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Wholesale Power Market Design in a Future Low-Carbon Electric System:
A Proposal for Consideration

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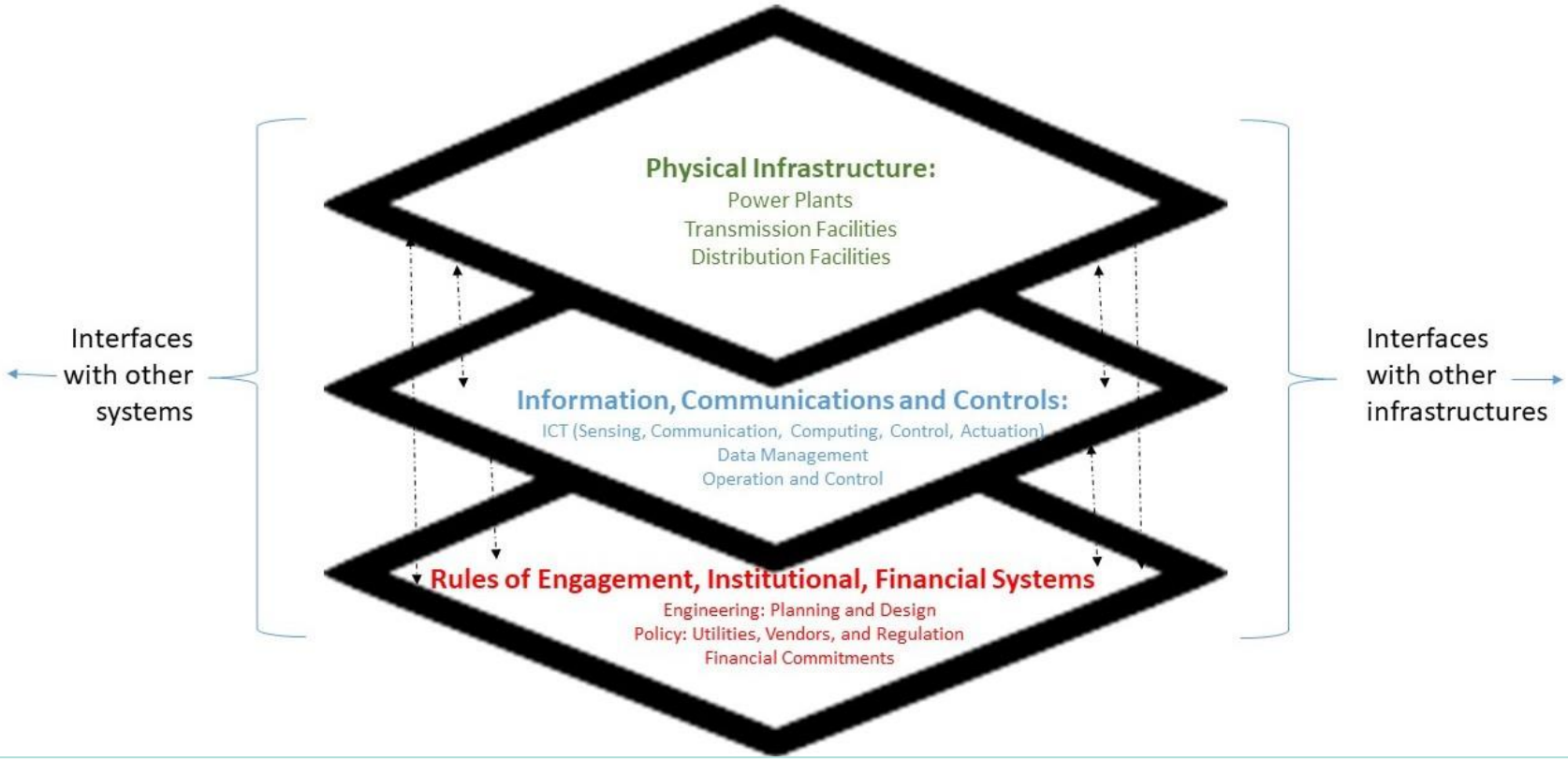
Overview: A proposal for your consideration

- My starting point: the electric system and its architecture
- My assumptions and premises (biases)
- How those factors influenced my reactions to very thoughtful comments from peer reviews
- How those factors influenced my thoughts about a future wholesale market design
- The elements of a future wholesale power market demand

