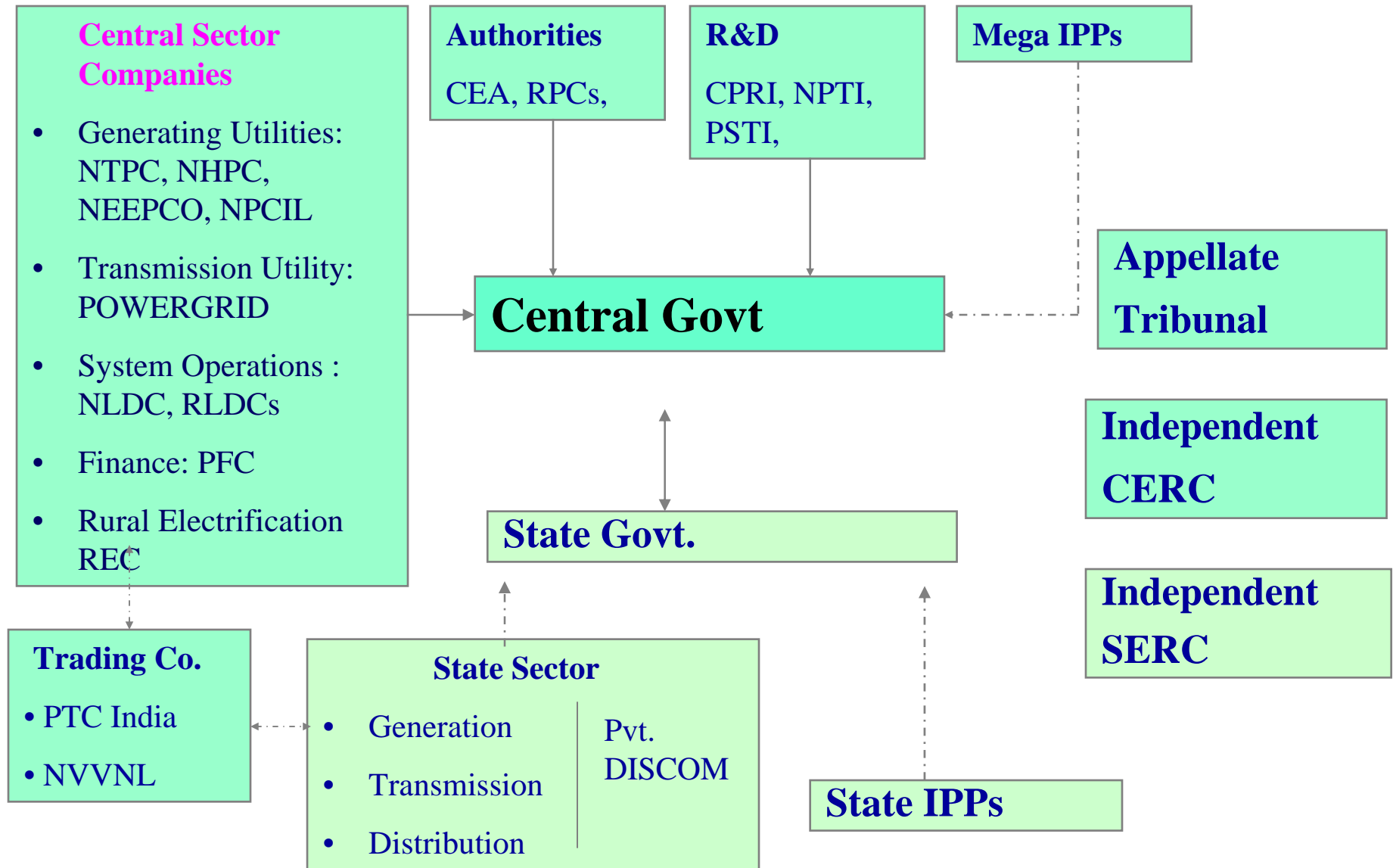
Private Trading Licensees

- Through regulations, CERC have issued terms and conditions for trading licensees. 42 Trading Licensees.

Private Transmission Licensees

- Many private JVs with CTU and private transmission licensees.

Institutional Framework... Complete picture



India Power Sector- Key Statistics



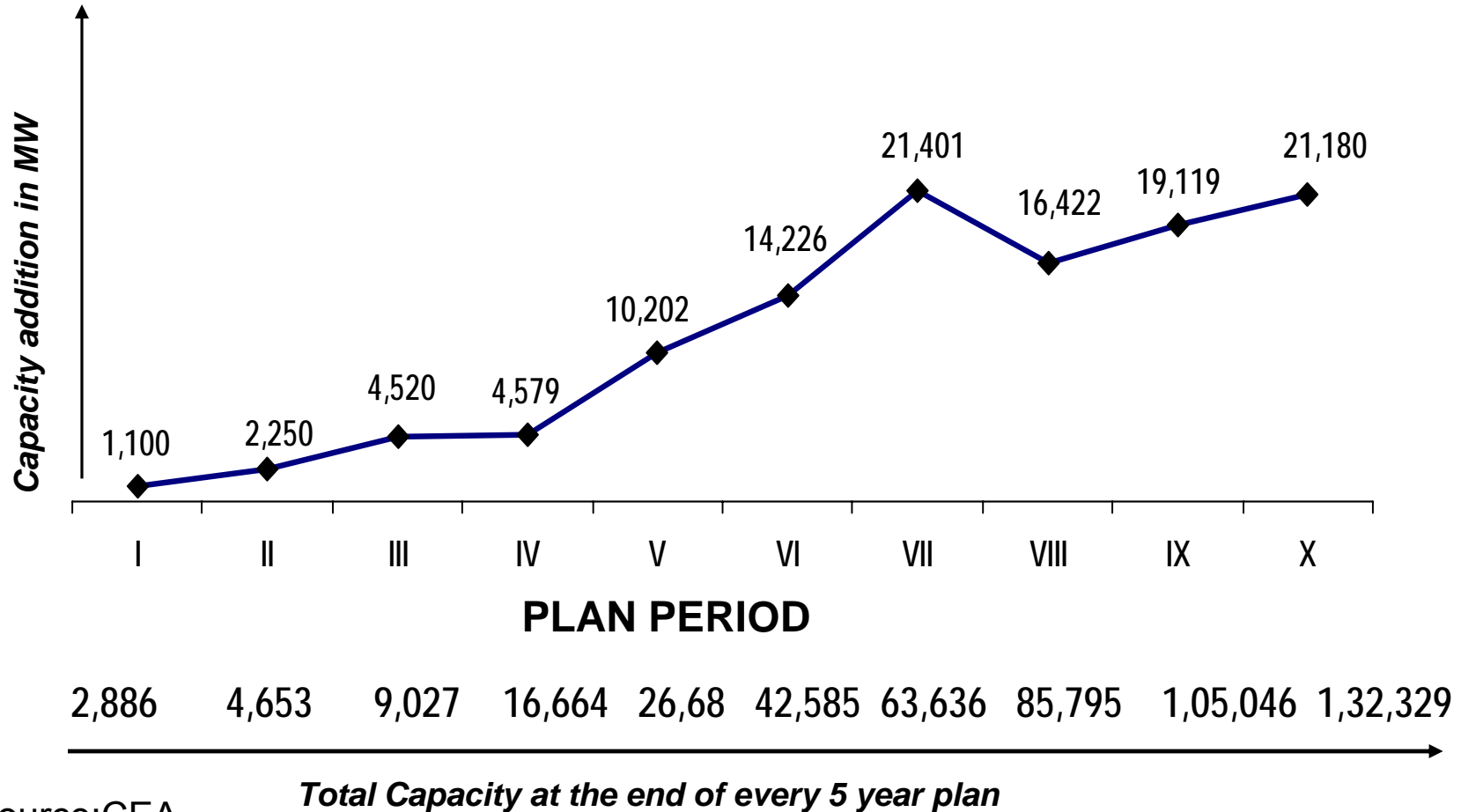
❖ Indian power sector is the third largest in Asia after China and Japan

- Area :2,973,190 km²
- Population : 1027 m
(urban 72%,rural 28%)
- Installed Capacity: ~1,48,000 MW (as on 31st March 2009)
- Peak Demand: 108,866 MW
- Demand Met : 90,793 MW
- Peak Deficit: 16.6%
- Energy Requirement : ~ 740 BU
- Energy Availability: ~ 666 BU
- Energy Deficit: 9.9%
- Per capita consumption : ~800 kWh
- Five regional grids
- Two synchronous grids

❖ Power for All by 2012 : 11th Plan (2007-2012) Target Capacity Addition : 78577 MW

