Residual Capacity Obligations

Evolving the PJM RPM in line with long-term trends in the bulk power system

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Who I am

- Former research physicist (UC, LBNL, IAS, Caltech, Stanford) with twelve years experience in the power sector policy field (started as AAAS Fellow at DOE).
- Senior Fellow working with the power sector transformation research and policy team at Energy Innovation, LLC. Energy Innovation is a nonpartisan energy and climate policy firm delivering research and analysis to help policymakers make informed choices.
- Lead on a five-year effort to examine how power markets should/might evolve hand-in-hand with a clean energy transition.

Agenda for Today

I would like to argue that a natural way to evolve the RPM over the long-term is as a residual capacity obligation on top of a bottom-up evaluation of portfolio reliability for load-serving entity long-term portfolios.

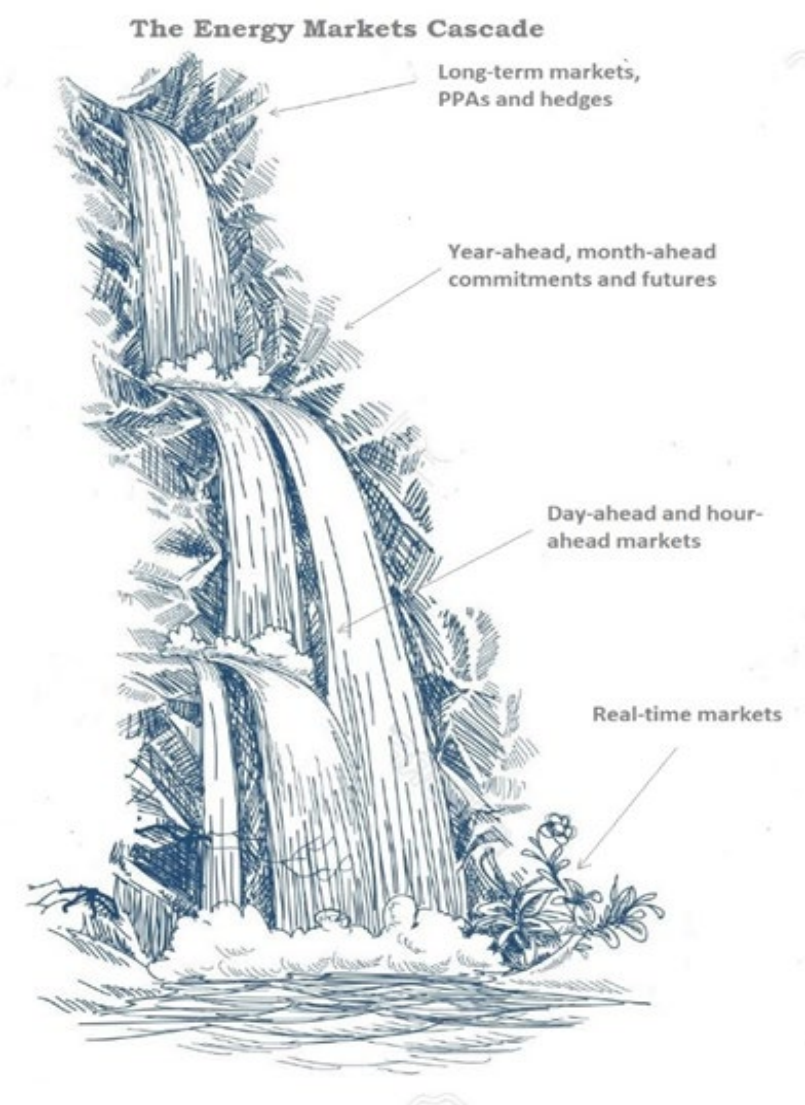
I will explain:

- Four industry trends that motivate this.
- How current RPM design is rowing against the tide.
- Problems that need to be solved to create a reliability marketplace and maintain regulatory reliability standards.
- Basic elements of the idea.
- How the idea solves the problem.
- NOT talking about MOPR – but this idea strongly alleviates tension with state policy goals.

RPM must work hand in hand with **other** market design elements that:

- Maintain the integrity of an energy markets cascade with a foundation in spot markets
- Protect the system from tail risk events (weather extremes, fires, cyber-threats etc.).
- Produce community-level resiliency and provide for local capacity needs.
- Promote demand-side participation.
- Facilitate public policy goals like a clean grid.