The starting point: electric system "architecture"

Architecture:

Complex set physical, communications and institutional systems ("layers") that have to interact with each other to keep the lights on



Assumptions and premises that affect this proposed market design (1)

- Subnational & private actors will take further action to move toward zero power-sector emissions.
- The national government is unlikely to adopt (soon) a unifying economy-wide carbon pricing policy.
- There'll be lots of tools that will be used on the path to change.
- The electric system will grow and play an increasingly larger role in providing energy services.
- That said, no one knows what the bulk-power and local electric systems will look like in 2030+.

Assumptions and premises that affect this proposed market design (2)

- The definition of resource adequacy needs to transition.
- The bundle of resources that together provide the system with adequate services, cost minimization, and needed functionalities and attributes will not necessarily result from auctions that consider price alone, especially in the absence of a price on carbon.
- Some specific resource/technology types at specific locations may need to remain in operation until other alternatives provide the needed reliability services.
- State policies will affect the extent to which the demand side participates in the wholesale market.

Assumptions and premises that affect this proposed market design (3)

- Over the past two decades, regional wholesale power markets have produced *substantial* benefits for consumers – in particular, reliable and affordable electricity production, and investment based on merchant model.
- The RTOs with centralized capacity markets are facing challenges in terms of producing a resource mix that both comports with many states' policy preferences for decarbonizing the power system and satisfies FERC.
- Without a meaningful price on carbon within such markets, the revenues in those organized wholesale markets alone are
  - neither high enough to retain some high-quality suppliers of zero-carbon supply
  - nor sufficient to accelerate entry of renewables and storage on the pace required to meet the relevant states' energy and climate goals.

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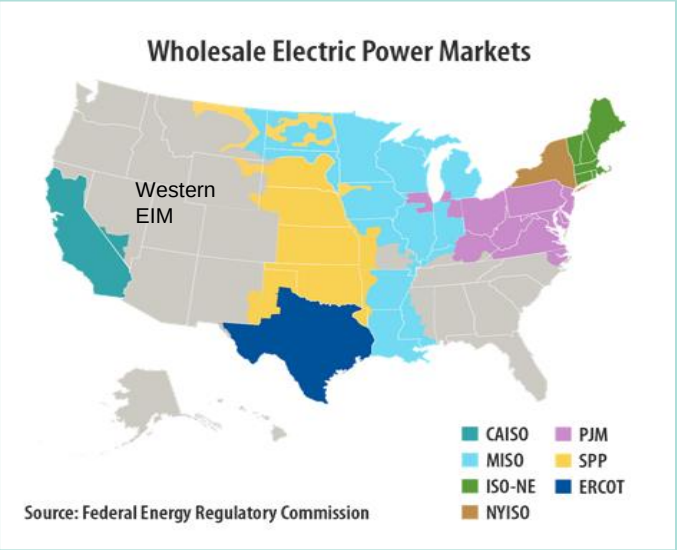
Assumptions and premises (4)

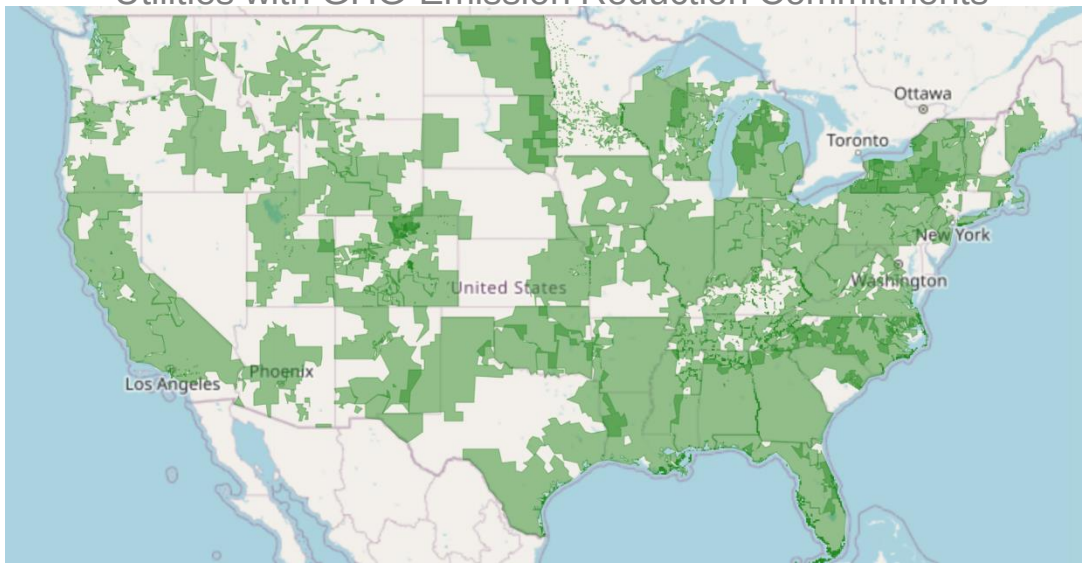
- 50%+ of the electricity used in the Lower 48 states occurs in a state with a GHG reduction commitment
- Nearly 80% of investor owned utilities have committed to GHG-reduction commitments
- Considerable overlap with the RTO/ISO footprints

