2024 ESIG Fall Technical Workshop

Markets for 100% Clean Electricity Workshop

Overview of Decarbonized Grid Methodologies

Ryan Schoppe, P.E.
EPRI

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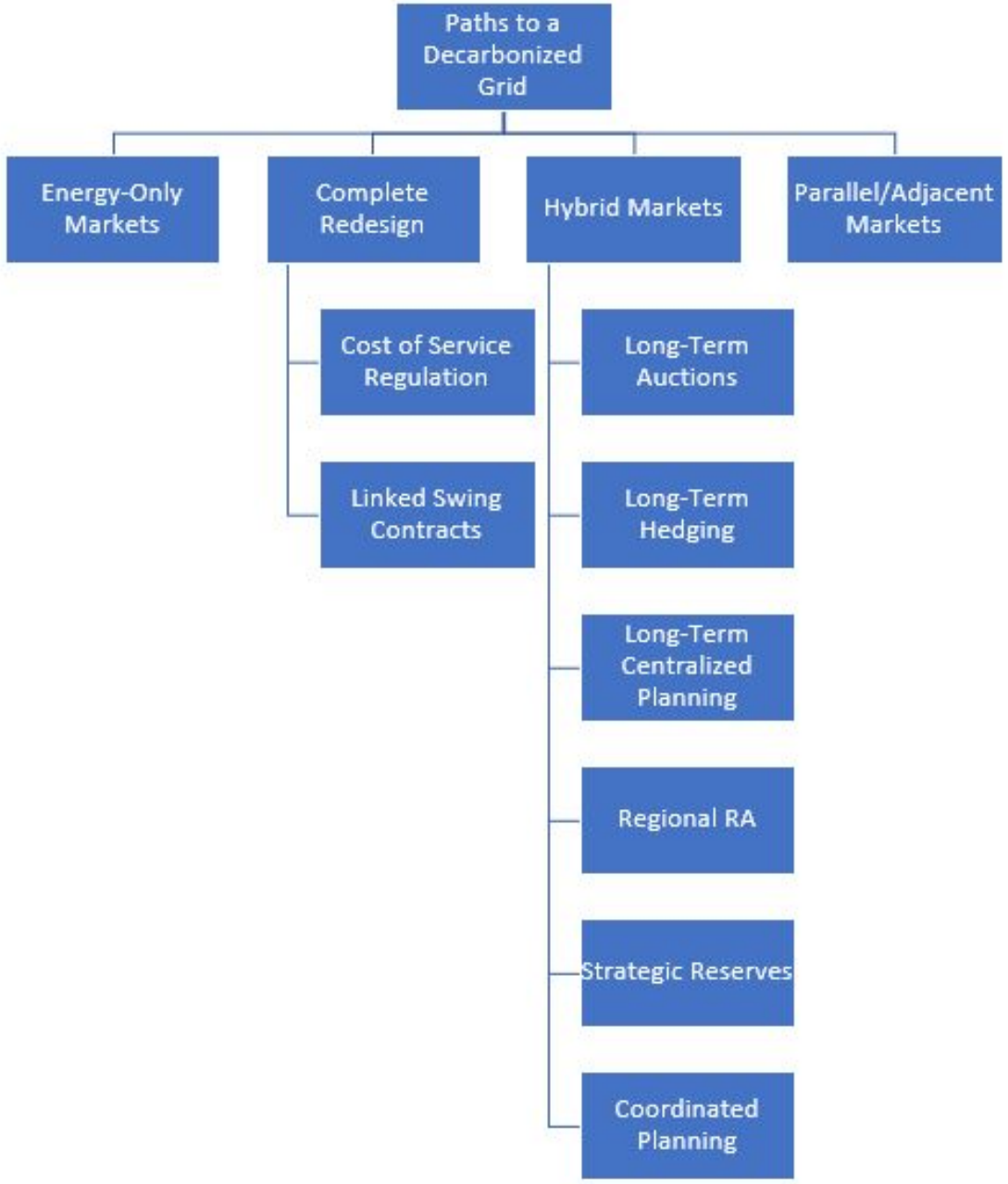
Background

