

"9th Capacity Building Programme for Officers of  
Electricity Regulatory Commissions"  
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## Theory and Economics of Power Sector Regulation

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### In Search for a Theory of Regulation



Why is there regulation?

- To address market failure
  - Monopoly/ natural monopoly
- Role of interest groups
- Role of political pressure



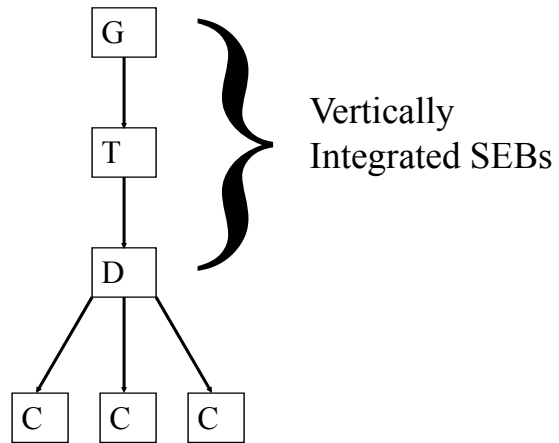
## ‘Theories’ of Regulation

- Public Interest Theory → Normative Analysis as a Positive Theory
- Capture Theory
- Economic Theory of Regulation
  - Stigler/Petzman Model
  - Becker Model

