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Wholesale Market Reforms and Simulation Tool

Presentation to KPCL and PCKL

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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.

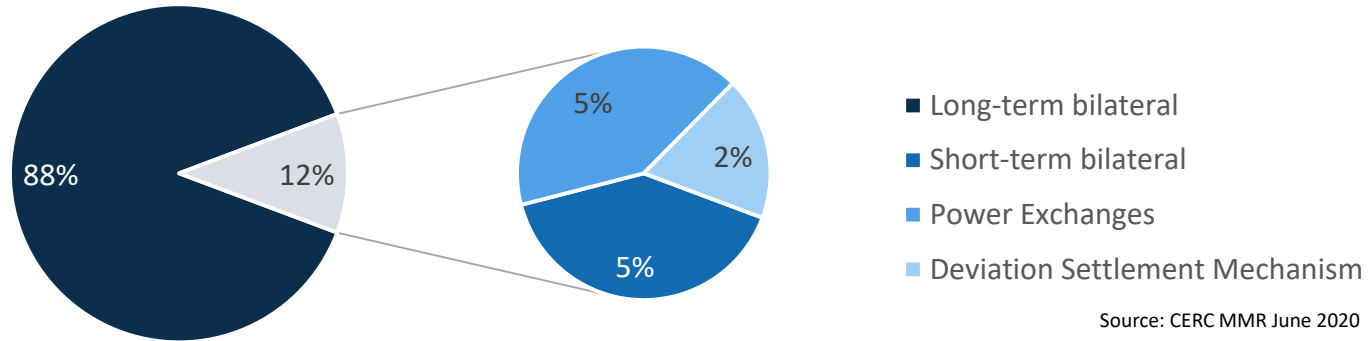


Present Wholesale Market Design

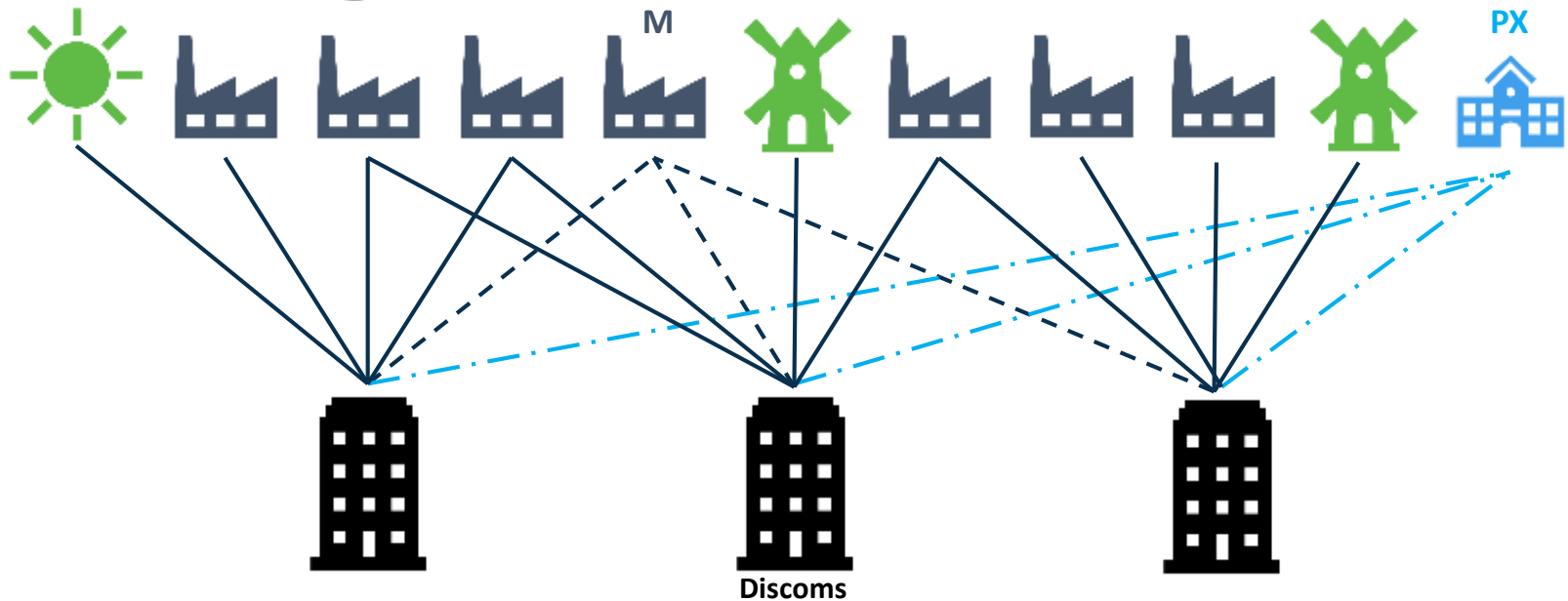
- Long-term power purchase agreements (PPAs) which are physical contracts
- Decentralized, bilateral day-ahead scheduling model
- Multi-exchange framework with a few market based products
- Frequency linked imbalance penalties