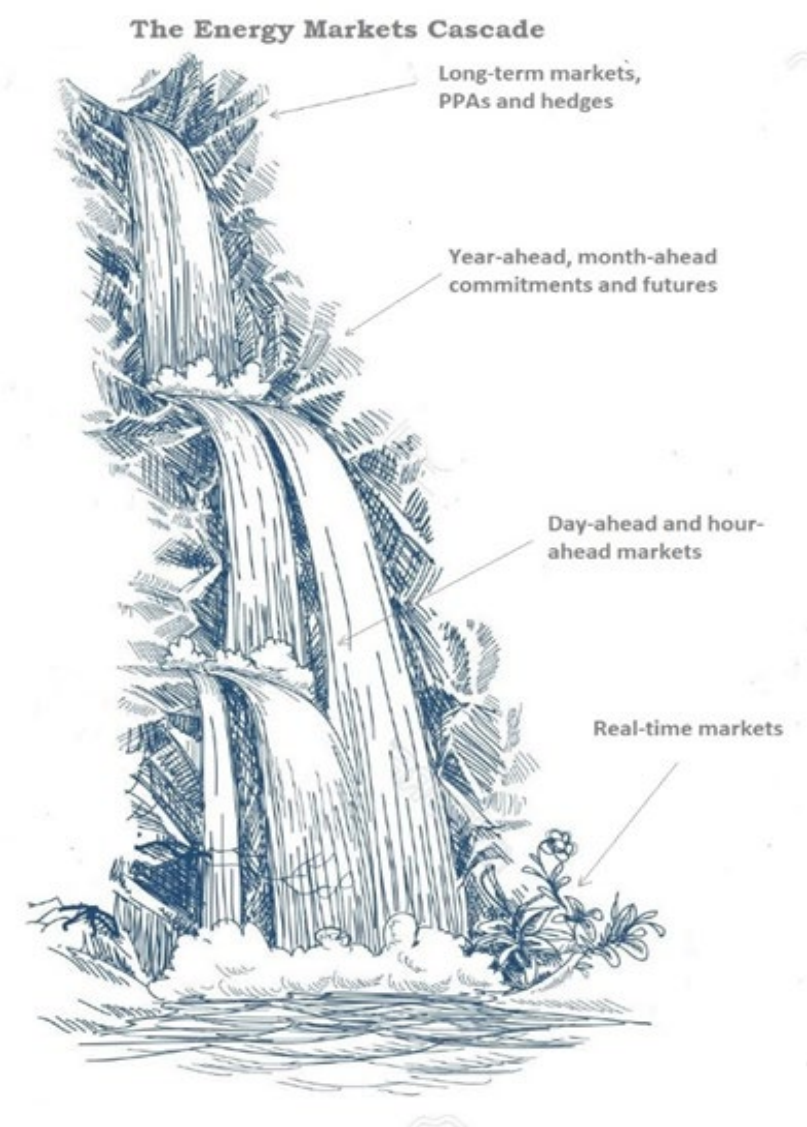
Energy Markets Cascade (EMC)



The energy markets cascade is an integral feature of a functional market design. "Functional" can mean many things, probably the best criteria is efficiency in the broad economic sense. In order to do this it must:

- **Provide *risk management* options for market participants,**
- ***Align technology* characteristics (e.g. forecast error, deployment times, storage capacity) with market options,**
- **Facilitate *planning and commitment* of resources.**

Ideal Design Principles for the EMC



(1) **The cascade should trade in only one underlying commodity, delivered MWh of electricity, so all markets except the real-time market should be *derivative* markets.**

(2) **Participations in of the derivative longer-duration markets should be *voluntary*.**

(3) **Markets in the cascade should be equal access (non-discriminatory), *transparent, and liquid*.**

Philosophy on the Role of the RPM

The RPM is a market intervention which reflects a policy-maker perception that the reliability or resource adequacy externality is not properly priced in the energy market cascade. Also conceived as reflecting reliability as a public good.

The RPM should minimize interference with the proper functioning of the EMC by:

- Mimicking "natural" solutions like a cap option.
- Avoid replicating other market tools like long-term energy price hedges.
- Minimize price impact on the energy spot market.