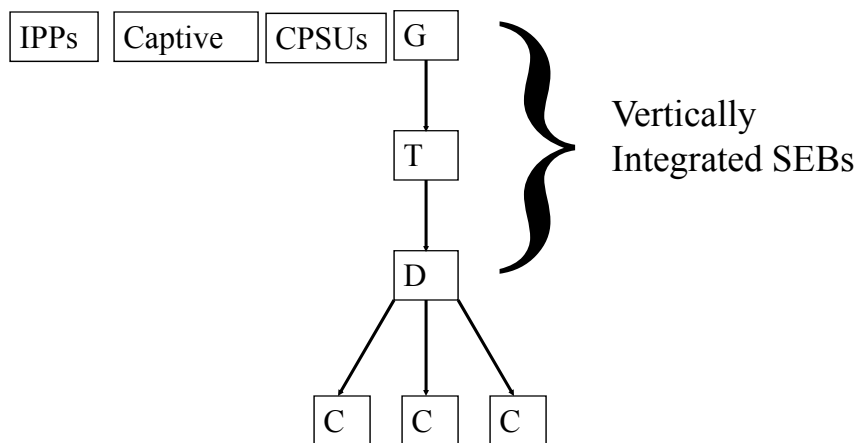
Emerging Market Structure



## Vertically Integrated SEBs



## Vertically Integrated SEBs





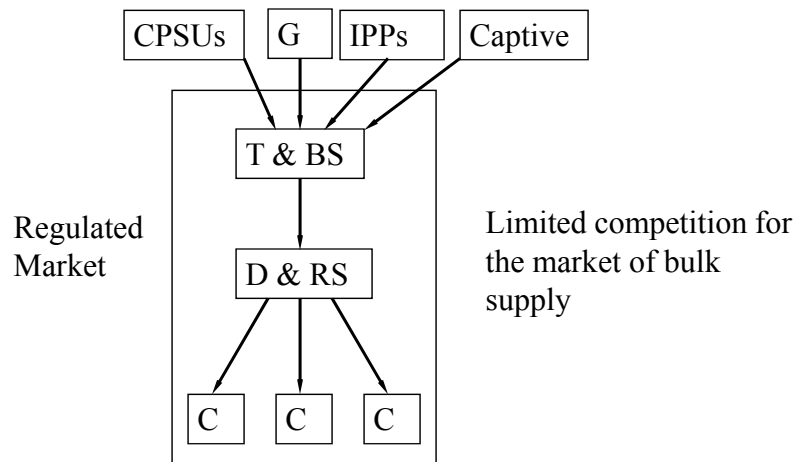
## Segments of the Electricity Markets

Main segments of the power sector are,

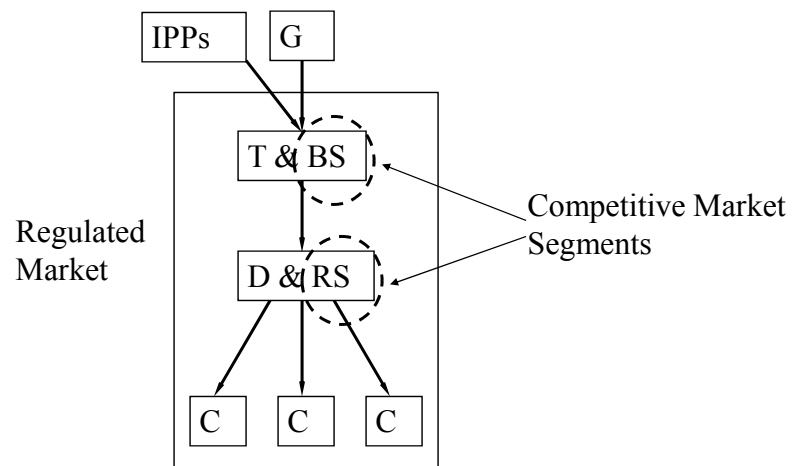
- |                 |          |         |
|-----------------|----------|---------|
| • Generation    |          | Genco   |
| • Transmission  | } T & BS | Transco |
| • Bulk Supply   |          |         |
| • Distribution  | } D & RS | Discos  |
| • Retail Supply |          |         |
| • Trading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



## Restructured Power Sector – Pre Electricity Act 2003



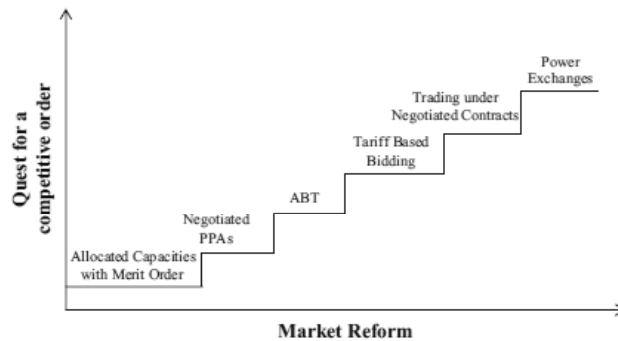
## Restructured Power Sector – Emerging Scenario (Post Electricity Act 2003)



## Post Electricity Act 2003



## Evolving competition in the bulk power market



## New Frontier for Competition



- Emergence of Retail Competition - Electricity Amendment Bill 2014
- Separation of Carriage and Content
- Can Competition for Bulk Power be replicated at retail level?



## Describing a Power Market (Contd.)

### Scope of Competition

- Negotiated
- Regulated
- Competitive Tendering
- Power Exchanges

### Scope of Participation

- Generators (including captive) and Discoms
- Traders and PXs
- Limited Customer Access
- Full Retail Competition



## Negotiated Contracts in Power Markets

- Negotiated PPAs directly between generator and distribution utilities (subject to regulatory approval)
- Short-term contracts brokered by registered traders (generally not subject to regulatory approval for price but for over all procurement limit for ST power procurement)



## Typical Characteristics of Infrastructure/Power Sector

- Technical characteristics
- Economic characteristics
- Socio-economic and organizational characteristics



## Technical characteristics

- Input into production
- Technical indivisibility (lumpiness of investment)
- Immobile
- Long life
- Assets not widely traded
- Exclusion could be technically difficult





## Economic characteristics

- Reduction of transaction costs
- Sub-additive cost function i.e. there are conditions for natural monopoly
- High sunk costs
- Network externalities
- Little rivalry in consumption



## Socio-economic and organizational characteristics

- Necessity of centralized planning and coordination
- Traditionally publicly owned but increasing private-public cooperation
- Sometimes considered citizen right (State should assure a minimum supply)



## Infrastructure/Electricity Provision & Need for Economic Regulation

- In in historic times, Kings built bridges, canals etc.!
- In modern times, ownership and operation of infrastructure is undertaken by the governments. While Policy/Regulation, Ownership and Operation was embedded with government, role of regulation was often ignored.

### Need for Economic Regulation

- Inadequate and poor quality of services, and poor financial performance under public ownership.
- Private ownership and operation brings in a concern of private monopoly for government as well as consumers .