Wholesale Market Snapshot

Share of Transactions

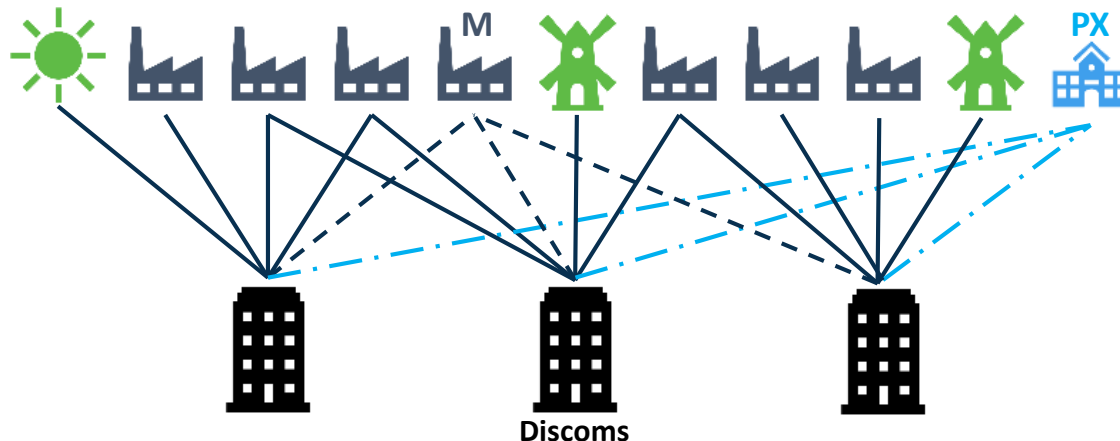


Source: CERC MMR June 2020



Challenges with Current Structure

- Lack of imbalance management in real-time
- Small balancing areas incompatible with increasing variable RE
- Optimization of resources only at the discom/state level, potential benefits of regional/national level optimization on the table.
- Cost of generation at the system level in any given time-block is undiscovered.