Industry Trend #1
Heterogeneous Resource Mix

Past System: dominated by dispatchable fuel-burning resources (gas/coal/oil/nuclear with some hydro) with various cap-ex/op-ex ratios and flexibility characteristics – few energy limits.

Future System: dominated by a bigger variety of resources with heterogenous profile, fuel burning potentially in the minority. Diversity of production profile by year/season/time-of-day/geography, battery energy storage, hybrid resources, wide mix of variable dispatchable loads, distributed energy resources, and on and on…

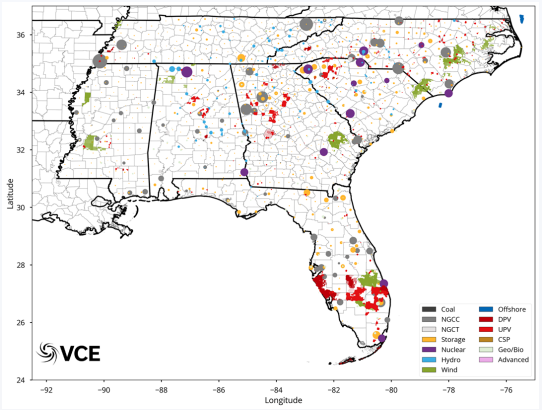
Industry Trend #2
The Planning Reserve Margin is Dead

The PRM made sense in the past system. Procuring enough resources to meet peak typically meant resource adequacy for the rest of the year – with a few tweaks.

2014 Polar Vortex events pointed to the need for a closer look at 8760 hours & capacity performance.

Future resource mix will create new potential periods of system stress that have nothing to do with system peak and vary a lot from one mix to another and potentially from one year to the next.

Story Break: Southeast ISO Study



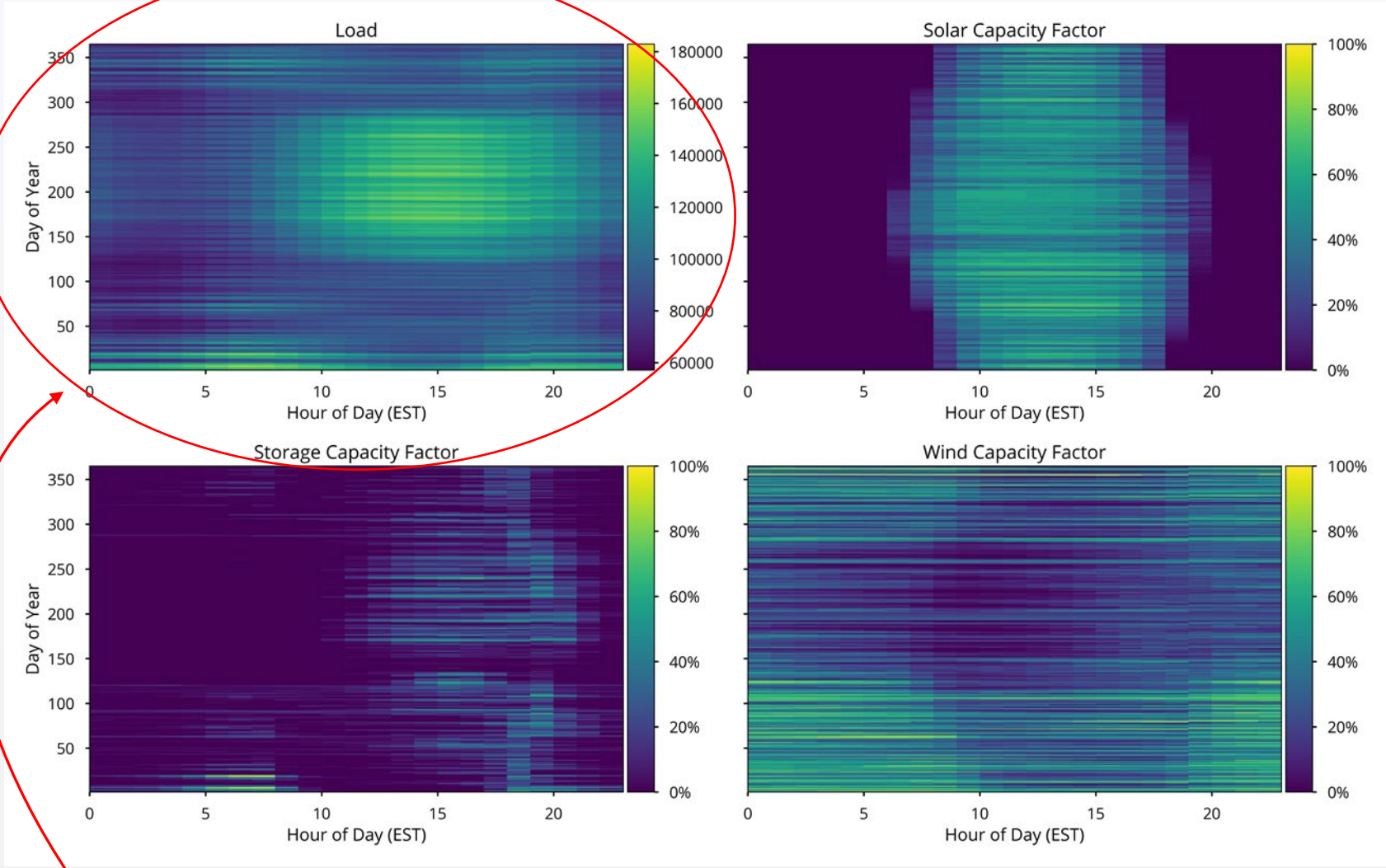
In Summer 2020, Energy Innovation and Vibrant Clean Energy released a study on the benefits of an ISO in the Southeast.