Source: CEA

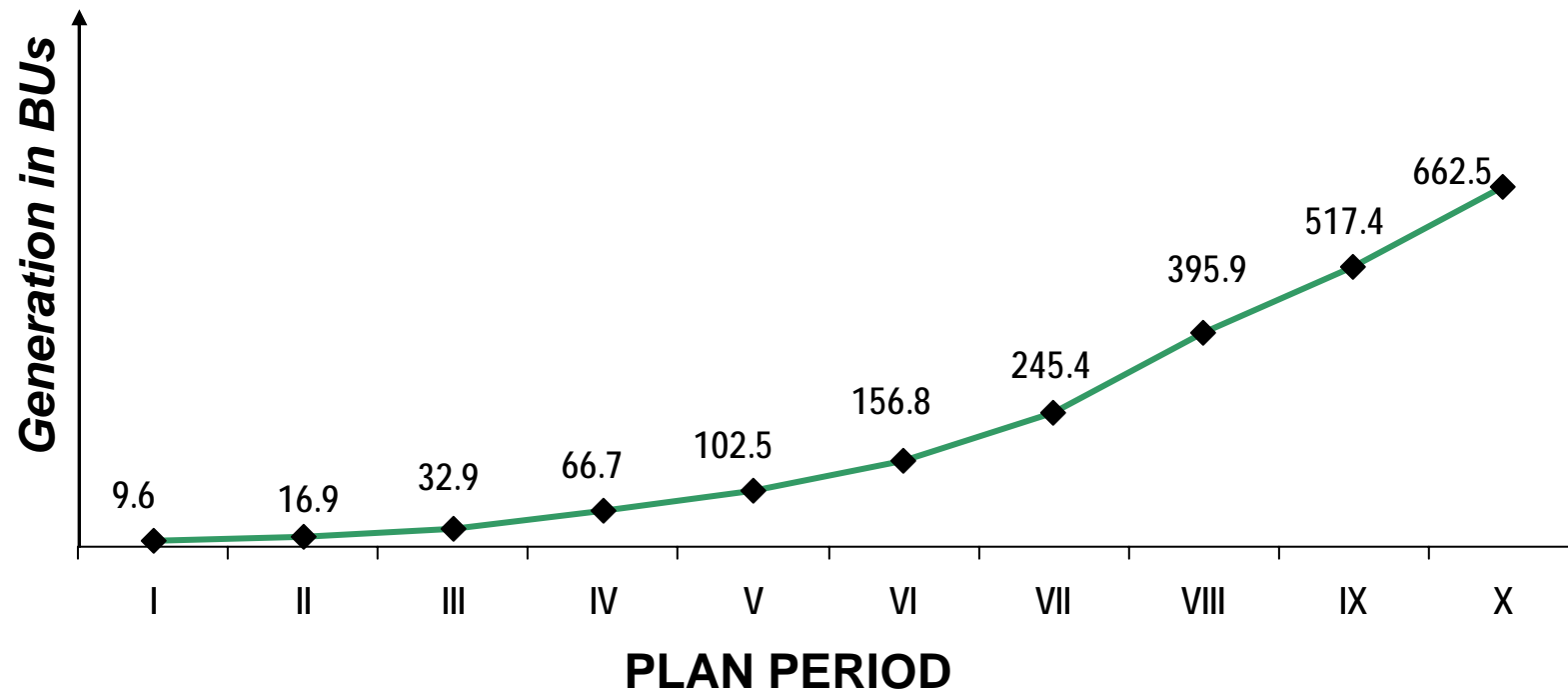
Generation capacity additions (over Five Year Plan Periods)



Source:CEA

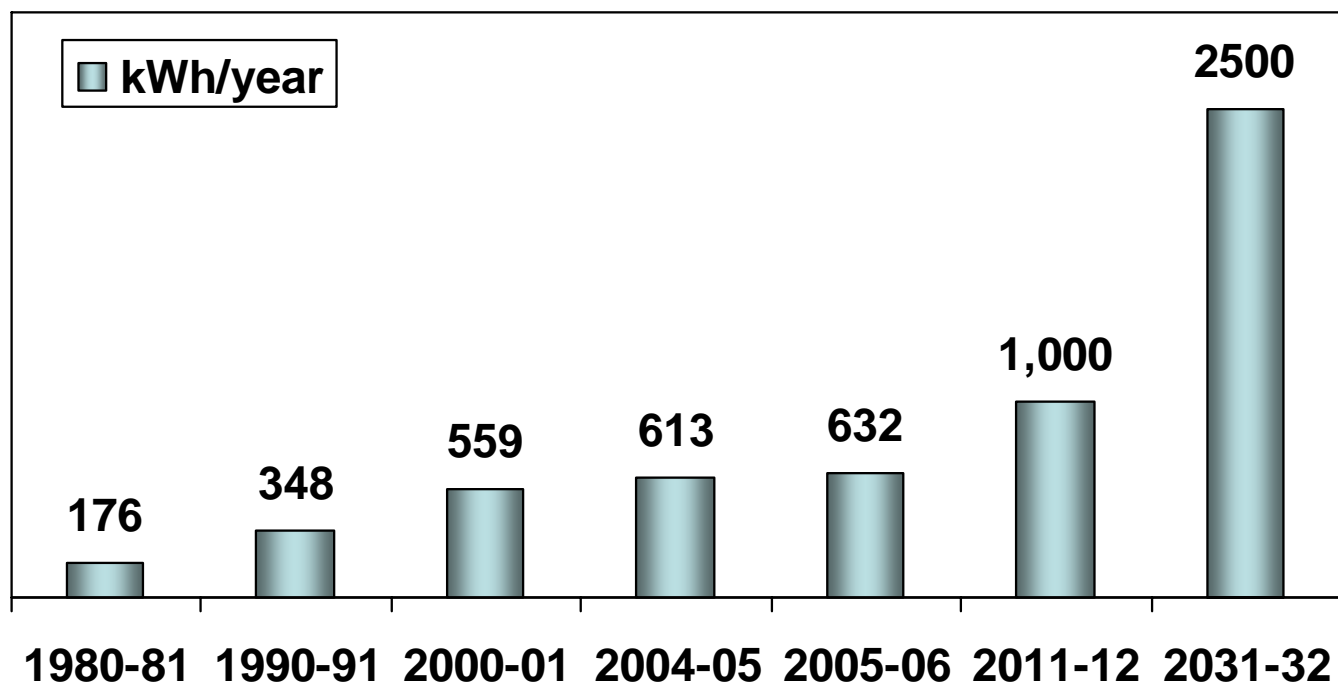
Yearly Generation

(over Five-year periods)



Source:CEA

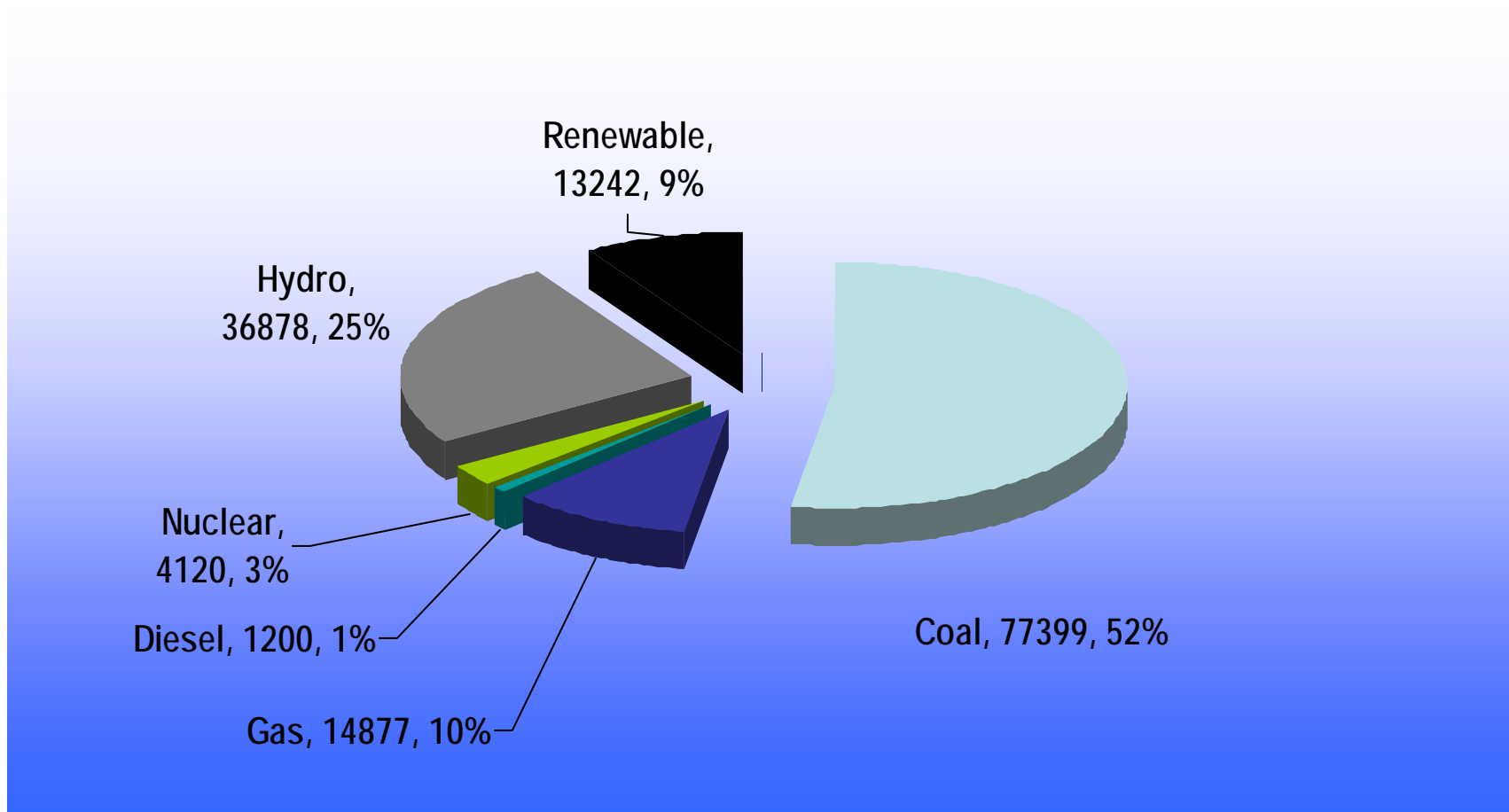
Per Capita Consumption of Electricity



Source:CEA , As per UN Methodology (Gross Electrical Energy Availability / Population)