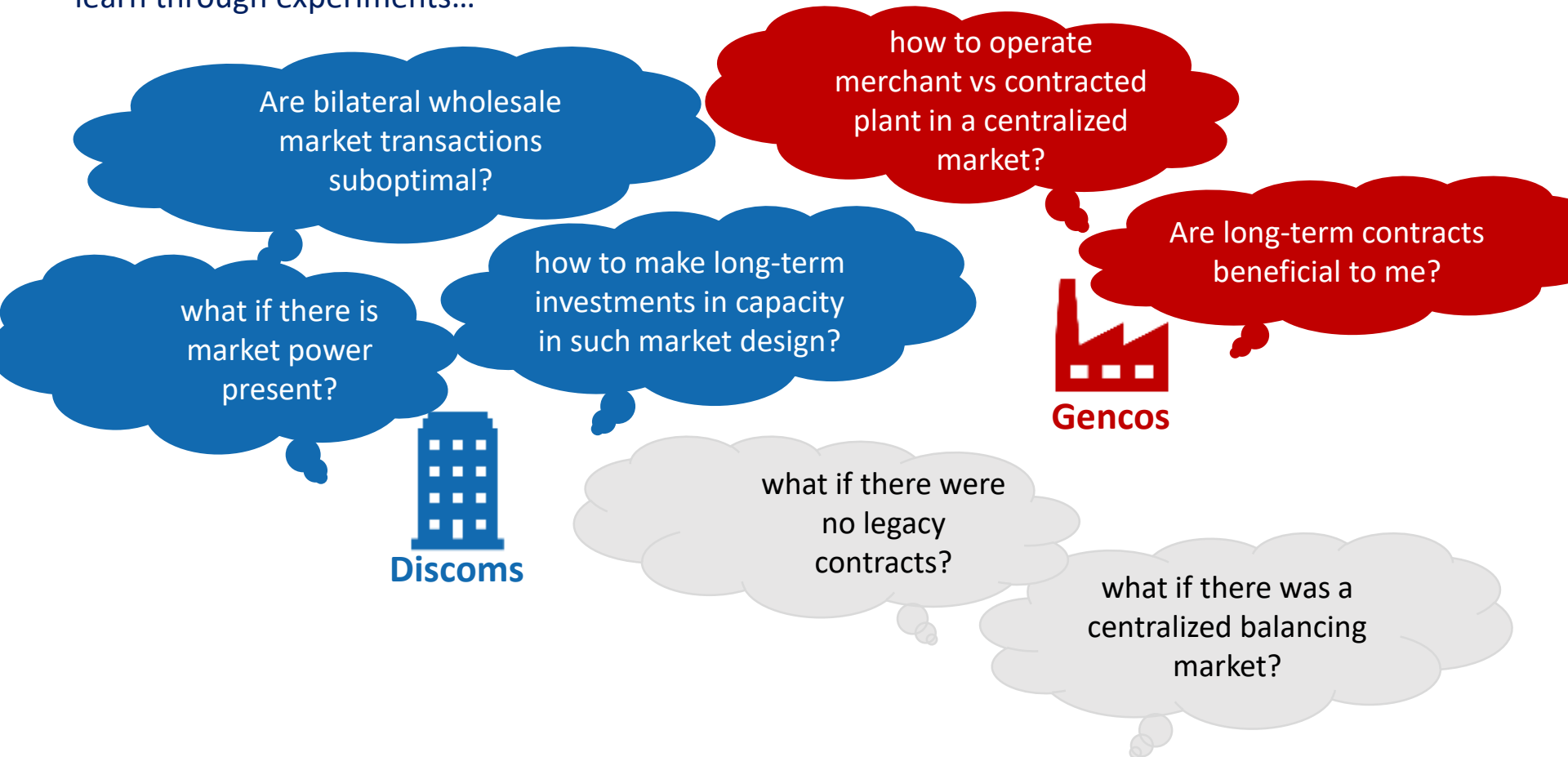


What has CERC proposed and implemented?

- Centralized platform for scheduling and dispatch of resources in day-ahead (MBED/DAM) and real-time (RTM).
- Uniform price auction mechanism to ensure the cheapest resources are being utilized at the national level.
- PPAs > financial contracts or hedges against market prices with no changes in underlying obligations.

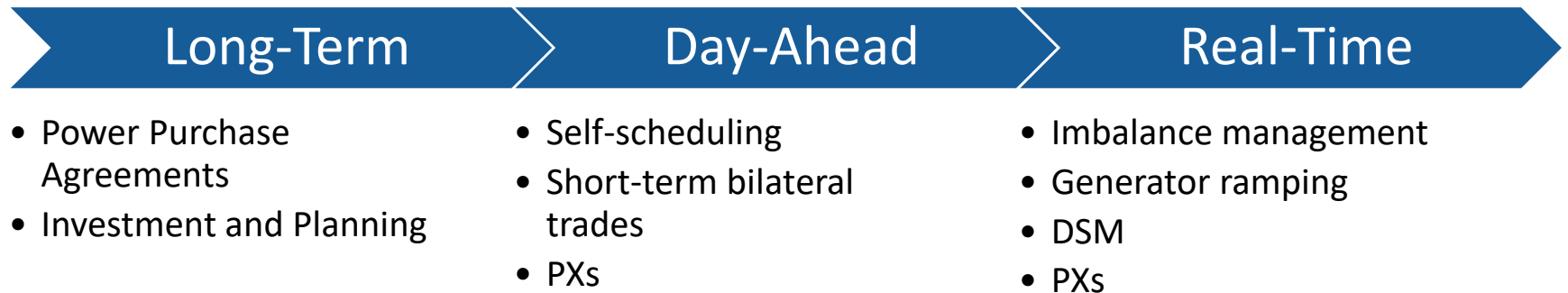
Questions and implications...