States with Renewable and/or Climate Commitments

- Zero-carbon resources need to enter the market in unprecedented quantities and at paces not likely to occur with today's RTO market designs alone.



Utilities with GHG-Emission Reduction Commitments



Assumptions and premises that affect this proposed market design (5)

- Looking ahead, a combination of probable conditions will put increasing pressure on current market designs in PJM, NYISO, and ISO-NE:
  - low prices in electric energy and ancillary-service markets – with missing money problem;
  - the absence of a *meaningful* price on carbon emissions;
  - some states' policies that use out-of-market mechanisms;
  - increasing tensions between federal market policies and state resource preferences;
  - large electricity customers' goals to accelerate changes in the region's power supply mix;
  - many states' reluctance (to date) to implement mechanisms that cause a broad base of consumers to see and have the opportunity to respond to real-time prices; and
  - chronic challenges in siting multi-state transmission facilities.

Assumptions and premises that affect this proposed market design (6)

- In the other RTOs (besides PJM, NYISO and ISO-NE), the electric industry structures give states a more direct role in driving resource portfolios that serve customers in their boundaries.
  - States with vertically integrated utilities: rely on some combination of long-term resource planning, utility and non-utility project proposals and investment, competitive resource procurements, and long-term contracting approaches to determine the portfolios of resources that satisfy state, consumer and utility preferences.
  - In ERCOT Texas: the state has jurisdiction over and support for the combination of mandatory retail competition, energy-only wholesale market with scarcity prices, incentives for bilateral contracting, platform of formal transmission planning with socialized cost-allocation to support access to renewables.

Assumptions and premises that affect this proposed market design (7)

- If the states with GHG commitments are serious about them, they will need to have influence over resource attributes (e.g., carbon content), in addition to the goals of efficiency and reliability.
- In states that participate in RTOs, future wholesale market designs will need to align market rules so that they row in the direction of these same multiple goals.
- Some RTOs may choose to introduce carbon pricing mechanisms, longer-term centralized capacity markets, allowances for greater bilateral contracting, and/or other approaches. And FERC will need to recognize state influence (as is now done in MISO, SPP and CAISO).
- More RTOs may evolve to look more like MISO, CAISO, SPP, with both efficient dispatch in short-term markets and a larger voice for states in resource portfolios (and competitive procurements)
- Exporting the ERCOT model? It would surprise me if any other states can or choose to pursue it, even if it has been successful there. (And the jury is out about how well it would work with it is dominated by zero-emitting resources, rather than 64% fossil.)

Issues and concerns raised in reviewer comments

- Those assumptions and premises (and biases) affected the features of my proposed design for wholesale market rules.
- And they affected my responses to peer reviewers' comments.
  - The comments were very thorough, thoughtful, concrete, constructive.
  - I greatly appreciated the time and attention of the reviewers.
  - Ironically, some reviewers felt I was anti-market and ignored ERCOT's success, while others felt I put too much faith in market mechanisms in dealing with electricity service.