Installed Generating Capacity

February, 2009 : FUEL WISE



India Power Sector- Electricity Act, 2003



- Generation free from licensing. (Section 7)
- Requirement of TEC for non-hydro generation done away with. (Section 7)
- Captive Generation is free from controls. Open access to Captive generating plants subject to availability of transmission facility. (Section 9)
- Clearance of CEA for hydro projects required. Necessary due to concern of dam safety and inter-State issues. (Section 8)
- Generation from Non-Conventional Sources / Co-generation to be promoted. Minimum percentage of purchase of power from renewable may be prescribed by Regulatory Commissions. (Sections 61 (h), 86 (1) (e))

- There would be Transmission Utility at the Centre and in the States to undertake planning & development of transmission system. (Sections 38 & 39)
- Load dispatch to be in the hands of a government company/organisation. Flexibility regarding keeping Transmission Utility and load dispatch together or separating them. Load Dispatch function critical for grid stability and neutrality as compare to generators and distributors. Instructions to be binding on both.
(Sections 26, 27,31, 38, 39)
- Transmission companies to be licensed by the Appropriate Commission after giving due consideration to the views of the Transmission Utility.
(Sections 15(5)(b))
- The Load Dispatch Centre/Transmission Utility / Transmission Licensee not to trade in power. Facilitating genuine competition between generators
(Sections 27, 31, 38, 39,41)
- Open access to the transmission lines to be provided to distribution licensees, generating companies. (Sections 38-40)
- This would generate competitive pressures and lead to gradual cost reduction.

- Distribution to be licensed by SERCs.
- Distribution licensee free to take up generation & Generating co. free to take up distribution licence. This would facilitate private sector participation without Government guarantee/ Escrow. (Sections 7, 12)
- Retail tariff to be determined by the Regulatory Commission. (Section 62)
- Metering made mandatory. (Section 55)
- Provision for suspension/revocation of licence by Regulatory Commission as it is an essential service which can not be allowed to collapse. (Sections 19, 24)
- Open access in distribution to be allowed by SERC in phases. (Section 42)
- In addition to the wheeling charges provision for surcharge if open access is allowed before elimination of cross subsidies, to take care of
 - Current level of cross subsidy
 - Licensee's obligation to supply. (Section 42)
 - This would give choice to customer.

- Trading distinct activity permitted with licensing. (Section 12)
- Regulatory Commission may fix ceiling on trading margin to avoid artificial price volatility. (Sections 79 (2) (b) & 86 (2) (b))
- The Regulatory Commission to promote development of market including trading. (Section 66)

Regulatory Commission/Appellate Tribunal

- State Electricity Regulatory Commission to be constituted within six months. (Section 82)
- Provision for Joint Commission by more than one State/UT. (Section 83)
- Provision for constitution of Appellate Tribunal consisting of Chairman and three Members. (Section 110, 112)
- Appellate Tribunal to hear appeals against the orders of CERC/SERC, and also to exercise general supervision and control over the Central/State Commissions. (Section 111)
- Appeal against the orders of Appellate Tribunal to lie before the Supreme Court. (Section 125)
- Appellate Tribunal considered necessary to-
 - Reduce litigation and delay in decisions through High Court.
 - Provide technical expertise in decision on appeals.

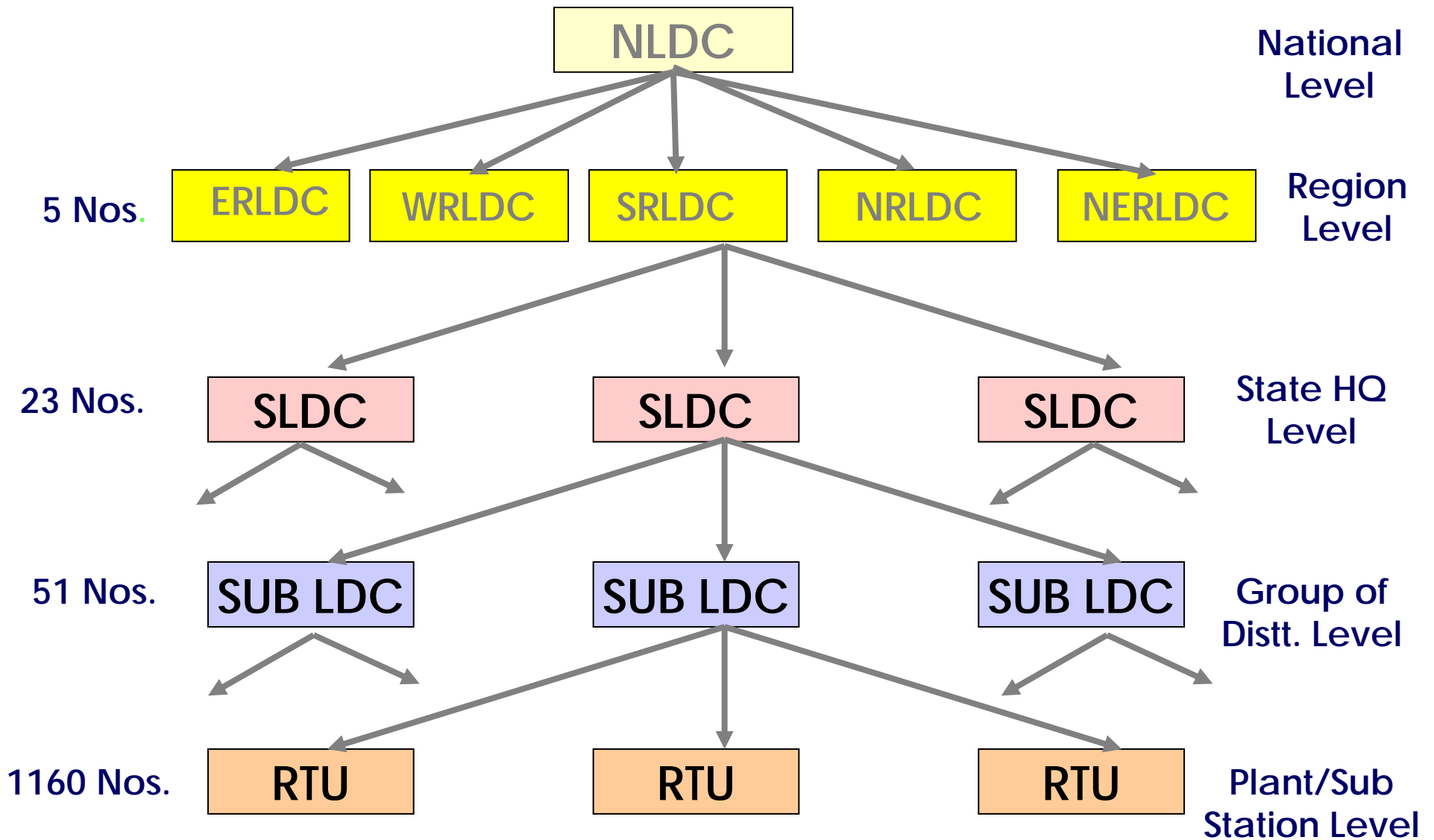
Measure against theft of power

- Focus on revenue realization rather than criminal proceedings. (Sections 126, 135)
- Penalties linked to the connected load and quantum of energy and financial gain involved in theft. (Section 135)
- Provisions for compounding of offences. (Section 152)
- Assessment of electricity charges for unauthorized use of electricity by the assessing officer designated by the State Government. (Section 126)
- Theft punishable with imprisonment. (Section 135)
- Punishment provision for abetment of theft. (Section 150)
- Special Courts (Sections 153-158)