Simulation tool is designed to provides insights to these concerns and an opportunity to learn through experiments...



How does the simulation work?

- Distribution and Generation companies interact with each other in different *market designs, structures and time horizons (stages)*.
- Players
 - 3 Distribution Companies
 - 6 Generation Companies
 - 3 Automated Generation Companies*
- Three Stages



What do the players have to do?

Distribution Company

- Manage existing portfolio of PPAs
- Make decisions regarding new PPAs
- Scheduling decisions based on forecasted load
- Real-time imbalance management of deviations due to load or RE generation

Generating Company

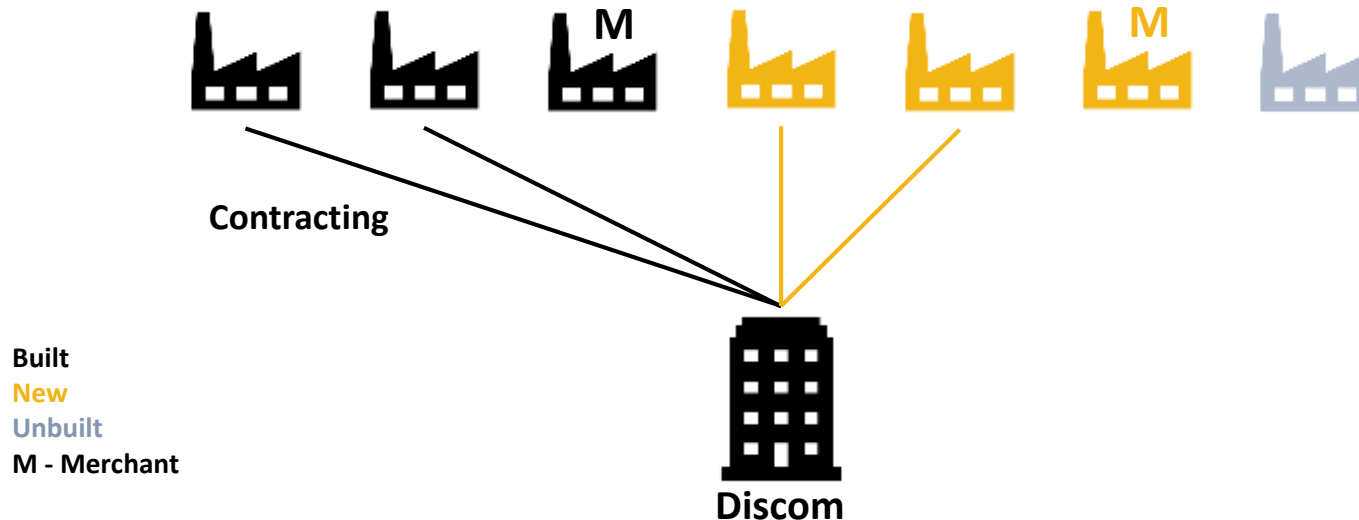
- Operate existing portfolio of power plants (coal and gas)
- Decision making regarding investment in new plants (contract or merchant?)
- Short-term trading opportunities (bilateral and market)

