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ORGANIZED LONG-TERM MARKETS FOR THE CLEAN ENERGY TRANSITION

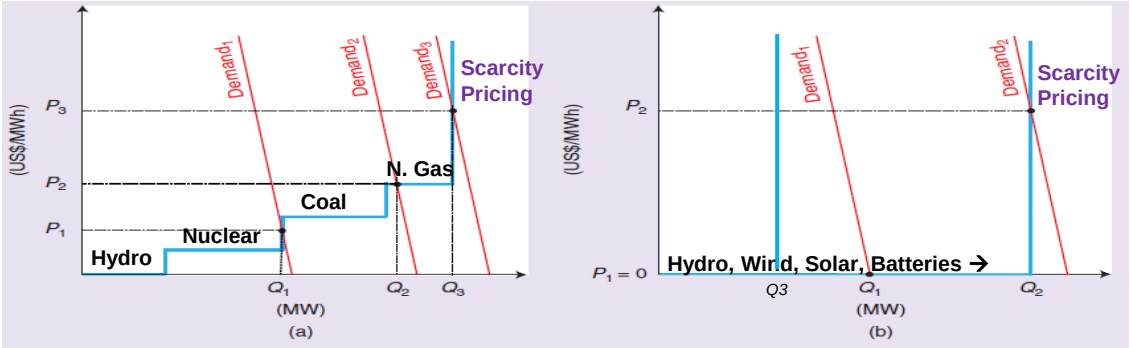
ESIG Webinar, May 26, 2021

QUESTIONS ABOUT CURRENT ELECTRICTY MARKET DESIGNS

Current market designs have their intellectual roots in a world dominated by thermal plants with a wide range of positive short-run marginal costs (SRMCs).

- Can current designs produce reliable, affordable, decarbonized electricity in systems with high penetration of variable renewable energy (VRE) with near-zero SRMCs?
- Can current designs "deliver" without a price on carbon?
- Can they work well with other carbon policies being adopted/considered in states and at the federal level?
- How do our resource adequacy constructs (including capacity markets) need to evolve in high VRE systems?

Do private bi-lateral hedging arrangements adequately address investment/financing challenges and promote efficient resource mix?



THREE CHALLENGES POSED FOR THE POWER SECTOR

Market design should promote/enable:

- **Scale & Pace:** Rapid build-out of wind, solar, storage, and demand-side resources. Continued operation of existing nuclear and flexible clean generators.
- **Innovation:** Market entry by emerging low- and zero-carbon technologies (e.g., advanced nuclear, gas or bioenergy with carbon capture, adv. geothermal, etc.).
- **Generation Mix:** Finding the best *combinations* of these existing and new resources.
  - With low-cost but variable wind and solar, complementarities among sources are much more important than with traditional firm and dispatchable generation.
  - Need ways to compensate back-up sources of firm energy to ensure RA in every hour.
  - Keeping total system costs as low as possible requires more attention than ever before to getting the right *mix* of generation.

JOSKOW: VISIBLE HAND PLAYS A ROLE IN MARKETS TODAY

Today's markets feature several administrative aspects

- Resource adequacy obligations or constructs guide investment and compensation
  - Resource adequacy delegated to states or handled through centralized markets
  - Administratively determined Operate Reserve Demand Curve (ORDC) in Texas
- Price caps to deal with market power
  - Often well below Value of Lost Load (VOLL)
  - Limit ability of shortage pricing to reflect true value of investment
  - Little exposure of retail loads to time varying prices
- Non-market mechanisms to stimulate clean electricity investment
  - Federal tax incentives
  - State RPS policies with various tiers and REC trading rules
  - PURPA

JOSKOW REFERS TO HYBRID MARKETS

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

Competition "for" the market

- Tendering of long term capacity 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 2019

STATES, UTILITIES AND COMPANIES USING LONG-TERM MARKETS

States / Utilities use competitive procurement to meet clean energy goals

- Developers want revenue assurance; states want low-cost energy
- States want to accelerate RE investment
    - piecemeal approach may not produce efficient mix
- Some utilities use competitive *all source procurement* to get efficient mix for IRP
- Procuring RA and Clean Energy jointly could be more efficient (NJ/Brattle proposal for ICCM)

Big Tech and other large buyers want 100 percent clean energy.

