The India Electricity Simulation Tool (IES)

Presentation at IIT-K for Officers of Electricity Regulatory Commissions (ERCs)

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Wholesale Electricity Markets?

- Where electricity is bought and sold, primarily by distribution and generation companies for delivering it to end consumers.
- How is India’s wholesale electricity market structured?
  - Decentralized, bilateral scheduling model
  - Long-term PPAs which are physical contracts.
  - A few market based products available in the PXs.
Wholesale Electricity Markets?

Where electricity is bought and sold, primarily by distribution and generation companies for delivering it to end consumers.
India’s current wholesale electricity market structure

- Decentralized, bilateral scheduling model
- Long-term PPAs which are physical contracts.
- A few market-based products available in the PXs.
What is happening today?

Type of transactions

- 87% Long-term
- 7% Short-term bilateral
- 4% PXs
- 2% DSM

Discoms
Challenges with Current Structure

- Lack of imbalance management in real-time
- Small balancing areas incompatible with increasing variable RE
- Sub-optimal use of generation resources due to scheduling in individual silos
- Cost of generation in any given time-block is undiscovered i.e. system marginal cost
What is CERC Proposing?

- Centralized platform for scheduling and dispatch of resources in day-ahead and real-time.
- Market based bidding mechanism to ensure the cheapest resources are being utilized.
- PPAs are proposed to be made into financial contracts or hedges against market prices.
- Co-optimization of ancillary services with day-ahead and real-time market.
Check out CERC’s proposals

- Day-Ahead Market
- Real-Time Market
  - Explanatory Memorandum
- Ancillary Services Market
Have you ever wondered

- what if there was a centralized balancing market?
- what if there were no legacy contracts?
- what if there is market power present?
- how to operate merchant vs contracted plant?
- how to make long-term investments in capacity?
- how decentralized bilateral wholesale market decisions are made?
India Electricity Simulation (IES)

Programmed by Bostian Consulting LLC
What is IES all about?

- Player-driven simulation
- Experiment with various market designs and structures
- Switch between the roles of Discoms and Gencos
- Go through multiple rounds of gameplay to assess various decision making behavior and its outcomes
Simulation Gameplay! (1/3)

Things to know

- Distribution and Generation companies interact with each other under different *market designs, rules and time horizons*. 

- Players
  - 3 Distribution Companies
  - 6 Generation Companies
  - 3 Automated Generation Companies*

- Three Stages
  - Long-Term – contracting and investment decisions
  - Day-Ahead – scheduling and procurement decisions
  - Real-Time – imbalance management
Simulation Gameplay! (2/3)
Long-Term Stage

- Market Design – **Decentralized Bilateral Long-Term Procurement**
  - Players start with some existing capacity.
  - Gencos present long-term offers to each Discoms for new capacity
  - Discoms can accept or reject offers
  - Gencos can choose to build capacity as Merchants or leave it unbuilt

![Diagram showing built, new, unbuilt, and merchant symbols for Discom and Gencos](image_url)
Simulation Gameplay! (3/3)
Day-Ahead Stage and Real-Time Stage

- Two Market Designs – Decentralized Bilateral Scheduling and Centralized Market-based Scheduling
- Deviation Settlement Mechanism

![Diagram of market designs and process]
## Simulation Features

### Policy Scenarios and Market Designs

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Long-term stage</th>
<th>Day-ahead stage</th>
<th>Real-time stage</th>
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<tbody>
<tr>
<td>1</td>
<td>Bilateral</td>
<td>Bilateral</td>
<td>DSM</td>
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<tr>
<td>3</td>
<td>Bilateral + Initial Resale</td>
<td>Bilateral</td>
<td>DSM</td>
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<td>Note - Discoms have an additional opportunity to resell their legacy contracts to one another in the long-term stage.</td>
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<tr>
<td>4</td>
<td>Bilateral</td>
<td>Bilateral + Centralized Auction</td>
<td>DSM</td>
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<td>Note - Most interactions occur bilaterally however Discoms are mandated to schedule at least 10% of their day-ahead forecast load from the centralized auction.</td>
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<tr>
<td>5</td>
<td>Bilateral</td>
<td>Centralized Auction</td>
<td>Centralized Auction</td>
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<tr>
<td>6</td>
<td>Bilateral</td>
<td>Bilateral</td>
<td>Centralized Auction</td>
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Simulation Features
Market Structures and Parameters

• Pair different scenarios with different market structures such as:
  • Less flexible capacity in the system
  • No legacy contracts
  • Level playing field
  • Market power in generation

• Modular simulations
  • Simulate specific stages in select scenarios as well
  • Faster gameplay and focus on specific topics
So let's get started!
Additional Resources

- Check out RAP’s Markets Learning Hub for other resource material.
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

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