Simulation Gameplay

Long-Term Stage

❖ Market Design – Decentralized Bilateral Long-Term Procurement

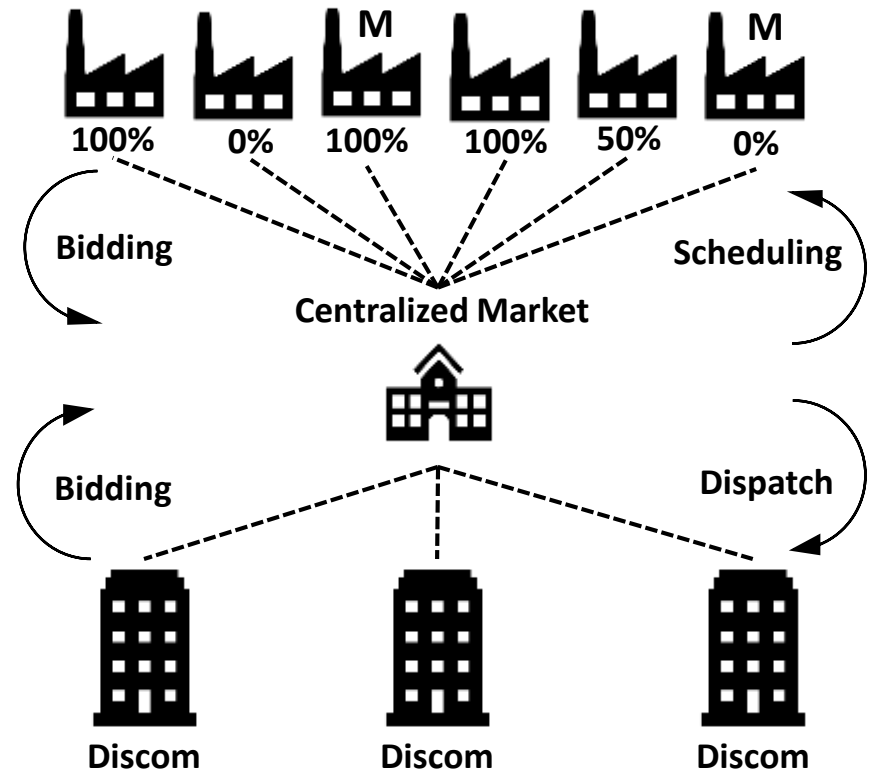
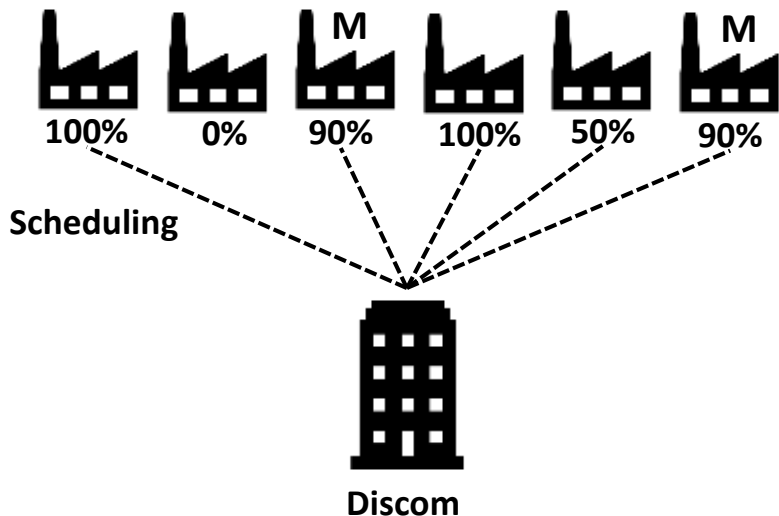
- Players start with some existing capacity.
- Gencos present long-term offers to each Discoms for new capacity
- Discoms can accept or reject offers
- Gencos can choose to build capacity as Merchants or leave it unbuilt