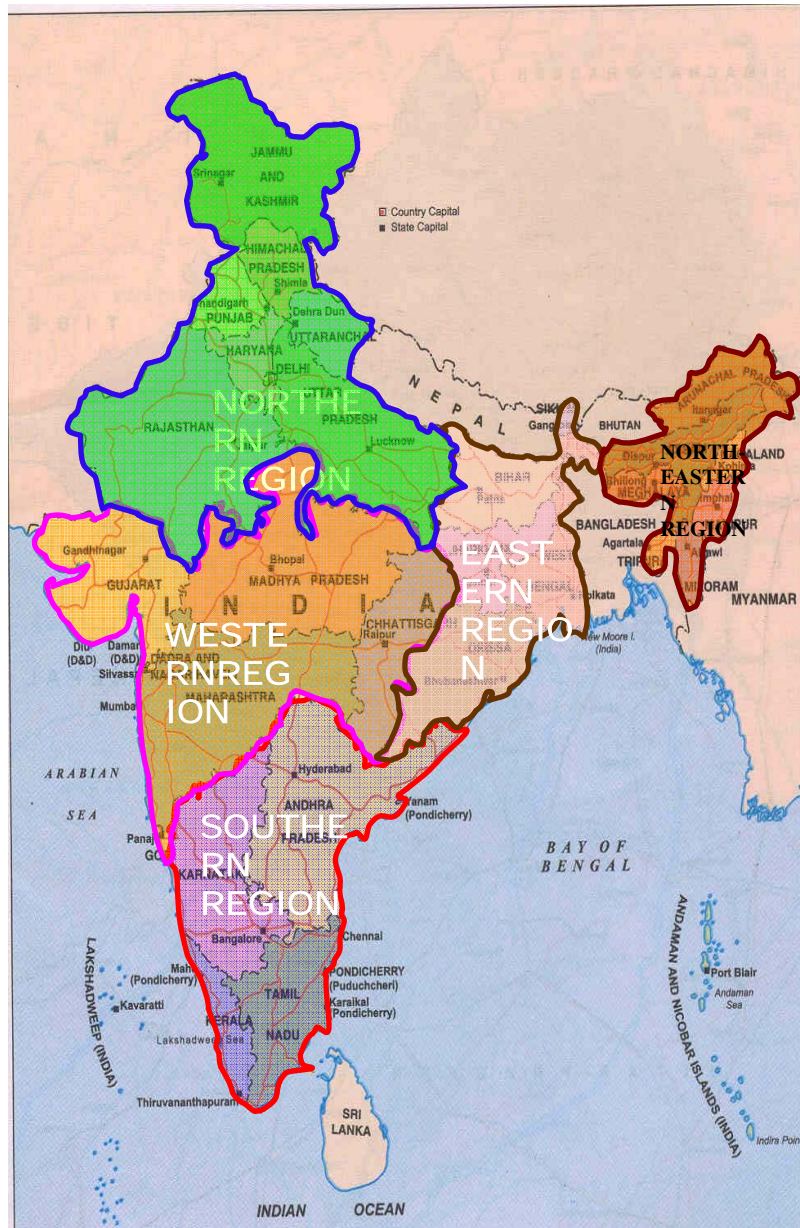
System Operations



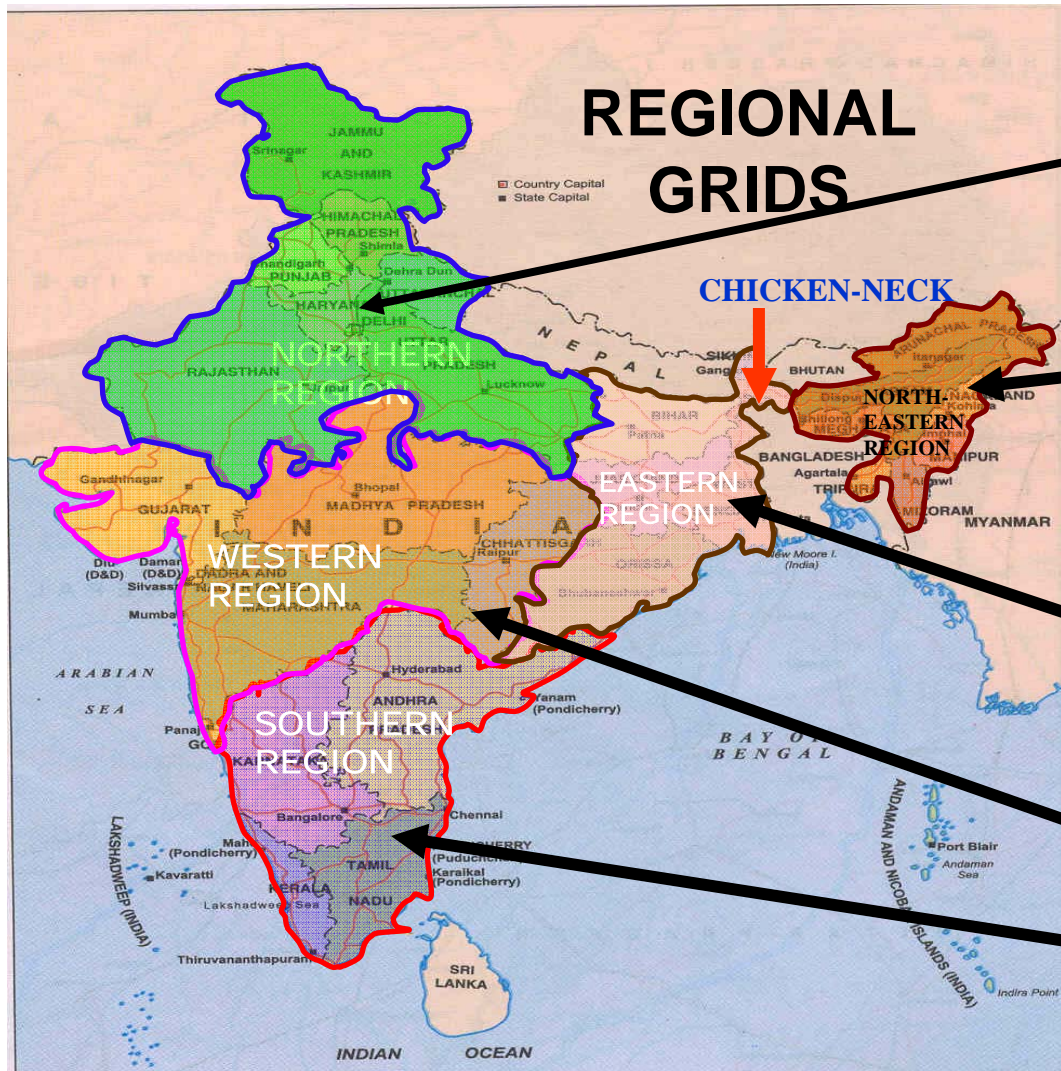
System Operation... Grid Operation Hierarchy



Electricity Regions in India



Peculiarities of Regional Grids



Deficit Region
Snow fed - run-of-the-river hydro
Highly weather sensitive load
Adverse weather conditions: Fog & Dust Storm

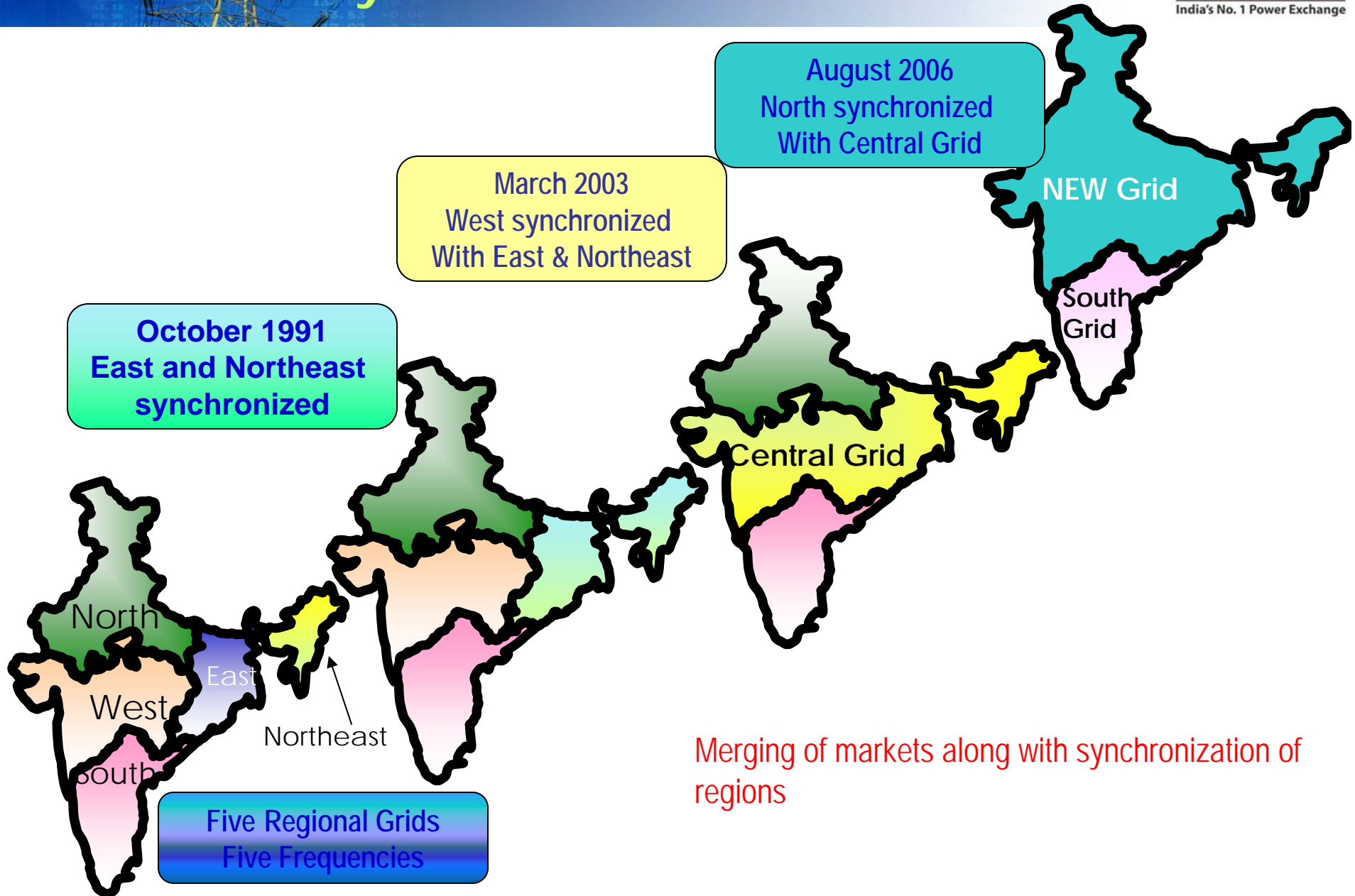
Very low load
High hydro potential
Evacuation problems