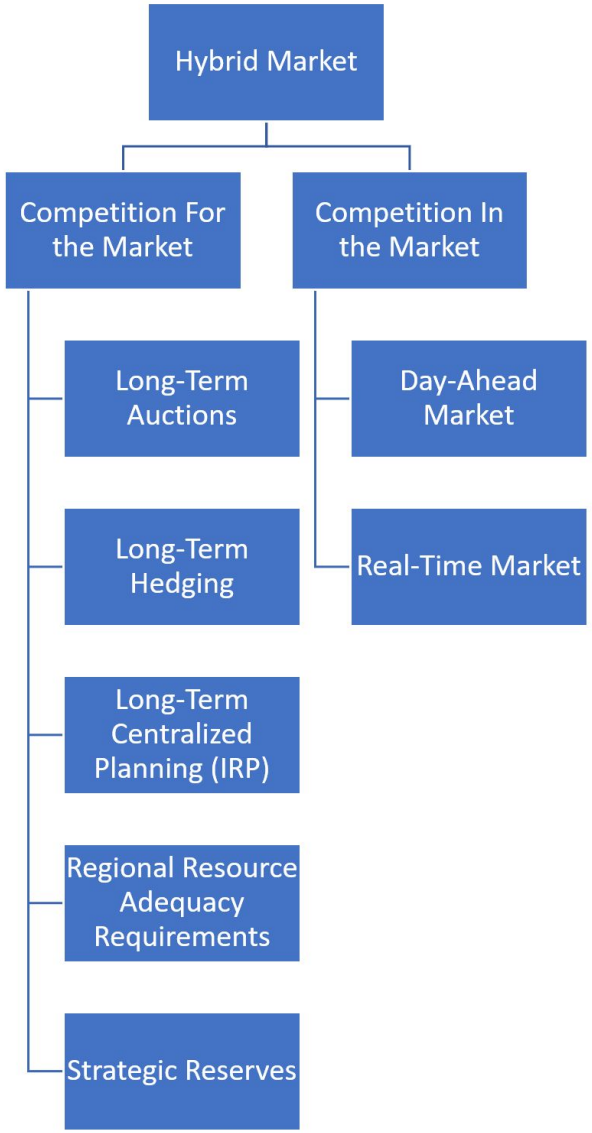
- Currently putting together a “Visions” paper that includes work from several contributors:
- ***Rob Gramlich*** → Fully decarbonized markets will require large amounts of transmission investment, fast/flexible renewables, load flexibility, carbon pricing, and clean/firm resources
- ***Kelli Joseph*** → Energy transition will require a large coordinated effort from institutions with important roles like states doing IRP and ISOs running coordination studies
- ***Jacob Mays*** → A hybrid market view w/ full-strength spot prices, mandatory contracting, & proactive transmission planning
- ***Ryan Schoppe*** → Provides an aggregate summary of various proposed solutions along with a taxonomy

Overall Taxonomy



Hybrid Markets

- A market design that includes a short-term day-ahead/real-time market coupled with an additional long-term mechanism for investment
- Acknowledges shortcomings in the energy-only design in incentivizing adequate investment for reliability and large-scale buildouts of renewable generation
- “Competition for the market” and “Competition within the market” is the mantra
- A significant amount of proposals tend to fall under this design where an additional long-term mechanism is proposed to supplement the short-term wholesale market



Competition both “For” and “In” the Market

Toward a new market model with ‘competition in two steps’ ?

Investment planning (years ahead) → **Operations planning (days /hours ahead)**

Competition “for” the market

- Tendering of long term contracts
- Can be technology neutral or specific
- Puts competitive pressure where it matters: CAPEX
- Can be used to stimulate new entrants and development of competitive market
- Ensures coordinated system development

Competition “in” the market

- Well integrated and liquid forward, day ahead and intraday markets
- Optimizes short term dispatch and minimizes costs for consumers
- Level playing field with balancing obligation
- No distortions as subsidies not based on production

Alternatives to implement two step competition based on long term contracts :