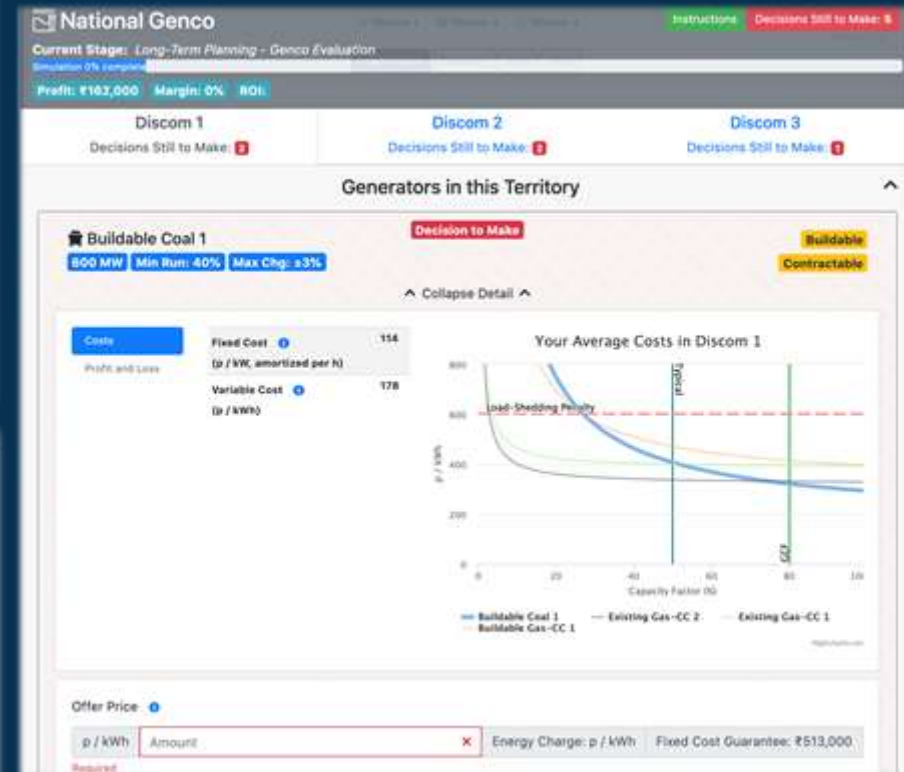
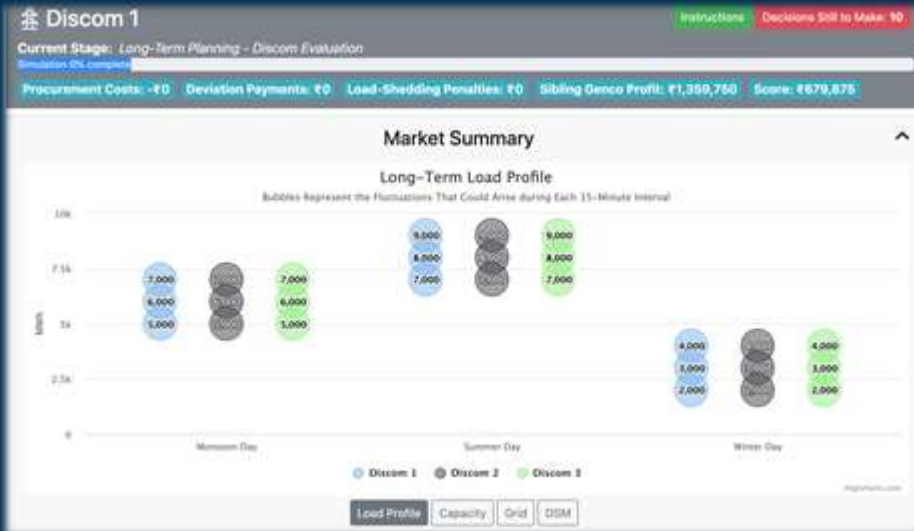
Simulation Gameplay