Low load
High coal reserves
Pit head base load plants

Industrial load and agricultural load

High load (40% agricultural load)
Monsoon dependent hydro

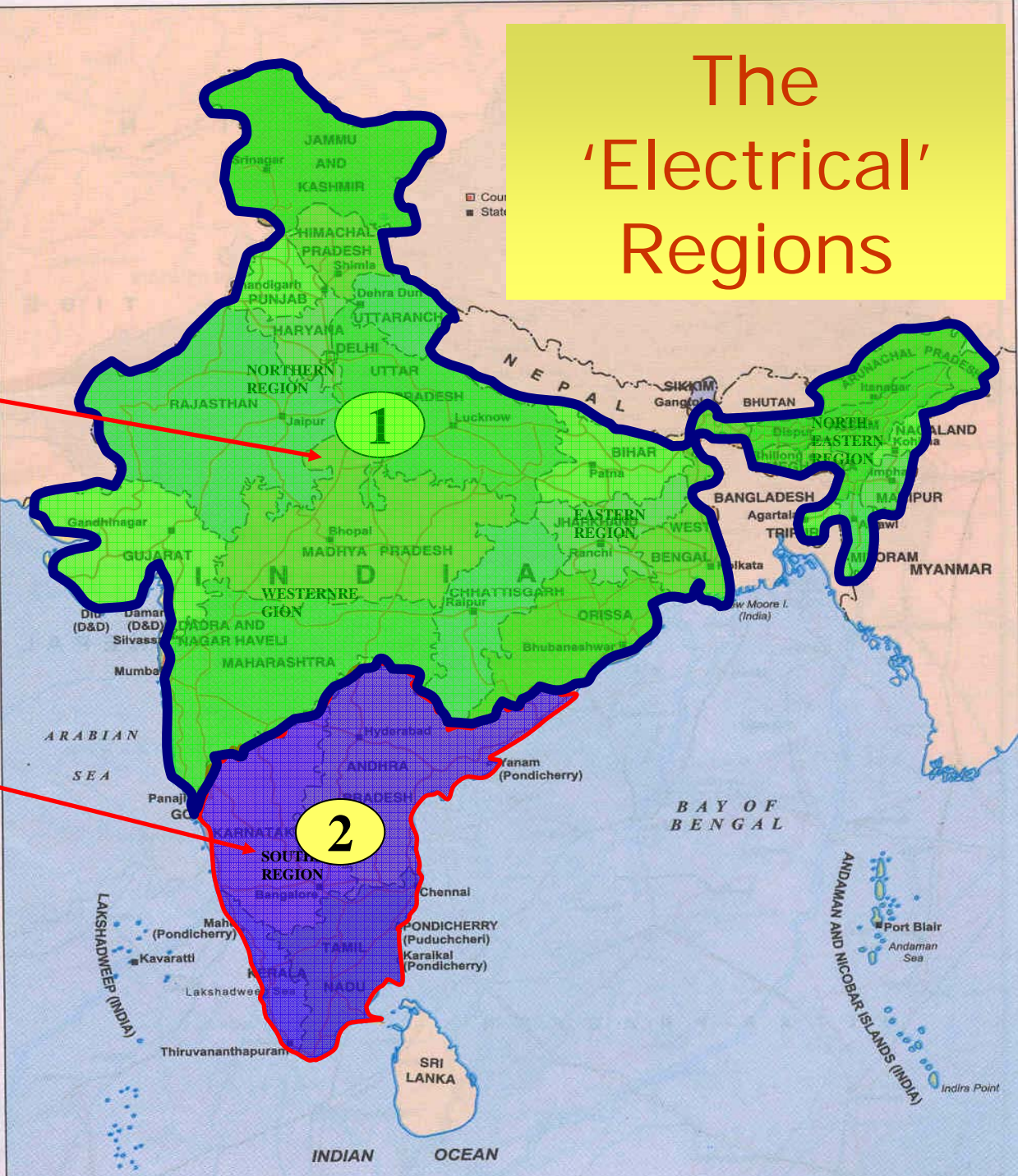
Evolution of Synchronous Grids





The 'Electrical' Regions

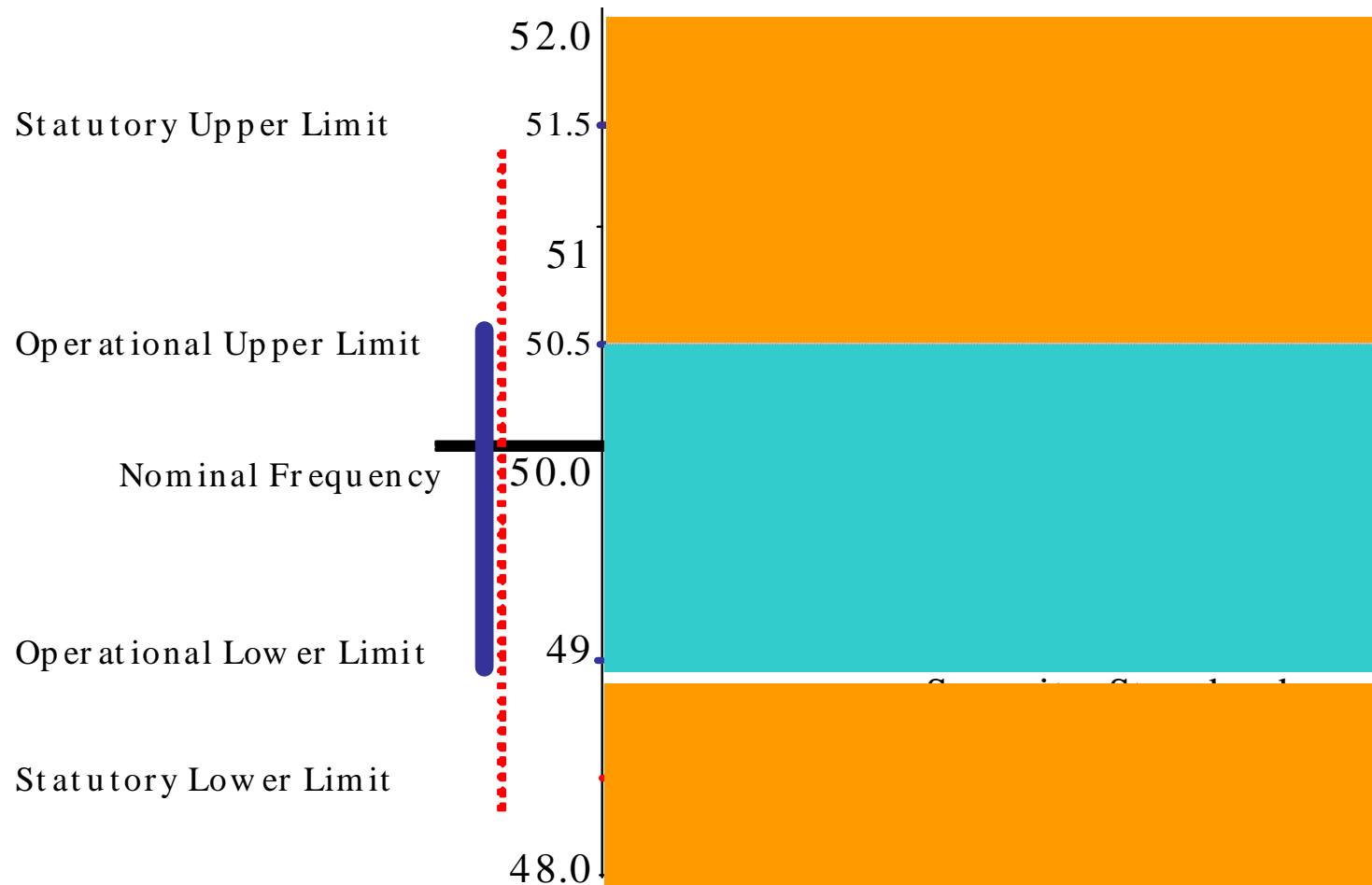
'N-E-W' Grid



SOUTH Grid



Frequency-related Stipulations



Indian Electricity Grid Code
Feb.'2000

Availability Based Tariff
2002-03

Open Access Regulations
2004

Power Exchange: Guidelines and establishment
2007-08

**Ancillary
Market**

**Capacity
Market**

Power Market Design

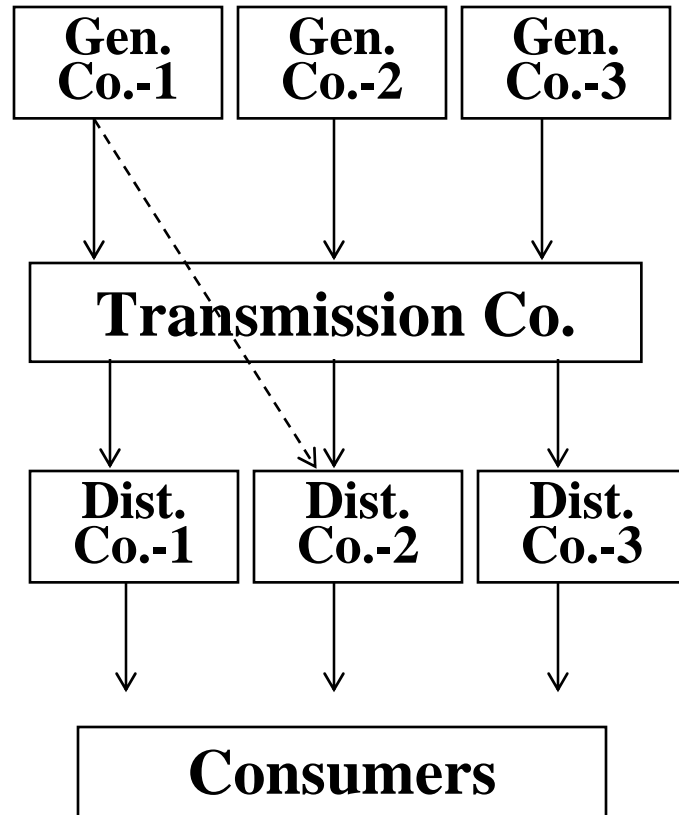


- **Transactions**

....a transaction where the price of power is negotiable and options exist about whom to trade with and for what quantum, to obtain the best bargain.

- **Electricity Act,2003 defines trading as
'Purchase of electricity for resale, thereof.'**

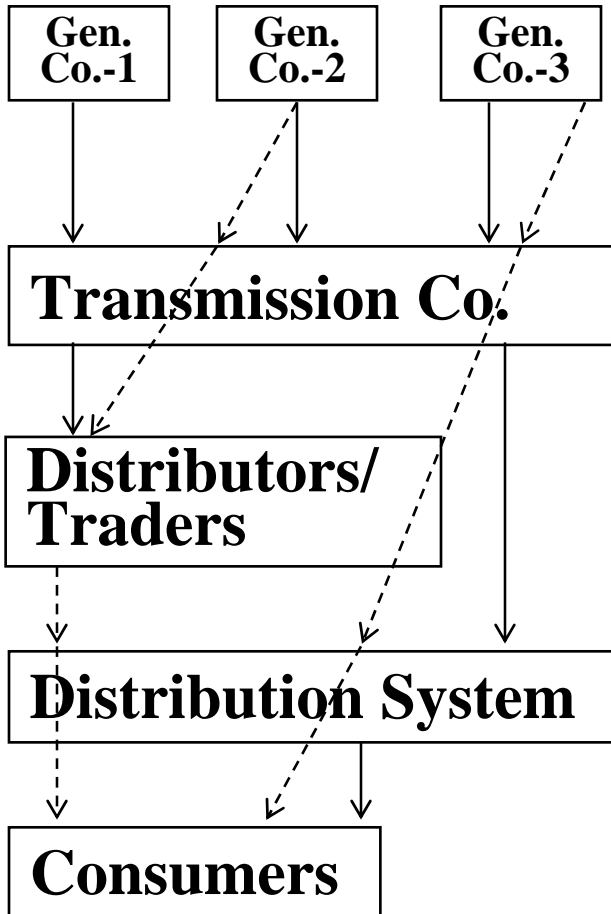
- Complete Monopoly
- Single-Buyer Model
- Wholesale Competition
- Retail Competition or Direct Access



Competition in generation

Transmission a natural monopoly therefore regulated

Distributors can choose who will supply them (Distributor can buy from any GENCO).