- Multi-year PPAs for renewables and supporting technology
- Low-cost way to achieve corporate clean energy goals
- Typically, without a system wide perspective on cost or dispatch

ORGANIZED LONG-TERM MARKETS (OLTM) PROJECT OVERVIEW

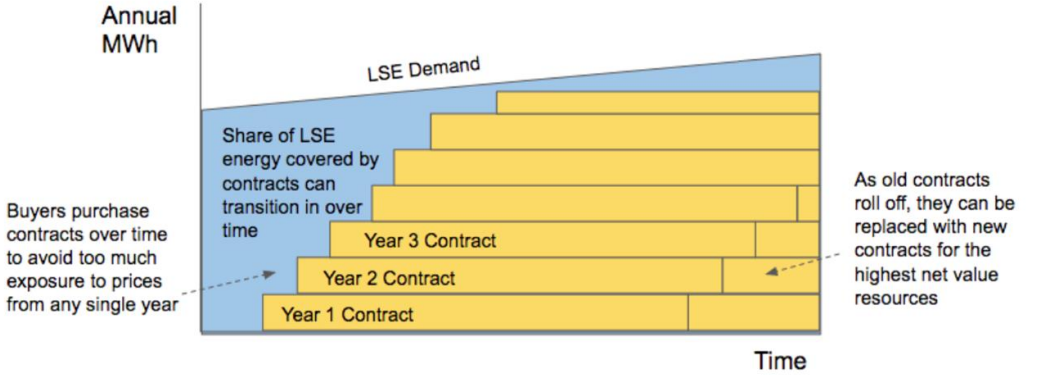
- Invited four authors (Corneli, Tierney, Pierpont and Gimon) to develop ideas for organized long-term markets in four new papers
  - Built on 2018/19 Energy Innovation project on market design
- Produced background report on competitive procurement and innovations in IRP
- Prepared summary matrix that compares four proposals along different themes
- Hosted two-day workshop for dissemination, discussion and feedback
  - Available at https://www.rff.org/events/workshops/market-design-for-the-clean-energy-transition-advancing-long-term-approaches/
- Produced workshop summary
  - Available at https://media.rff.org/documents/WRI_RFF_workshop-summary-proceedings.pdf

“ORGANIZED LONG-TERM MARKET” (OLTM)

Shared starting points for conceptual designs by four authors:

- **Current energy market (as implemented in similar form across all RTO/ISOs)**
  - **Co-optimized energy and ancillary services / SCED / Day-Ahead & Real-Time**
  - **Does a good job at dispatch. OLTM should operate parallel.**
  - **Improvements needed but outside scope: integrate storage & demand response**
  - **Move toward more real-time retail pricing – important to enable storage and demand response, and for electrification of end-uses**
- **Market host: RTO/ISO, multistate collaborative, or…**
- **Allow partial or full self-supply by LSEs**
- **Accommodate state climate/ clean-energy goals**
- **Incremental additions to system**

Figure 11 – Long-term contracts of different vintages can be layered together over time to meet load serving entities’ demand



A QUICK OVERVIEW

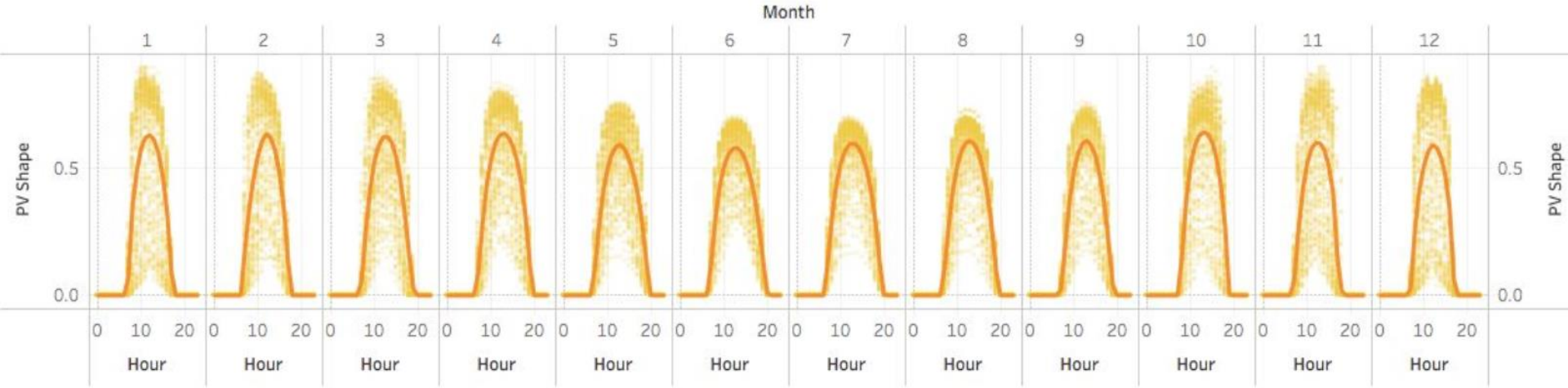
Author	OLTM Goals	Product
Pierpont	Promote readily financed clean energy investments	MWh – forward energy schedules (hourly) Swap contracts: as-bid hourly schedule prices for energy prices
Gimon	Promote readily financed, efficient clean energy portfolios with liquid, tradable long-term contracts	MWh – Swap contracts: forward energy schedules for energy prices
Tierney	Resource Adequacy Climate/energy goals Least cost	Capacity (MW) + must-offer available energy Adds new "RA" products: "Local RA" and "Flexible RA"
Corneli	System balance (match load & generation in all hours even under extreme conditions) Decarbonization constraint Least-cost system optimization	"Capability" + must-offer available energy Swap contracts: as-bid project costs for energy revenues