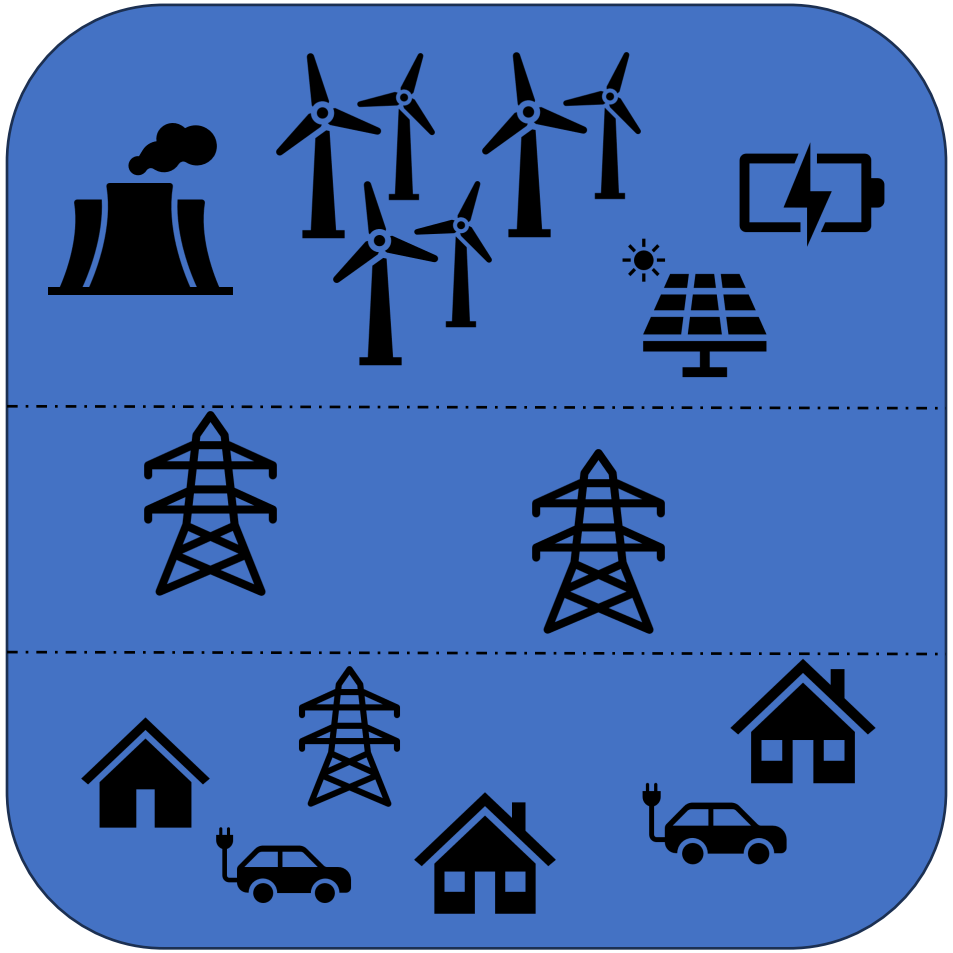
1. Mandate an independent organization to define the type of contracts and to procure them through a centralized auction (e.g. capacity auction, CFDs, etc.), or
2. Implement a decentralized process with contracting obligations on suppliers (e.g. capacity obligation, renewables obligation, etc.)