## Economics of Regulation

- Perfect Competition - Pricing
- Monopoly - Pricing
- Consumer & Producer Surplus
- Market Failures
- Economic Regulation
- Pricing for Natural Monopoly

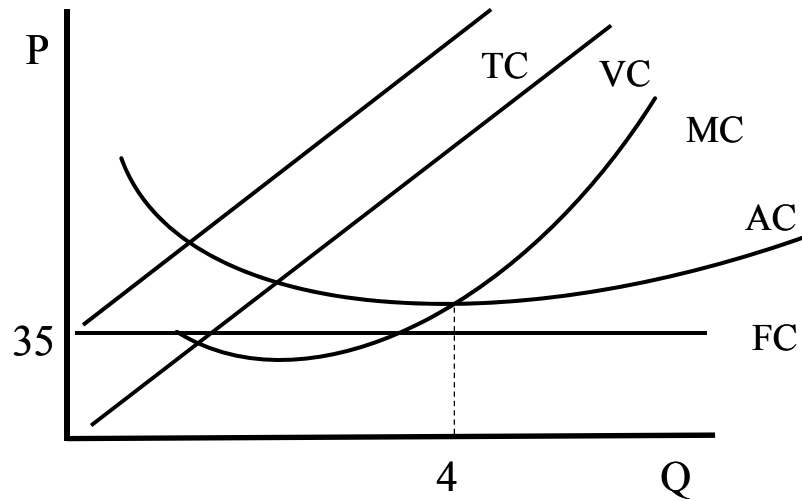
## Concepts of Perfect Competition and Monopoly

### Perfect Competition - Characteristics

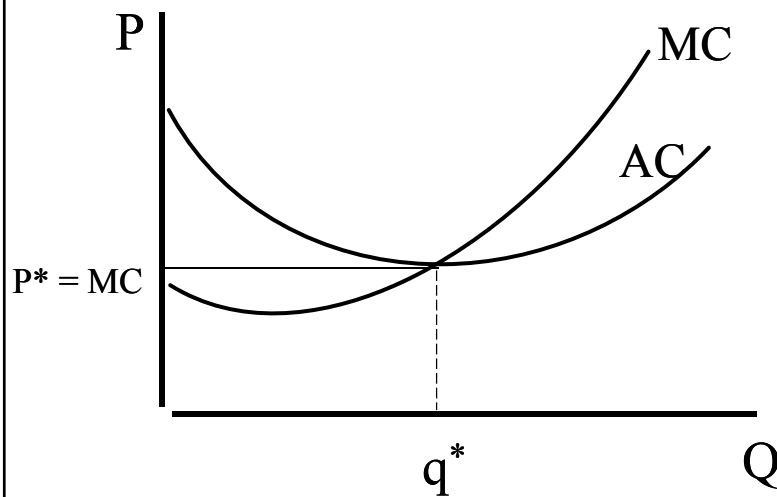
- Large number of buyers and sellers, each acting independently
- No buyer or seller is so large to influence the market
- Homogeneous product
- No barriers to entry or exit
- No artificial restraint on prices
- Perfect information
- Profit maximizing firms
- Perfect mobility of factors of production