PIERPONT OLTM

- **Does not aim for Resource Adequacy or system optimization**
- **Primary aim is enabling rapid build-out of solar and wind (i.e., resources with ~all fixed costs)**
- **Builds on widespread use of Contracts For Differences.**
- **Sellers bid hourly prices for forward schedules to deliver energy**
- **Key element is a long-term hourly price forecast used to evaluate and rank bids.**
- **Market operator could be an RTO, government agency, third-party exchange, etc.**

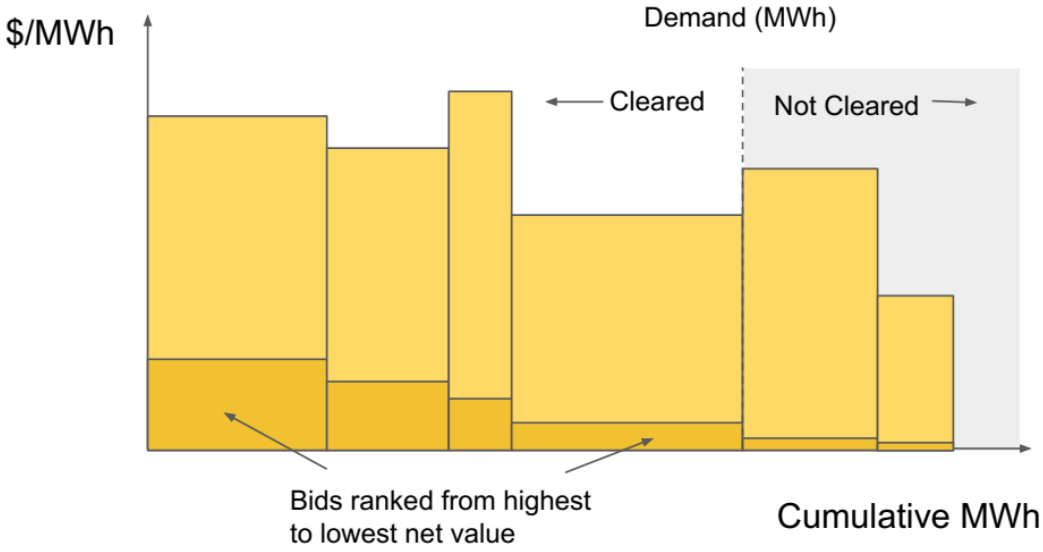
Product definition: example

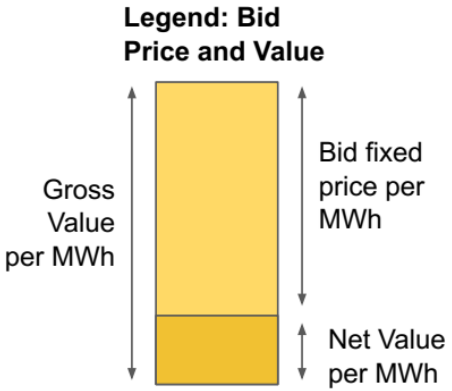
- Actual production varies from day to day, year to year.
- Project is paid fixed price per MWh for the contracted shape, not actual production.
- Actual production sold into real-time market, and project earns actual MWh times real-time price
- Contract for differences settles by netting back to buyer contracted profile times real-time price



Selecting winning bids: option 1

- LSEs submit how many MWh they seek to purchase, total demand is aggregated
- Bids evaluated against agreed upon forward price projection (with hourly price profiles)
- Bids ranked from highest to lowest net value (gross value per MWh - fixed bid price per MWh)
- Winning bids are pooled, and allocated proportionally to LSEs