**Fabien Roques (2021). Market Design for Financing Capital Intensive Low Carbon Technologies

Hybrid Proposal	Description	Advocates or Users
Long-Term Auctions	Some form of long-term market is run (perhaps several years in advance) to determine which resources are chosen to accomplish the goals of the auction. For example, a new storage or renewable facility might receive a fixed contract to build out the facility and in return give up the market revenue. The idea is similar to capacity markets, but may be more tailored to clearing clean energy resources.	Steve Corneli, Brendan Pierpont
Long-Term Hedging	Renewable resources and demand both are required to obtain contracts to hedge their risk and reduce concerns of short-term price volatility. Some specify a certain low percentage (e.g. 0% 48 months ahead) of energy must be cleared in the long-term and the percentage increases until reaching 100% in DA	Frank Wolak, Jacob Mays, Cramton
Long-Term Centralized Planning	The ISO or a new entity would take on the integrated resource planning (IRP) responsibilities on behalf of the states/participants and determine an optimal resource/transmission mix based on the goals of reliability, affordability, and limiting emissions.	Hala Ballouz, Sean Meyn
Regional Resource Adequacy Requirements	The ISO determines resource adequacy requirements (e.g. a planning reserve margin) and the states are given a certain share of the requirements and must ensure they bring a certain amount of generation to the table. The participants are free to figure this out on their own (e.g. PPA w/ a developer) or build their own generation. These are sometimes referred to as “bilateral capacity markets”.	SPP, CAISO
Strategic Reserves	The state procures contracts with resources that would normally not participate in the markets. Firm energy agreements are also made with neighbors. These reserves are called online during times of need.	CAISO, Germany
Capacity Markets	The longer-term reliability of the grid is ensured by “procuring an amount of power supply resources needed to meet predicted energy demand” for some time period in the future. Resources must be available during system emergencies or pay a large non-performance payment (PJM).	PJM, France, Italy
Renewable Support Schemes	Methods that help support the development of renewable energy resources such as feed-in tariffs, production tax credits, investment tax credits, R&D, and renewable auctions.	Ireland, USA…etc
Coordinated Planning	Similar to the Long-Term Centralized Planning concept, but the ISO or a new entity doesn’t do the IRP. Instead, the state does the IRP as is traditional and there is tight coordination between the ISO, state, regulators…etc, such as the ISOs running regional reliability studies using the state’s IRP results	Kelli Joseph

Cost of Service Regulation

- This model would resemble the fully vertically integrated utilities still common in the West and Southeast
- These entities would handle their own planning of which resources, transmission, and demand response programs they need and include the overall costs in their rate base
- Centralization has some benefits as state level goals involving reliability, affordability, and emissions can all be planned for in a manner that meets stakeholder approval
- This could limit innovation and lead to cost overrun concerns, but the utilities could still use competitive procurement processes
- This model has backing from some former FERC staff (e.g. Christie, McNamee)



Linked Swing Contracts

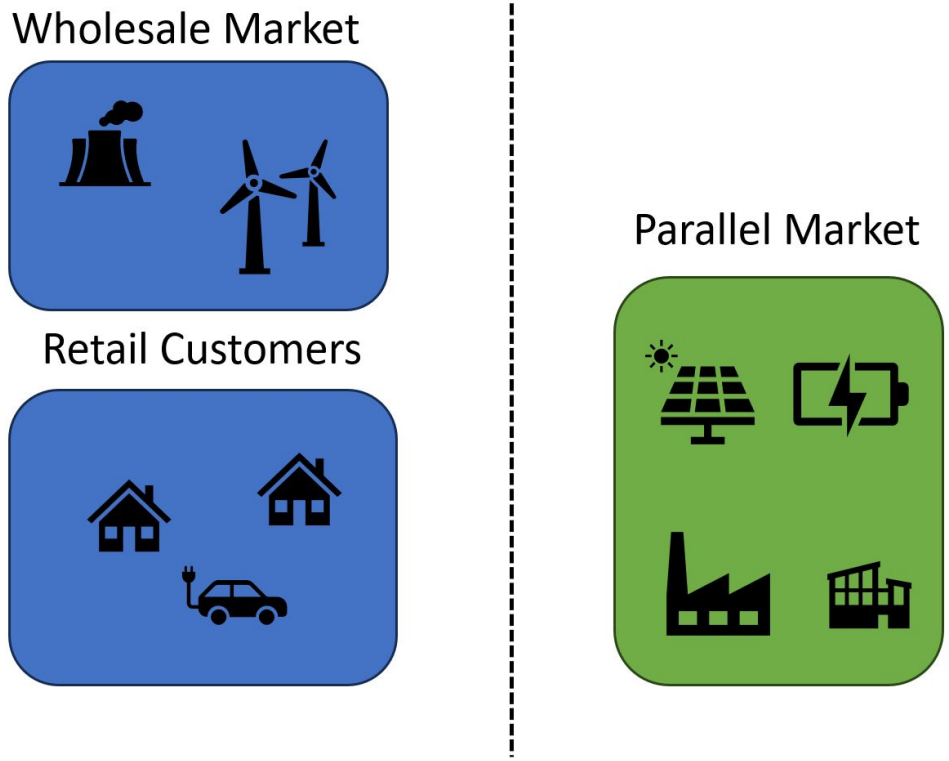
- Proposed by Dr. Leigh Tesfatsion as a solution to what she claims are conceptually problematic issues with ISO markets
  - Does not believe grid-delivered energy meets the necessary requirements to be a commodity, so marginal cost pricing is not appropriate
  - ISO markets are complex with hundreds of pages of rules
- The RTO/ISO would run a series of auctions (i.e. long-term, mid-term, short-term) for contracts that reflect the avoidable fixed costs and variable costs and clear/dispatch the contracts accordingly
  - This design handles both long-term investment and short-term operations
  - Process is run multiple years in advance and then closer to the operating day and on the operating day….each time it clears certain contracts and puts them on the ISO's book of contracts
- The design is still new though and Leigh is continuing work on expanding the design