This was a co-optimized capacity expansion and production cost model with 8760 reliability overlay (8 possible load/weather years).

~30% wind and solar, compatible with nuclear and one quarter of peak capacity is storage.

Bottom-up participation in ISO result equated with top-down optimization because of the power of markets to find lower cost solutions and co-optimize multiple participant investment decisions.

Industry Trend #3
Portfolio Assembly is King



2040 Modeling Results from Vibrant Clean Energy Southeast RTO study with Energy Innovation

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Industry Trend #4
Opportunity Cost Means Something Else

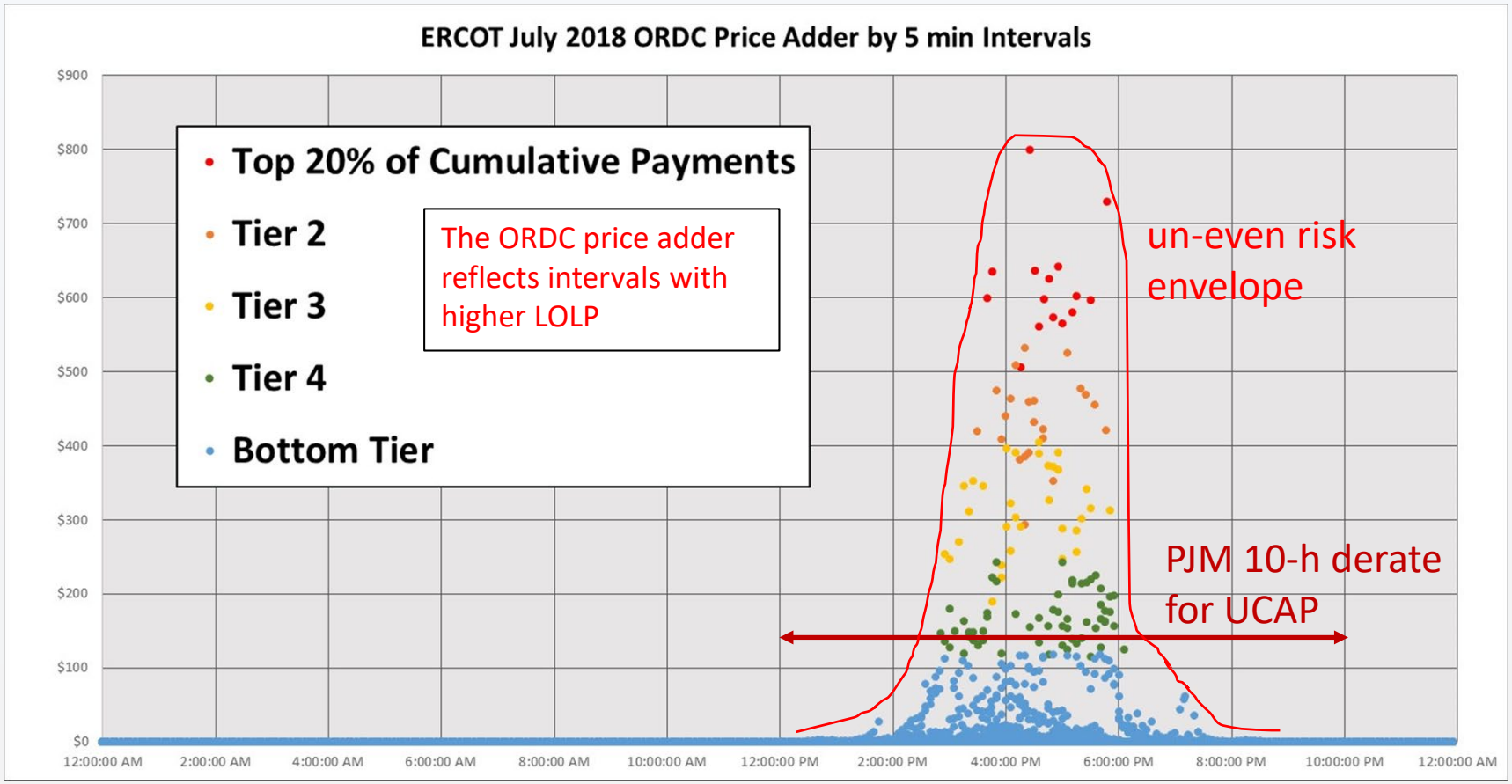
In the old system opportunity costs mainly means the cost of fuel – identified with short-term marginal cost (although hydro-heavy systems understand otherwise)