A proposed low-carbon wholesale market design: 3 building blocks

- With regional variation, common elements might include three core building blocks:
  - (1) **wholesale energy and ancillary services markets** with security-constrained economic dispatch and locational prices;
  - (2) a **resource-adequacy approach** influenced directly by state policy that would establish the criteria for soliciting resources with particular attributes, and supported by regional resource planning and a combination of market-based mechanisms to support the exit of GHG-emitting fossil generation and the entry and retention of low-carbon-emitting and flexible resources from both the supply side and demand side of the market; and
  - (3) sufficient resource capability for **price-responsive demand** from end-use customers in different geographic parts of the region.

A proposed low-carbon wholesale market design: 3 building blocks (+)

- In retrospect, there should have been a transmission building block:
  - Addressing on-going transmission planning, cost-allocation and siting for multi-state, regional and seams are essential elements of how wholesale markets will function reliably and efficiently in the context of a very-high penetration of zero-emitting resources.
  - Opening up access to regions with rich renewable resources may require updating FERC transmission policy with consideration of the kind of approach adopted in Texas.

Building block #1: energy and ancillary service markets

- **Co-optimized competitive wholesale energy and ancillary service markets** to ensure efficient dispatch of supply-side and demand-side resources.
  - Bid-based day-ahead and real-time markets, with locational clearing prices.
- **Carbon-pricing mechanisms**:
  - The FERC-approved wholesale market tariff would account for state directives for carbon-pricing mechanisms for resources located in their boundaries states, with provisions for how these mechanisms would affect price formation, dispatch, prices paid by loads, and compensation to suppliers.

Building block #1: energy and ancillary service markets

- **Price variation based on marginal resources in a location:**
  - There will likely be many hours of the year where the marginal resources has no variable cost.
  - There will likely times and locations where prices rise (even spike to scarcity prices) to signal need for, say, flexibility services that might be provided by fossil generation, storage, or price-responsive demand.
  - There will also likely be times and locations where an oversupply of generation (e.g., from solar) creates negative prices, sending signals for flexible demands to rise (e.g., by filling storage).
  - The market rules would need to determine how the auction and offer acceptance criteria in both the day-ahead and real time markets would make decisions among competing offers with similar prices (e.g., $0/MWh, or even similar negative prices).

Building block #2: resource adequacy approach

- **The FERC tariff would rely on a revised definition of resource adequacy:**
  - The new definitions of the meaning of “resource adequacy” would go beyond today’s definition tied to covering peak load and reserve requirements.
  - Additional criteria could include:
    - The type(s) of resources needed to be located in particular constrained areas
    - The type(s) of preferred attributes (e.g., increasing quantities of zero-carbon capacity) for the system as a whole and in the right types and in the right places to provide reliable and low-emitting resource capabilities.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on a revised definition of resource adequacy:**
  - Three principal resource adequacy products:
    - **System RA** – which reflects amounts of capability to meet peak and attribute requirements (with varying capacity value by technology type)
    - **Flexible RA** – which reflects amounts of capability to provide ramping & other flex services
    - **Local RA** – which reflects any amount of capacity needed to be maintained in load pockets