		Current DAM	SC DAM
Similarities		• Conducted day-ahead to plan for next-day operations • RTO/ISO-managed • Participants include LSEs, dispatchable resources, & VERs • Same types of system constraints (line capacity limits; power balance; gen attributes; reserve requirements; …)	
Differences	Optimization formulation	SCUC & SCED	Swing-contract clearing
	Settlement	Locational marginal prices	Contract-determined prices
	Payment	Payment for next-day energy before energy delivery	Payment for reserve availability now & reserve performance ex post
	Out-of-market payments	Make-whole payments (e.g., for unit commitment)	No out-of-market payments
	Info released to participants	Unit commitments, LMPs, & next-day dispatch schedule	Which swing-contracts have been cleared

		Current DAM SCUC	Current DAM SCED	SC DAM Optimization
Similarities		• Both SCUC and swing-contract (SC) clearing are solved as mixed integer linear programming (MILP) optimization problems subject to system constraints		
Differences	Objective	Min [Start-up/shut-down costs + no-load costs + dispatch costs + reserve costs]	Min [Dispatch costs + reserve costs]	Min [Offer cost + expected performance cost + expected imbalance cost]
	Unit commitment constraints	Yes	No	Unit commitment constraints are implicit in submitted swing-contracts
	Key ISO decision variables	Unit commitments	Energy dispatch & reserve levels	Which swing-contracts are cleared
	Settlement	No	LMPs calculated as SCED dual variables	Offer prices paid for cleared swing-contracts

Parallel/Adjacent Markets

- Parallel/adjacent markets is a term used to point out proposals that advocate for demand and generation not part of the utility's grid
- Examples
  - Data center co-located with nuclear plant
  - Industrial facility or Industrial clusters with on-site generation
- Lots of different examples of this being discussed right now:
  - Upcoming FERC Technical Conference on Co-Location of Large-Load Customers w/ Generating Facilities
  - Various EPRI work
  - Kiesling blog posts
  - …etc
- This does not address existing concerns with how to transition the wider grid
  - This is more of an incremental development to keep and eye on



Price Adders

- Contribution from Jessica Greenberg (ENEL)
- Points out the importance of energy prices for renewables in comparison to other markets (e.g. RECs)
- Asks about investment signals in the long-term with decarbonized markets when everyone has a zero short-run marginal cost
  - How do you plug the gap from the missing energy prices?
  - How do you recover your capital investment costs?
- The industry assumes that the addition of price-responsive demand will come to the rescue, but will that be the case?
- Is there a need for some kind of price adder?

Summary

- We cannot predict the future under an industry that is evolving so fast
  - However...we can make some assumptions based on going through all the different proposals
- There seems to be a fair amount of agreement regarding the role of hybrid markets in facilitating an energy transition that meets both environmental and reliability goals
  - There are many different forms of market hybridization and we will likely see many of these in-use in the future
  - Incremental evolution may seem more likely than rapid revolution, but this has to be balanced against aggressive decarbonization goals