Day-Ahead Stage and Real-Time Stage

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



Walkthrough Simulation Interface



Simulation Features

Policy Scenarios and Market Designs

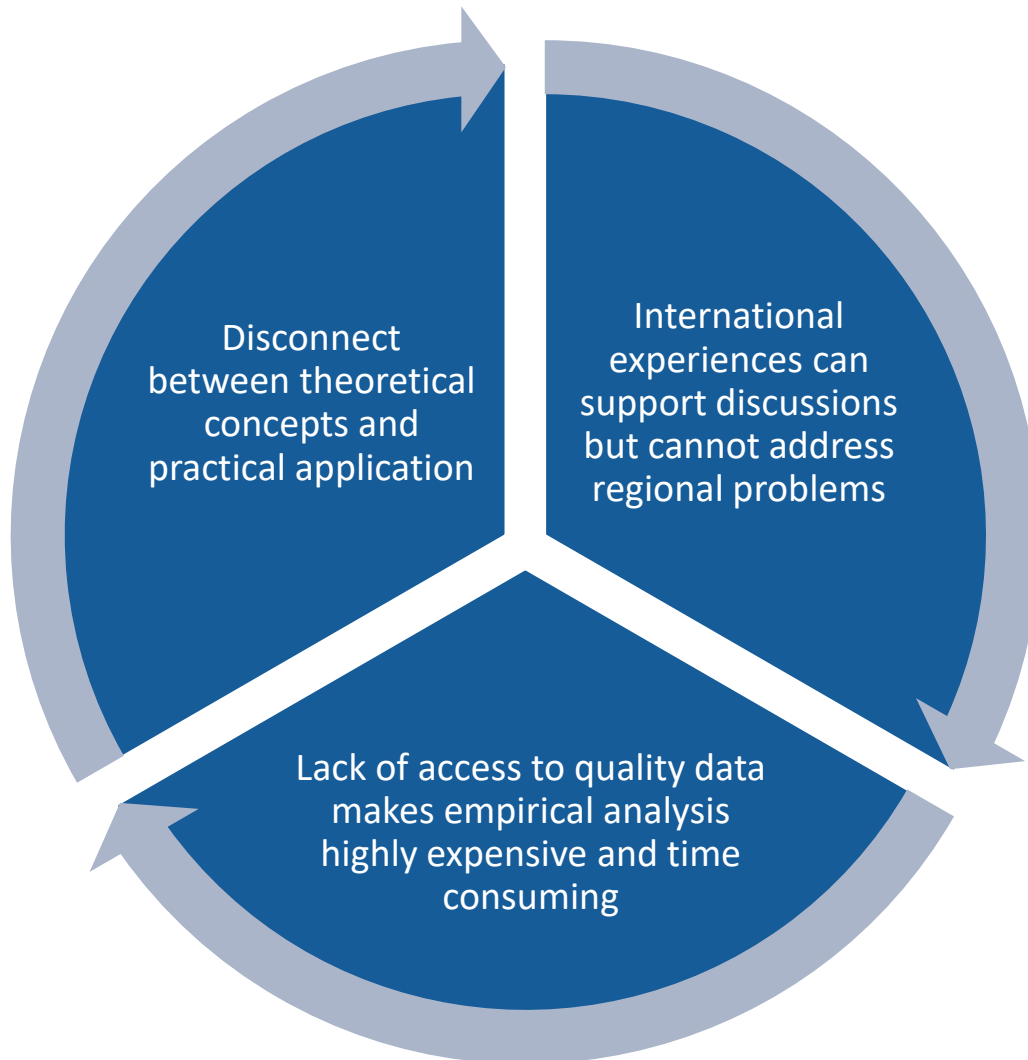
Scenario	Long-term stage	Day-ahead stage	Real-time stage
1	Bilateral	Bilateral	DSM
3	Bilateral + Initial Resale	Bilateral	DSM
	Note - Discoms have an additional opportunity to resell their legacy contracts to one another in the long-term stage.		
4	Bilateral	Bilateral + Centralized Auction	DSM
	Note - Most interactions occur bilaterally however Discoms are mandated to schedule at least 10% of their day-ahead forecast load from the centralized auction		
5	Bilateral	Centralized Auction	Centralized Auction
6	Bilateral	Bilateral	Centralized Auction