With the rise of cheap battery storage and DERs (Order 2222) we will see resources with relative opportunity costs because of energy and contextual limitations: do I charge/discharge now or later?

Current RPM Design flies in the face of all four industry trends

- It doesn't properly account for the diversity benefits of a well constructed portfolio
- It has a one-size-fits-all view of market participant characteristics (normal for a commodity market!)
- Still oriented around a PRM mindset for calculating LSE obligation
- Must offer obligation and standards for dispatch potential do not work with well with energy-limited resources and other relative opportunity cost

Example: 10-hour derate for storage



There is a tension between round-the-clock reliability mandate for the RPM and differential system stress!

Problem Statement for a Modern RPM

(1) Properly value the reliability characteristics of bottom-up portfolio of supply-side & demand-side resources with heterogenous technical characteristics and economic imperatives across a full 8760 hours.

(2) Properly price the reliability imperative with a tradeable, homogeneous, sub-additive product in the RPM.

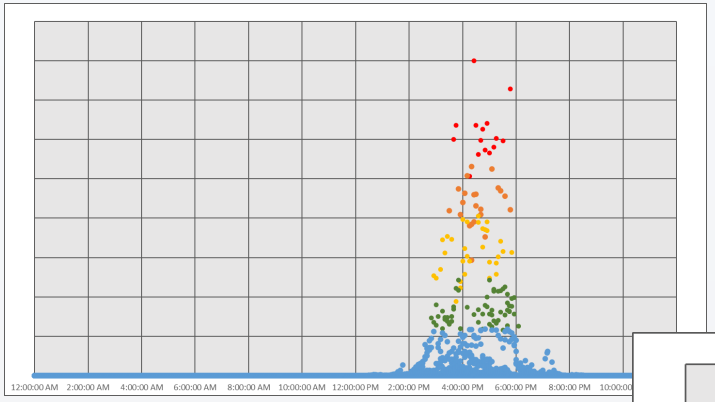
Proposed Solution: A Residual Capacity Market