Building block #2: resource adequacy approach

- **The FERC tariff would look to state preferences for attributes of resources:**
  - The tariff would allow each state to identify its preferred approach to resource adequacy (e.g., relying on LSEs' resources or relying on the RTO as the central buyer for capacity, or relying on a combination of approaches).
  - The rules would give states the ability to identify attributes (e.g., zero-carbon emissions profile) that would be part of the specifications for capacity resources procured by the RTO on behalf of those states' LSEs.
  - States would have the option of specifying amounts of emerging technologies for LSEs within the state.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on the RTO to conduct long-term resource planning with inputs that include state preferences for attributes of resources:**
  - The RTO's resource plan would identify such things as:
    - incremental amounts of various RA products needed over the planning period;
    - new transmission enhancements and non-wires alternatives needed for reliability, supporting public policies, and/or economic efficiency; and
    - expected carbon-emission trajectories based on commitments of LSEs, compared to levels consistent with states' policies.
    - expected distributed energy resources.
  - The resource plan would inform the amounts and types of capacity for which each LSE would be responsible in future years, and the amounts and types the RTO would procure in the near term or long term.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on the RTO to conduct resource procurements reflecting amounts and attributes of resources in future years.**
  - The RTO would conduct annual competitive 10-year procurements of resources to meet incremental capacity that is required for either of two resource-adequacy purposes:
    - (a) any resources needed to be located in particular places (Local RA) and
    - (b) any resources needed to assure the provision of flexibility services (Flexible RA)
  - For an category of resource needs (e.g., zero-carbon delivered in a particular location), any resource capable of supply those specifications would be eligible.
  - The annual procurement would be used to fill increasing proportions of capacity needs over the years of a planning period (e.g., 10 years) so that commitments starting in distant years are limited to only those preferred resources that require very long lead times.
  - The RTO would conduct interim reconfiguration procurements to account for changes in resource availability, loads, etc.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on the RTO to conduct resource procurements reflecting amounts and attributes of resources in future years.**
  - Suppliers of Local RA and Flexible RA would need to participate in the procurement.
    - Any market participant (including LSEs) wanting its resources counted as Local RA or Flexible would need to offer them into the RTO's central procurement of these resources.
  - Offers would reflect:
    - Amounts, locations, attributes of resources, length of commitment
    - Delivery period(s) in future (e.g., years 1 onward; years 5 onward; year 9 onward)
    - Prices reflecting the bidders' $/MW requirements over the expected term of a long-term contract, net of each bidders' expected revenues in future energy and ancillary services markets.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on the RTO to conduct resource procurements reflecting amounts and attributes of resources in future years.**
  - The RTO procurement of System RA would be voluntary
  - LSEs' may choose whether to meet their System RA obligations through bilateral contracts, or participation in the RTO procurement, or some combination of both
  - Suppliers of System RA may choose to participate in the RTO process if they have capability that is not committed to bilateral agreements in any year of the procurement.
  - Offers would reflect:
    - Amounts, locations, attributes of resources, length of commitment
    - Delivery period(s) in future (e.g., years 1 onward; years 5 onward; year 9 onward)
    - Prices reflecting the bidders' $/MW requirements over the expected term of a long-term contract, net of each bidders' expected revenues in future energy and ancillary services markets.

Building block #2: resource adequacy approach

- **The FERC tariff would rely on the RTO to conduct resource procurements reflecting amounts and attributes of resources in future years.**
  - The RTO would select winners based on best-fit/cost-minimized portfolio of offers that together satisfy the particular resource need(s) identified in the solicitation.
    - The RTO would start with selecting any Local RA needed, then selecting any Flexible RA.
    - These would be credited against the System RA requirements for each affected LSE.
    - The RTO then would select the remaining amount of System RT to be centrally procured.
  - Winning projects would enter into long-term performance-based contracts, with costs assigned to relevant LSEs.

Building block #3: retail pricing approach

- **The FERC tariff would include the ability of retail resources to participate in wholesale markets (energy, ancillary services, and Local, Flexible and System RA procurements)**
- **Outside of the FERC Tariff:**
  - Transparent information about prices needs to be available to retail customers to enable loads to see dynamic electricity prices and determine whether to respond to them.
  - This needs to be enabled through advanced metering or other communications devices accessible to loads.
  - Loads might participate in wholesale markets either directly (e.g., with pricing signals seen directly by end-use customers) or indirectly (through utility or third-party load aggregators which manage the interactions between end uses and the wholesale market).

Recap: How does this wholesale market design address GHG emissions?

- First, by assuming that the effects of any federal/state/regional carbon-pricing mechanism adopted and administered external to the RTO markets (a la RGGI) would still show up in price formation in the RTO's energy and A/S markets (and indirectly in the forward RA procurements)
- Second, through the FERC tariff acknowledging the ability of states to:
  - Adopt (additionally) an explicit carbon pricing mechanism within the RTO energy market (e.g., if one state in PJM wanted to introduce a more stringent carbon price for loads and offers within that state)
  - Determine the GHG-emitting attributes of resources procured through the RA contracts
  - Decide, even, whether there is an emissions budget (dispatch constraint) for generation within that state.

Three-part wholesale market design

- This three-part+ market design is premised on the need for market designs to satisfy multiple objectives: reliability, economic efficiency, and an electricity system with significantly fewer and eventually no GHG emissions.
- The wholesale power market designed to accomplish those outcomes has to accommodate trade-offs across these objectives. In such a system, a foundational principle should be to exploit market-based mechanisms in service of cost-effective, low-carbon and reliable electricity supply.

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