## Cost Concepts

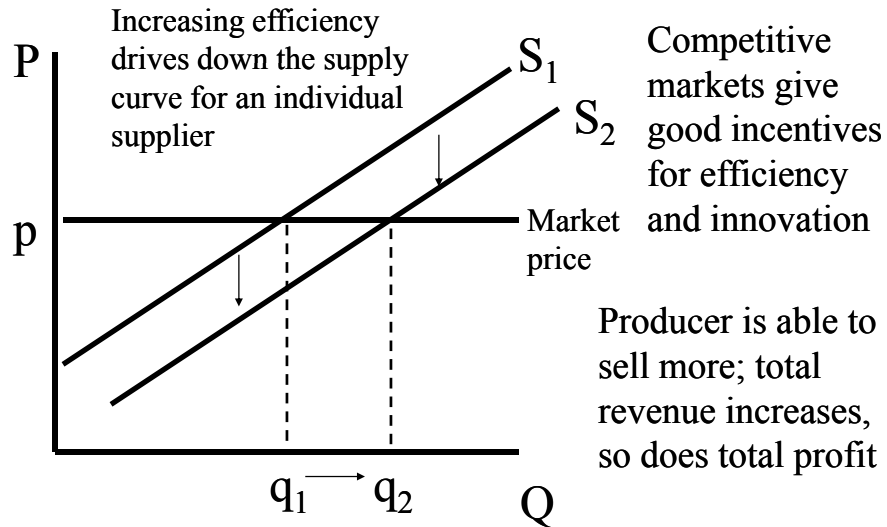


## Pricing – Perfect Competition Outcome for firm

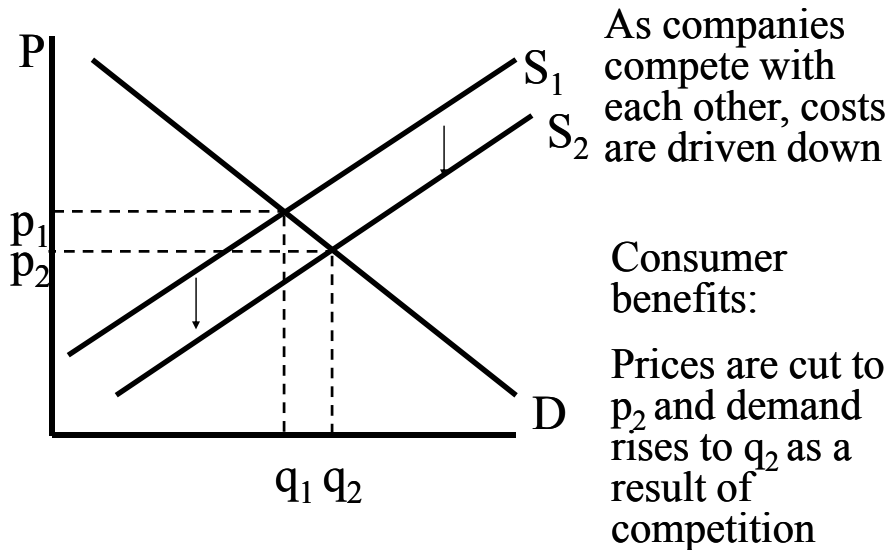




## Why companies care about costs

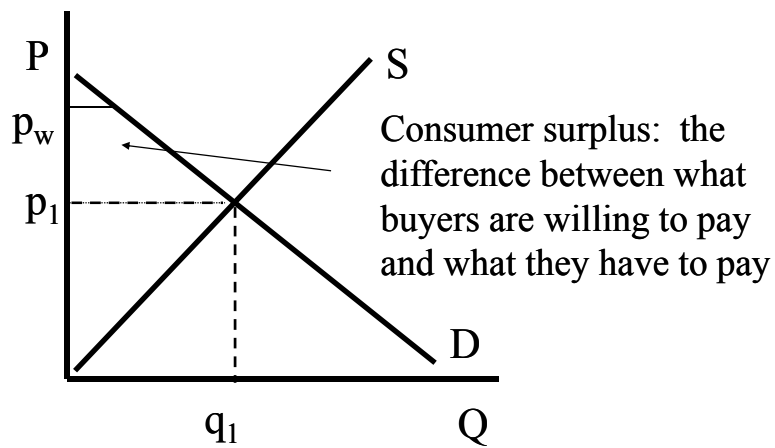


## Benefits of competition

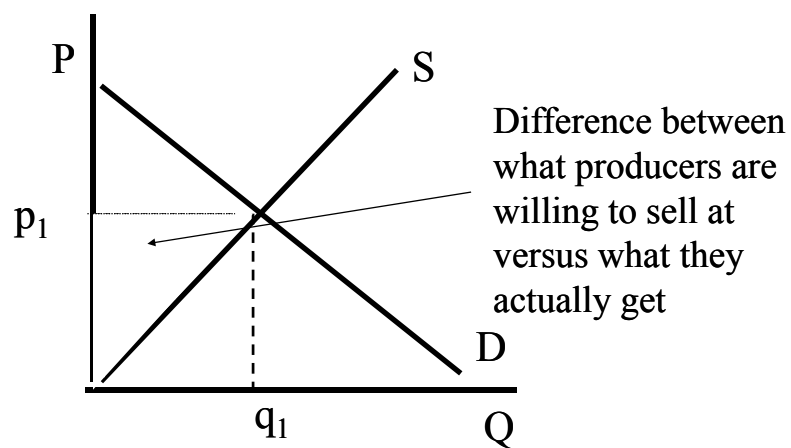




## Consumer surplus

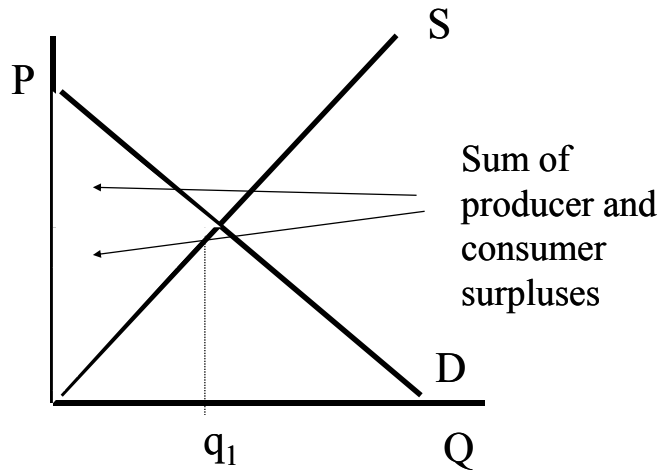


## Producer surplus



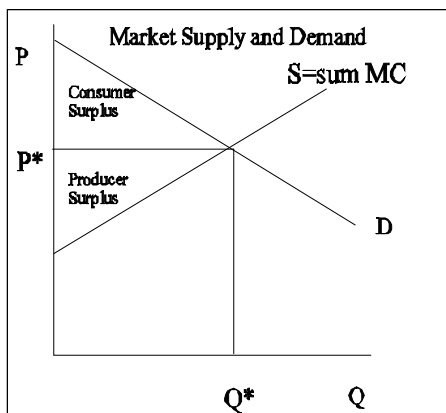


## Total surplus



## Perfect Competition - Social Welfare

- Efficiency in Production - incentive to produce at lowest possible cost
- Efficiency in Allocation - right amount of good is produced since MC to produce equals marginal willingness to pay equals price