Competition in Generation

Transmission: Natural monopoly

Distributors can choose who will supply them

Distribution: A monopoly

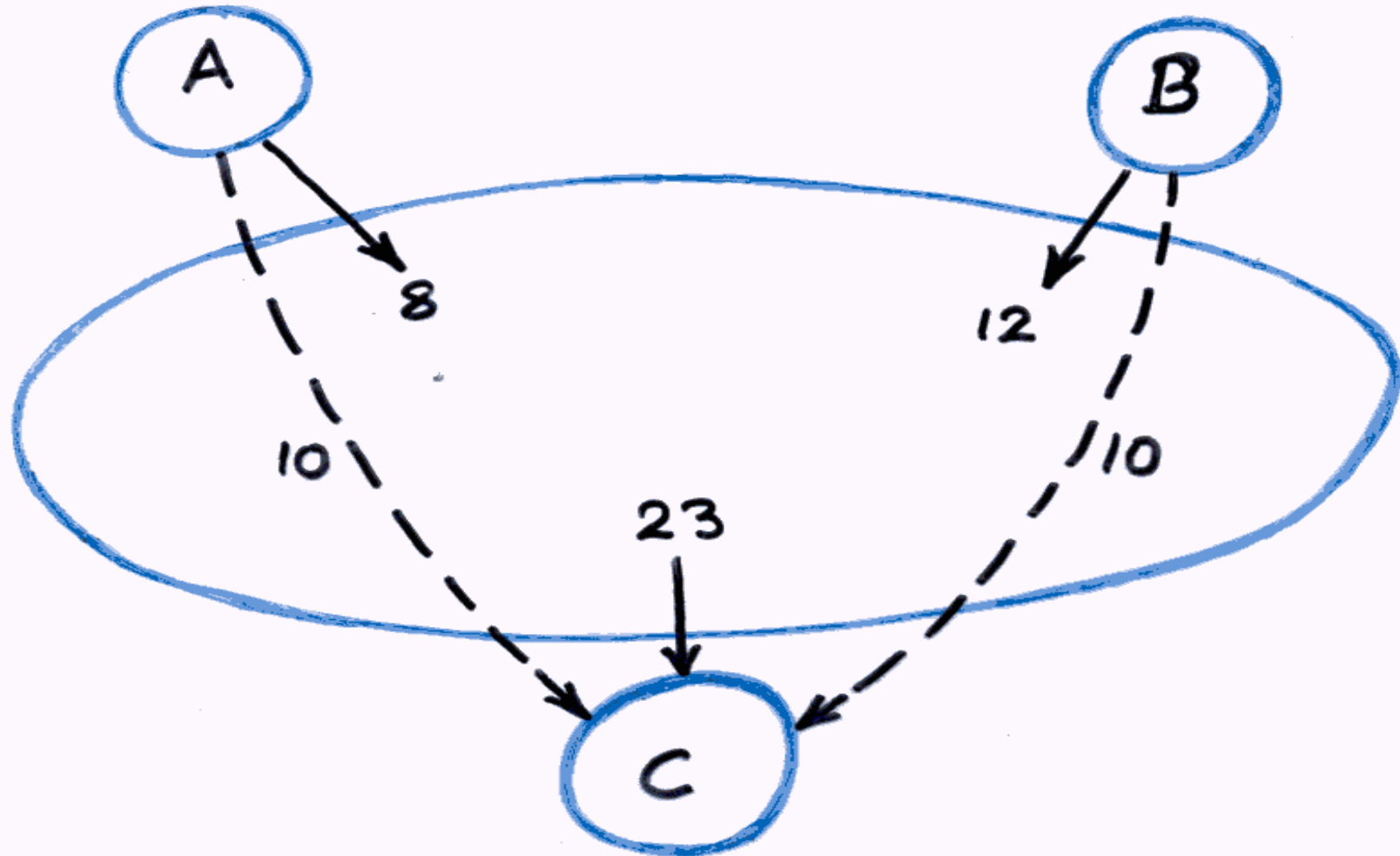
End consumer can choose who will supply them

How do you buy or sell a commodity ?

- which can not be seen, counted in numbers, or measured in kg, litres or metres,
- which can not be put in a container with a forwarding address, on a particular truck taking a particular route, but flows as per laws of physics,
- which can not be stored, and whose availability and cost keep changing widely,
- which intermingles with all other supplies in an inevitable pool, and can not have an owner's name tag ?
- ***There is another peculiarity. the buyer has no control over what the seller supplies, and the seller has no control over what the buyer draws from the pool, and the two may not match !***

It is crucial to have mechanism for commercial handling of mismatches

Market Design...



- 1) Power trading has to be notional: buyer to pay the agreed amount to the supplier for scheduled quantum of power.
- 2) Payment for variations from the schedule through a common mechanism, e.g. U.I.