Simulation Features

Market Structures and Parameters

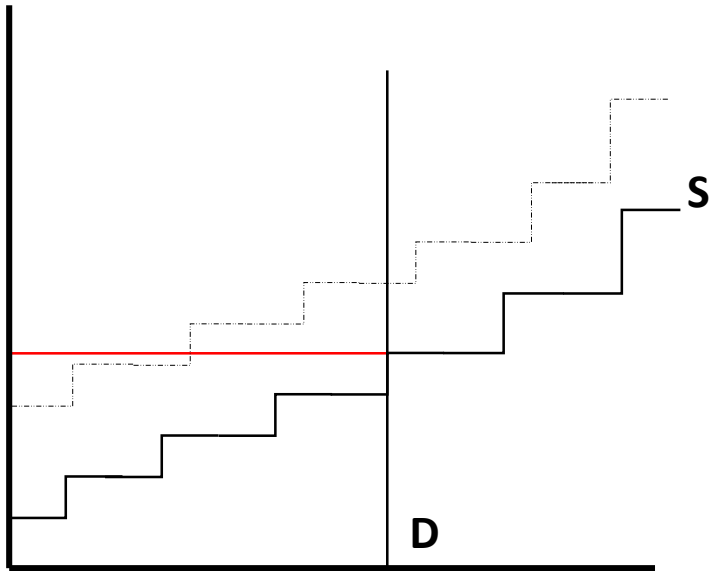
- Pair different scenarios with different market structures such as:
 - Less flexible capacity in the system
 - No legacy contracts
 - Level playing field
 - Market power in generation
- Modular simulations
 - Simulate specific stages in select scenarios eg: only DA stage in Scenario 5
 - Quicker simulation with focused insights and outcomes

Why an immersive tool?

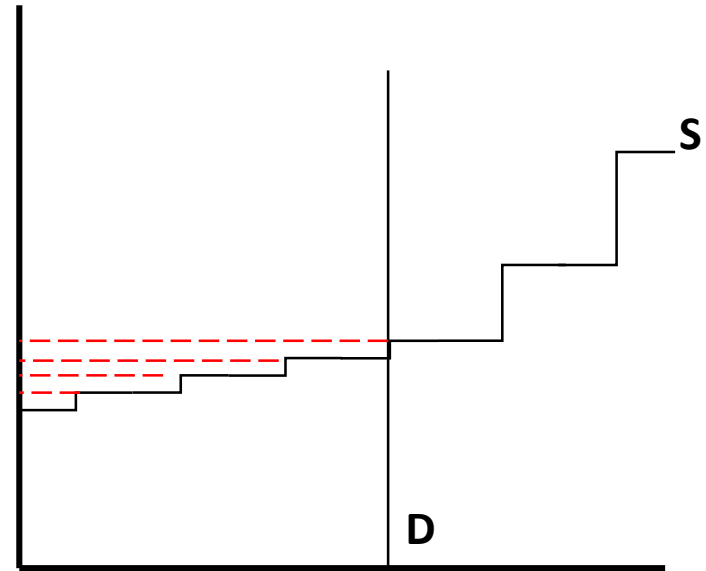


Pay-as-Bid vs Uniform Price

Which mechanism yields a lower price in the long-run?



Uniform Price



Pay-as-Bid

Uniform Price Auction (DAM/RTM)

How it impacts supply-side bidding strategies?

- Generator Data
 - Fixed Costs = Rs. 1/kWh
 - Variable Costs = Rs 2.5/kWh
 - Units – 100000

MCP (Rs/kWh)	Strategy 1 = VC Bidding @ 2.5			Strategy 2 = TC Bidding @ 3.5		
		VC Costs	Revenue		VC Costs	Revenue
2		0	0		0	0
2.6		2,50,000	2,60,000		0	0
2.9		2,50,000	2,90,000		0	0
3.4		2,50,000	3,40,000		0	0
5		2,50,000	5,00,000		2,50,000	5,00,000
4.5		2,50,000	4,50,000		2,50,000	4,50,000
3.2		2,50,000	3,20,000		0	0
Total (Rs.)		15,00,000	21,60,000		5,00,000	9,50,000

- Total Fixed Costs = Rs. 7 Lakhs
 - Fixed Cost Recovery (S1) = 21.6 Lakhs – 15 Lakhs = **6.6 Lakhs**
 - Fixed Cost Recovery (S2) – 9.5 Lakhs – 5 Lakhs = **4.5 Lakhs**

Economic-Engineering Fundamentals of Wholesale Markets

1. The Language of Costs
2. Services of Different Plants
3. Costs of Different Plants
4. Existing Plant Decision-making
5. New Plant Decision-making
6. Contracts, Auctions and Exchanges
7. System Management

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.

Learn more about our work at raponline.org



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