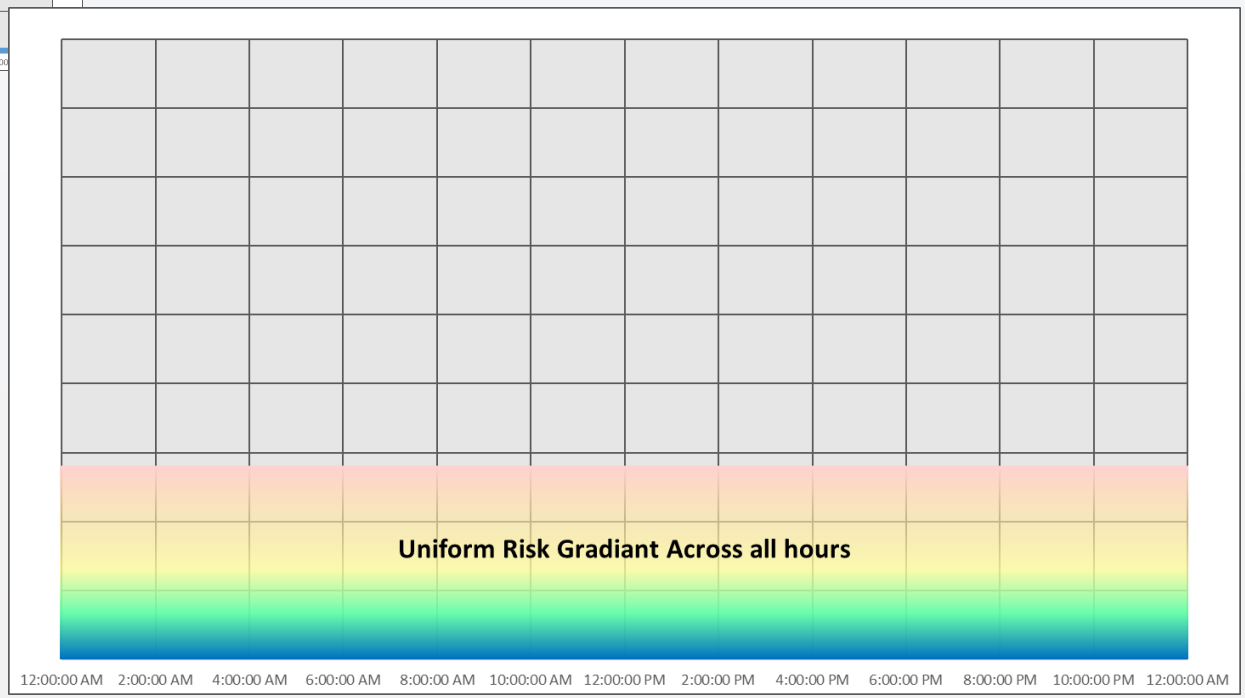
- Each LSE shows a snap-shot of its energy procurement strategy at the appropriate advanced interval (i.e. three years) featuring a bottom up-construction of an energy portfolio with resources, bilateral obligations along with load probability and control characteristics.
- Using a standardized methodology, PJM assigns a residual capacity obligations for procurement in the RPM based on the maximal LOLP above a certain threshold across possible load & weather years.
- Suppliers in this residual market can offer a synthetic product but are on the hook for 8760 provision of capacity with no duration limitation.

Two Key Points

- Energy Portfolio allows for a wide diversity of solutions doing the lions share of the resource adequacy work. Even though this bottom-up, market interactions allow for cost co-optimization across multiple portfolios through trade.
- The energy portfolio will tend to target an even residual risk to minimize the purchase requirement for residual capacity obligations → creates a sub-additive uniform tradable product.

Change in residual risk profile





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Important Policy Features

- Covers the reliability imperative.
- Doesn't clash with state policy as much as current RPM design because state policy mostly aimed at energy portfolio, not at the residual reliability.
- Voluntary in that there is always the choice to tighten energy portfolio and reduce residual exposure.
- This framework can evolve. For example, you could start with ELCC methodology for the portfolio and normal UCAP for the residual market (like Resource Adequacy Commodity Exchange concept)
- Slices of energy portfolio can be traded over the counter, or eventually in a more organized manner (cf. work on Organized Long-Term Markets)

Thank you!

Resources:

Energy Innovation papers on wholesale electricity market design for rapid decarbonization:

https://energyinnovation.org/publication/wholesale-electricity-market-design-for-rapid-decarbonization/

World Resources Institute and Resources for workshop on market design for the clean energy transition:
https://www.wri.org/events/2020/12/market-design-clean-energy-transition-advancing-long-term

Contact me at eric@gimon.org for questions or connect with me on Twitter @EricGimon

Appendix: Organized Long-term Markets

An Organized Long-Term Market is a concept I developed that will:

- Connect long investment time-frames for clean energy with short-term marginal pricing.
- Allow multiple sellers and buyers to transact at once, creating standardized long-term energy contracts.
- Setup the bulk power system to succeed in delivering resource adequacy 24/7 and all year long.