TO AVOID DISPUTES

Indian Power Markets ... historical perspective

- ▶ **Pre-1991 : Era of single-part tariff**
- ▶ Bilateral transactions in radial transfer mode
- ▶ Very few one-to-one transactions (3-month / year)
- ▶ Single-part tariff

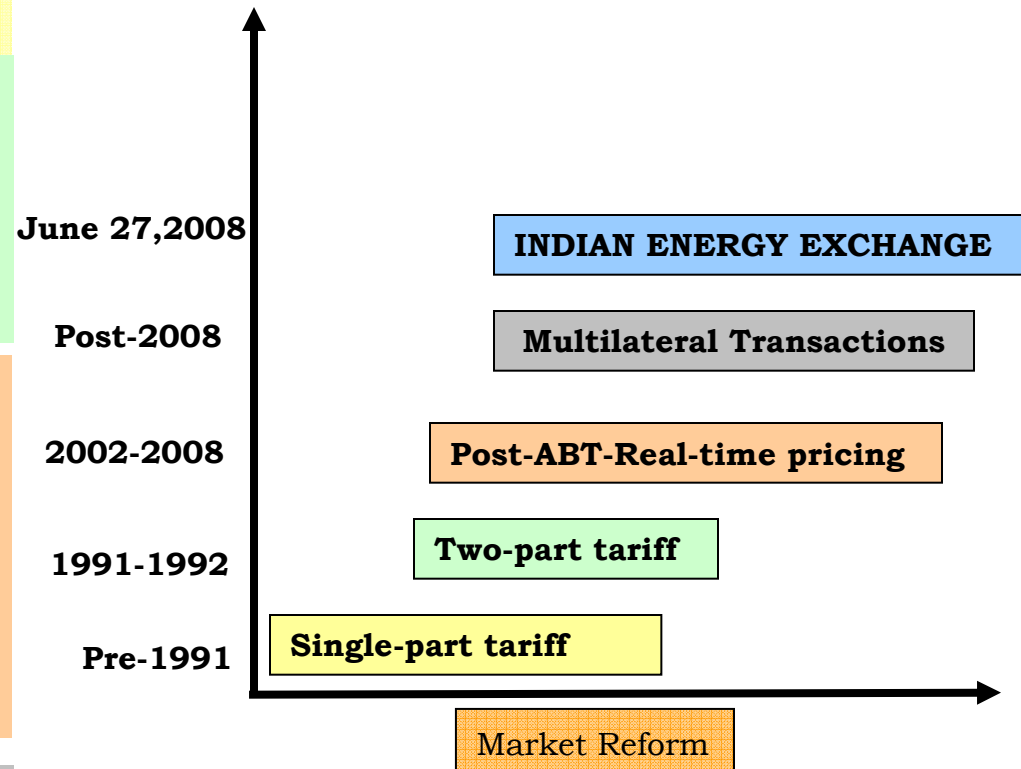
- ▶ **1991-2002 : Era of two-part tariff**
- ▶ Bilateral market in intra-region parallel mode
- ▶ Few transactions (month-wise)
- ▶ Two-part tariff
- ▶ CGS Share trades in form of overdrawal/underdrawa

2002-2008 : Post-ABT - Era of real-time pricing

- ▶ Electricity Act: Emphasis market Development
- ▶ Real-time market
- ▶ Multiple regions in parallel
- ▶ Large transactions – UI market Vs Bilateral market
- ▶ Trading on Day and ToD basis

Post 2008 : Era of Multilateral Transactions

- ▶ Era of true competitive markets
- ▶ UI, Bilateral and Collective transactions
- ▶ Very large transactions
- ▶ Trading on hourly basis



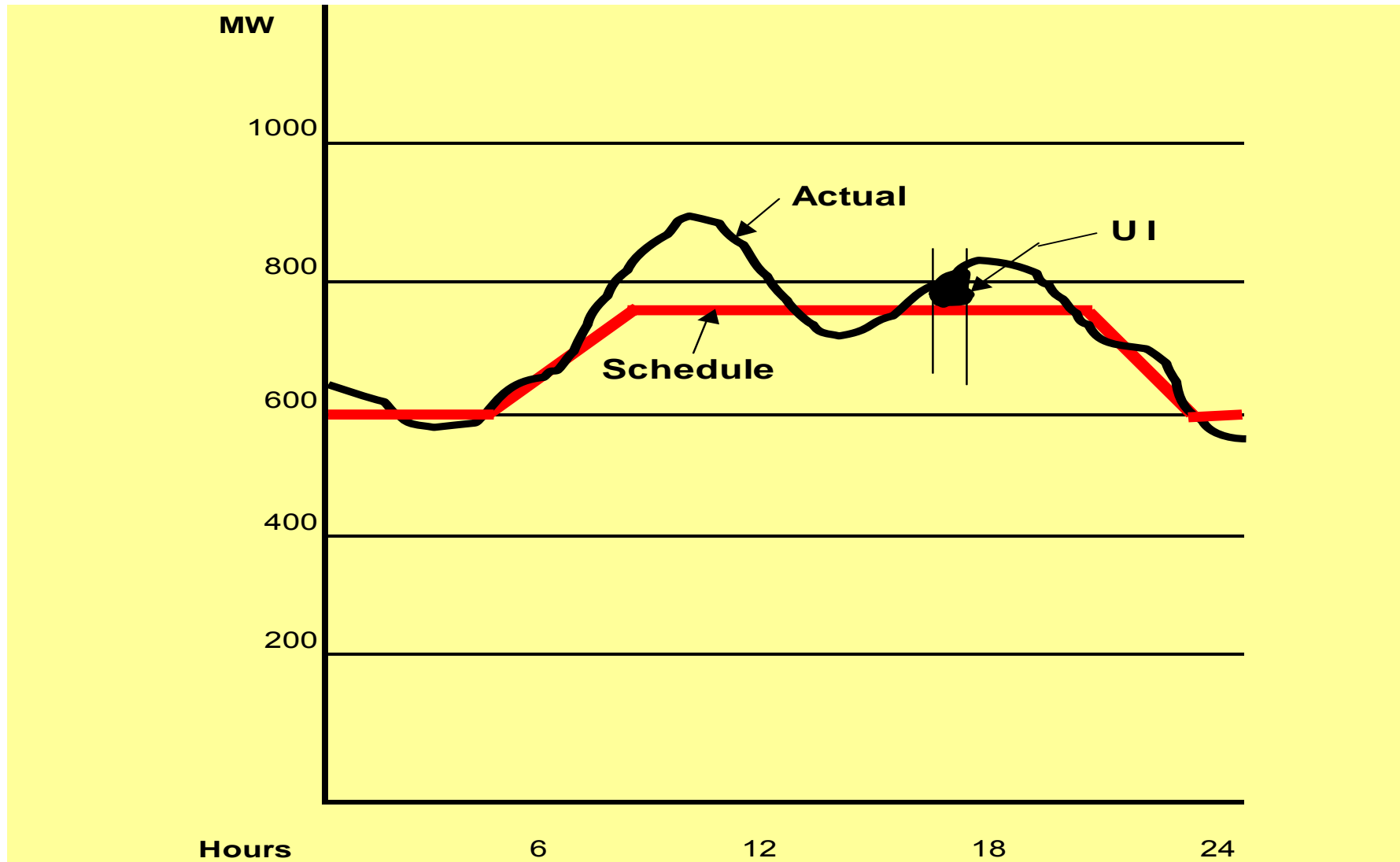
Source : Paper by IIT Kanpur at INDICON 2008

AVAILABILITY BASED TARIFF (ABT)

Features:

- ❖ Unique commercial mechanism linked with frequency
- ❖ Fixed Charges i.e. Capacity charges
 - As per Plant Availability.
- ❖ Variable Charges i.e. Energy charges
 - As per Schedule.
- ❖ Unscheduled Interchange(UI) i.e. deviations from schedule (Schedule – Actual)
 - Price as per prevailing system frequency