# Concepts of Monopoly



## Monopoly

- Single producer (supplier) of products
- Price set by the Monopolist
- Faces no competition because of barriers to entry:
  - high entry costs (investment)
  - legal protection
  - patents, copyrights
  - natural monopoly

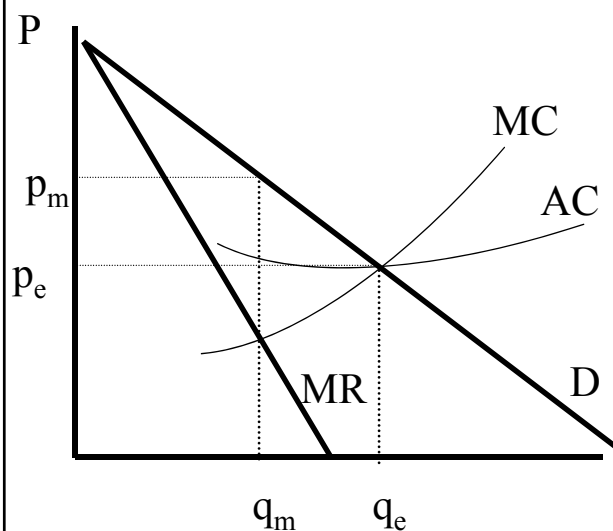




## Monopoly behaviour

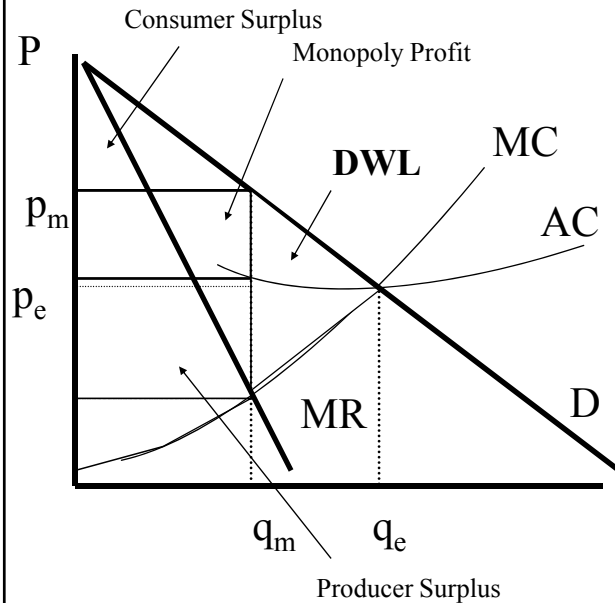
- Goal: maximize profits
- Rational choice: sell less quantity at a higher price (than perfect competition) to maximise profits
- Total surplus (consumer plus producer surplus) is lower than in competitive market case. Dead weight loss.
- X-inefficiency - firm doesn't work hard to cut costs.