Appendix: Organized Long-term Markets

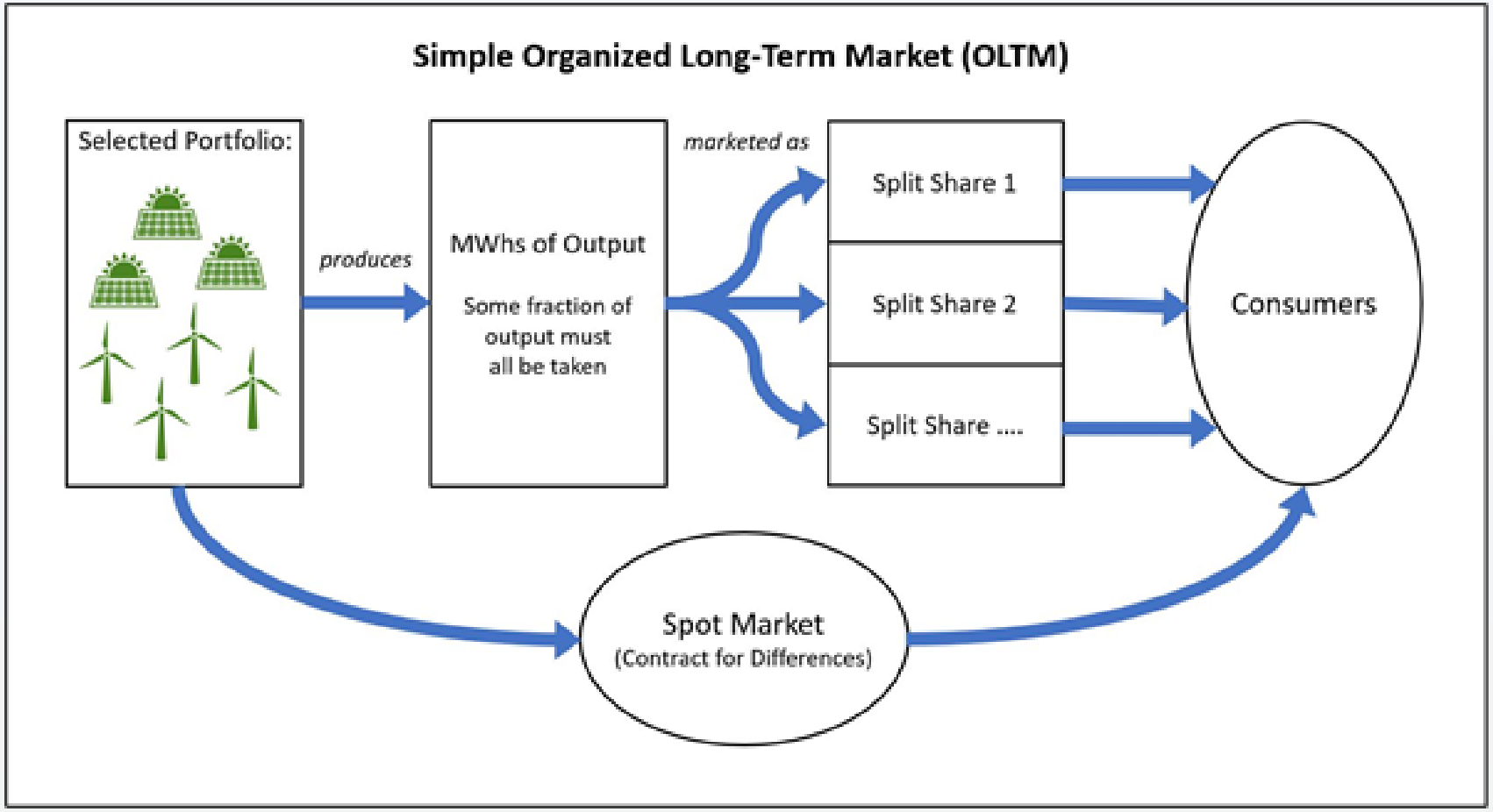

Figure 1 Simple OLTM, similar to syndicated PPA deals today.