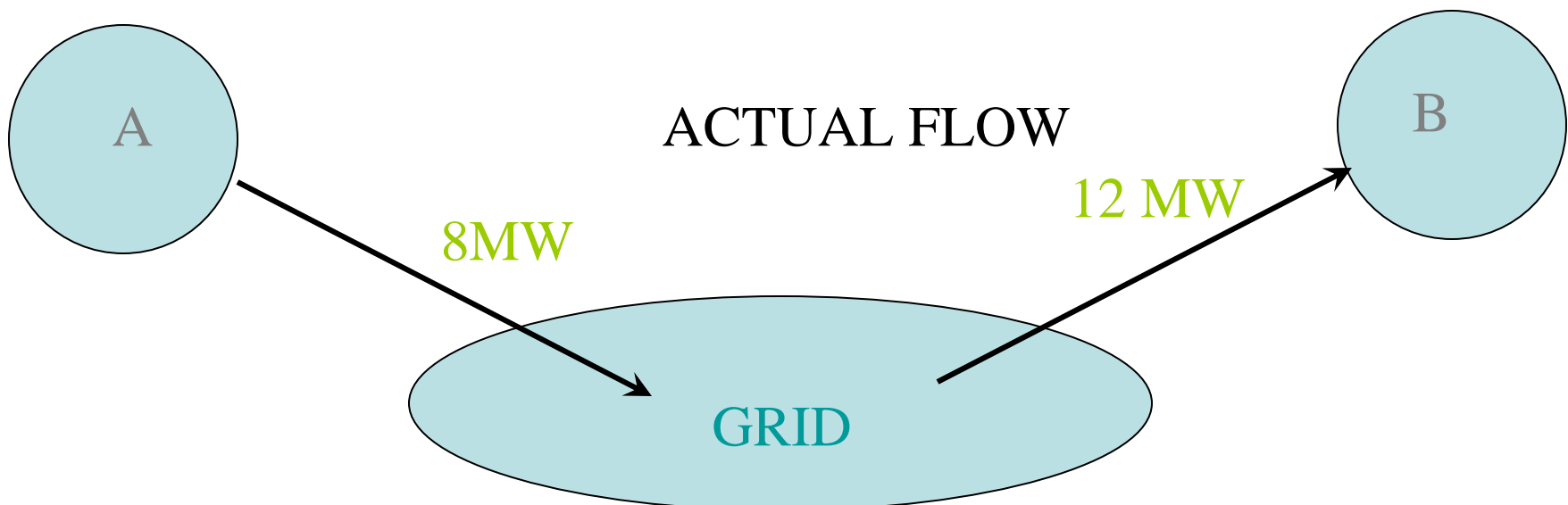
Schedule vs actual drawal of a Utility



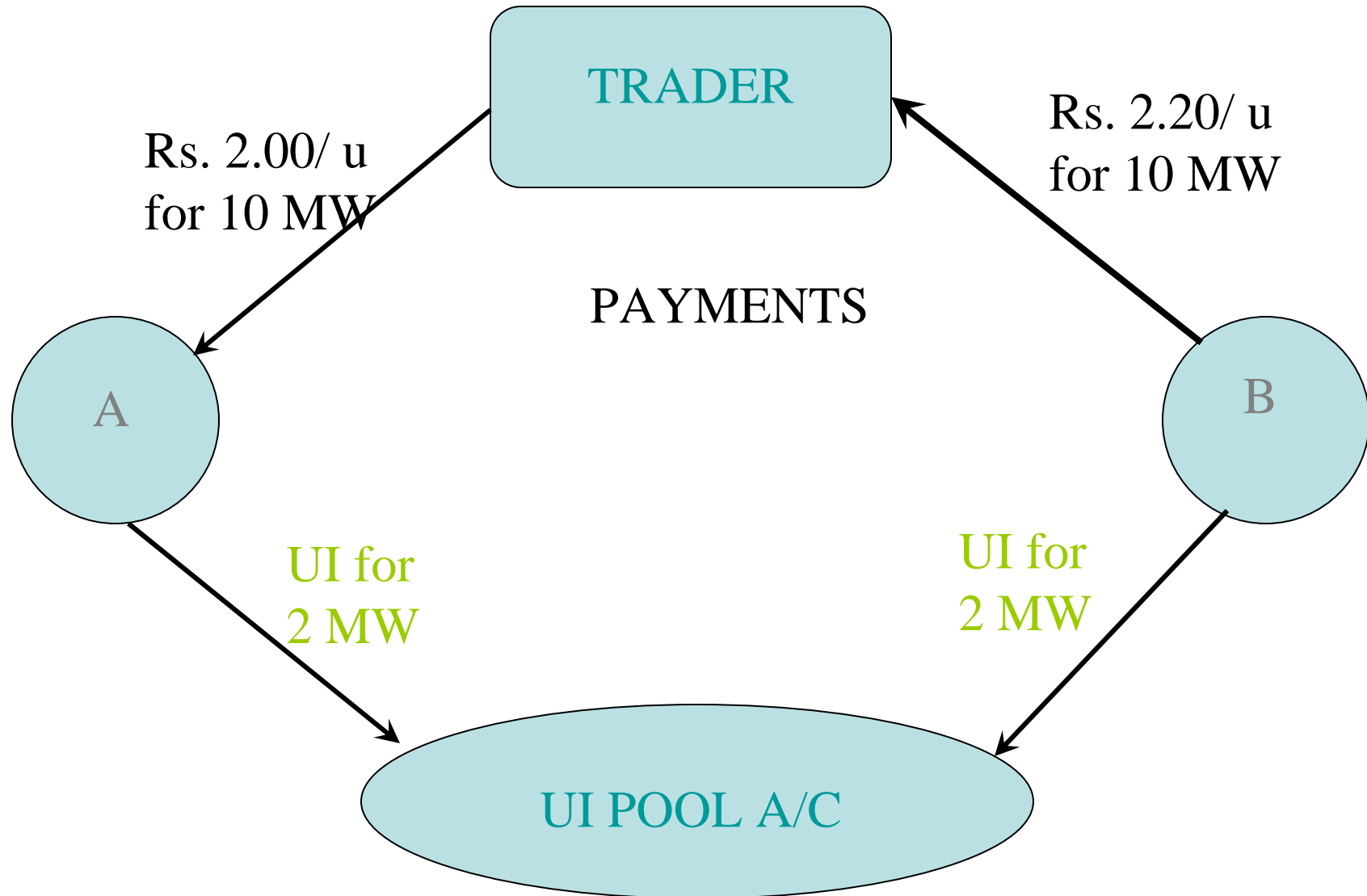
- **Achievements**

- Implemented between July 2002 and Nov.'2003
- Improved quality of supply.
- Merit order Operation.
- Grid discipline
- Emphasis on load forecasting
- Discourage overdrawals during low frequency
- Facilitate bi-lateral trading
- Maximisation of generation availability

Market Design...



Market Design...

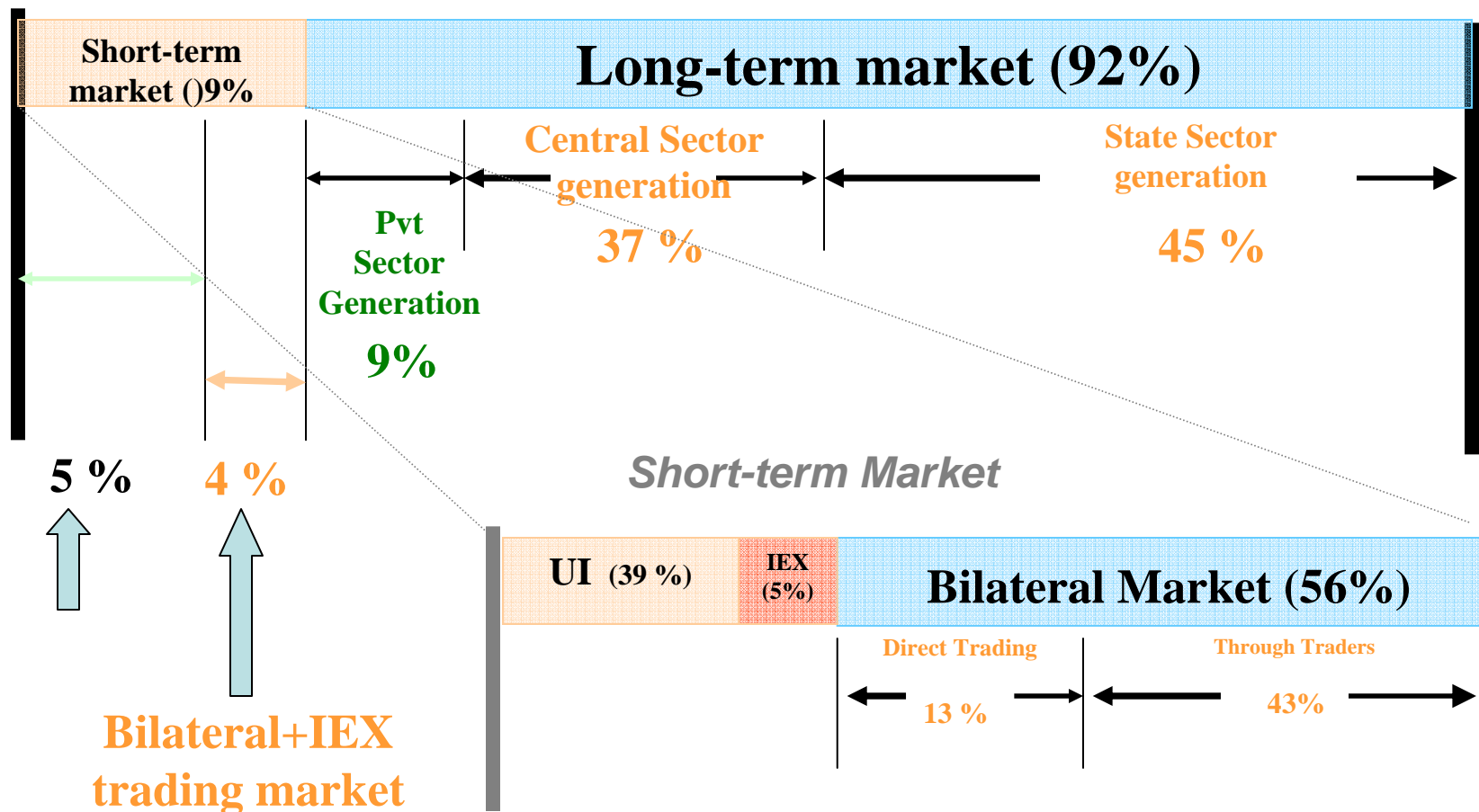


- Trading
 - Long / Short term directly OR through trader under bilateral contracts OR through Power exchanges
 - Spot trading through UI.

- UI : Spot Market
 - Unscheduled exchanges with the pool.
 - No trader involved
 - Price linked to system frequency, available everywhere
 - Robust settlement system

Electricity Market Segments

An electricity market is a system for effecting purchase and sale of electricity using supply and demand to set the price.



Market Design

- Indian Market Design is suitable to our conditions where command-and-control doesnot always give most optimal results.
 - In developing country like ours, grid-discipline is difficult to maintain
- In case, different mechanism exist, still we can agree to maintain UI mechanism for inter-country deviations

Security-related Provisions in Grid Code

- Should grid-code be similar?

Exchange based transactions

- Delivery point, transmission charges, losses, deviation-settlement ?

Thank You !!!
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