## Monopoly: Price Setting



Monopolist sets quantity where profits are greatest, output at which  $MR=MC$

## Monopoly: How society loses



Monopolist captures part of consumer surplus. Consumer surplus lower compared to competitive market case. “deadweight loss”; social loss as compared to perfect competition

## Market Failures

Sometimes markets can fail to operate in beneficial way. Market failures can be so severe as to merit regulation. There are three main classes of market failure:

- Market Power
- Externality
- Information asymmetry



## Market Failures (contd.)

- Market Power – Ineffective competition; actual or potential; Monopoly, cartel, monopsony; (special case - Natural Monopoly)
- Externality - behaviour of one firm affects others for reasons other than prices (when firms or people impose costs or benefits on others outside the marketplace)
- Information asymmetry – consumers do not have enough information about the goods that they buy



## Natural Monopoly

- Industry cost is minimised by having only firm in the industry.
- Average costs are declining.
- Natural monopolies are likely to exist when there is large fixed-cost component to cost. (fixed costs are large as compared to marginal cost).



## Natural Monopoly (contd.)

- In case of natural monopoly – allocative and productive efficiency can not exist together.
- Productive efficiency requires that only one firm produces all output (cost minimised).
- Such firm will fix prices above cost to maximise profits – allocative efficiency is violated.
- For allocative efficiency – a number of firms need to compete to bring prices down to marginal cost ( $P = MC$ ).



## Externality

- Actions of agent A effect the welfare of B.

Negative externality

e.g. environmental pollution, fishing

Positive externality

e.g. beekeeper & farmer



## Information Asymmetry

- Infn may not only be imperfect but also asymmetric
- Eg. “Market for lemons”



## Why Regulation?

- Regulation – restrictions on decision of economic agents (Firms, consumers)
  - Rationale for Regulation
    - Market Power - Natural Monopoly
    - Externality
    - Information asymmetry
- } Market Failure



## Types of Regulation

- Antitrust Policy (licensing / certifications) - seeks to protect consumers from anticompetitive behavior through the judicial system (MRTP / Competition Act)
- Direct Regulation or Economic Regulation - controls pricing and/or output due to the belief that the industry is inherently Monopolistic (Power, Telecom etc.). Market power is the main focus of utility regulation.



## Types of Regulation (contd.)

- Social Regulation - controls undesirable consequences of firm behavior to obtain various social goods such as clean air and water, safe products and workplaces. (Pollution Control Acts, Safety Regulations etc.);
- Technical - licensing requirements, drug regulations, quality certifications like BIS etc., safety in nuclear plants, water flow in hydro plants

## Economic Regulation - What can be regulated ?



- Price
- Quantity
- Entry & Exit
- Quality
- Investment
- Access to Resources

## Economic Regulation - What can be regulated ? (Contd.)



- Price - power, telecom (partly)
- Quantity - spectrum#, banks branches
- Entry & Exit - telecom, power, banking, insurance
- Quality - telecom, power etc.
- Investment – capacity expansion during license raj
- Access to Resources – mining rights for power (coal), Iron & Steel etc

## How to ease Monopolistic Pressure (including regulated natural monopolies)?



- Allow / facilitate entry of more market players
- ‘Control/influence’ prices / quantity supplied
- Create incentives so that Monopolists emulates a competitive behaviour.

Thank You

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## Further Readings

- “Power Sector Reform in India: Current Issues and Prospects”, Energy Policy, Elsevier, Volume 34, Issue 16, November 2006.
- “Towards a Competitive Market for Electricity and Consumer Choice in Indian Power Sector”, Energy Policy Vol. 38 4196-4208, 2010. (Elsevier)
- “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.
- “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.



## 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
- National Workshop on “Project Financing for Energy and Infrastructure Sector”, April 19-22, 2007
- 2<sup>nd</sup> 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
- 3<sup>rd</sup> Capacity Building Programme for Officers of Electricity Regulatory Commissions, 23-28 August, 2010
- Energy Conclave 2010, 8-15 Jan. 2010
- 4<sup>th</sup> Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 July, 2011
- 5<sup>th</sup> Capacity Building Programme for Officers of Electricity Regulatory Commissions, 18-23 Oct., 2012
- 6<sup>th</sup> Capacity Building Programme for Officers of Electricity Regulatory Commissions, 9-15 Feb., 2014
- 7<sup>th</sup> & 8<sup>th</sup> Capacity Building Programme for Officers of Electricity Regulatory Commissions, Jan./Feb., 2015
- IITK-IEEX Training Program on Power Procurement Strategy and Power Exchanges, 20-22 April, 2015