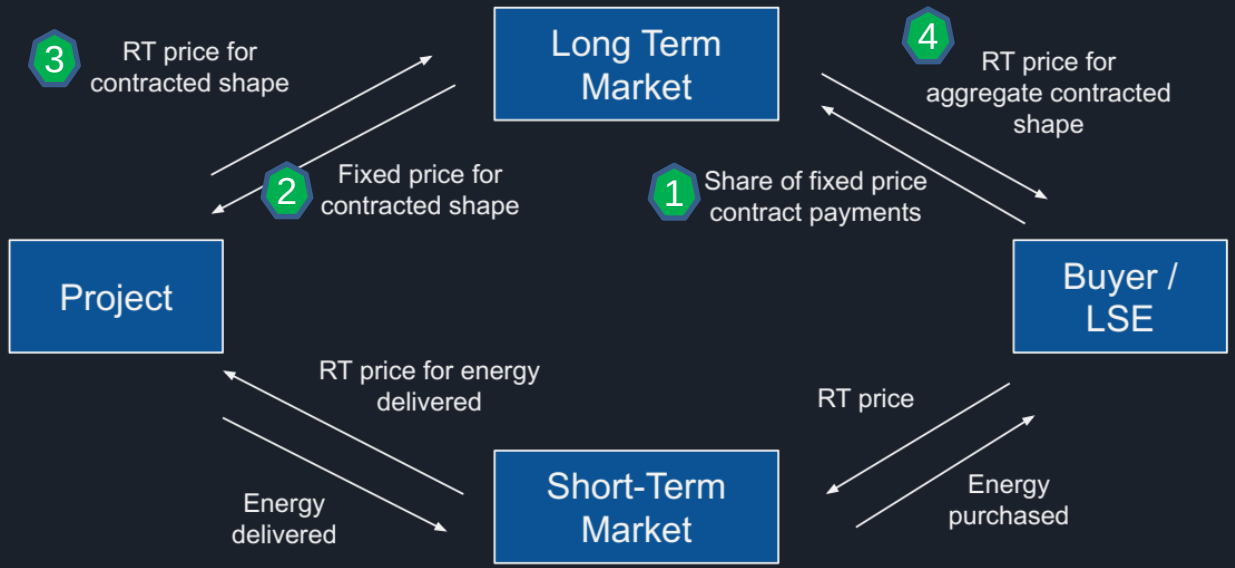




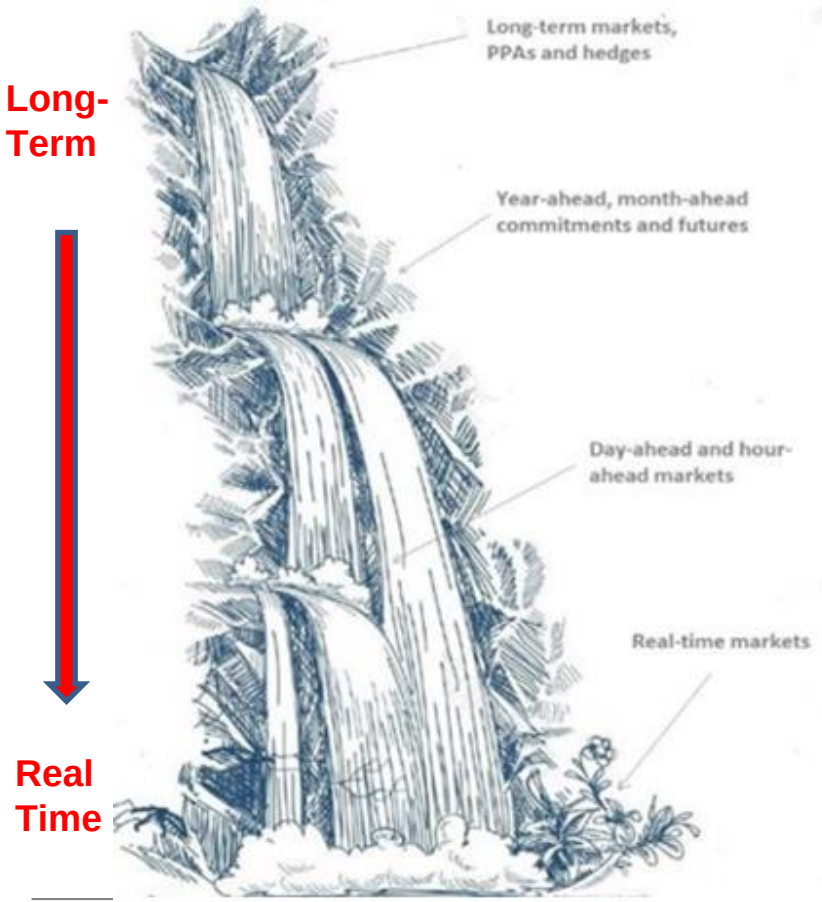
Final “Net Value per MWh” is levelized over contract years of project

FINANCIAL FLOWS

- Long-term contract for differences for a specified production profile (shape)
- Seller gets fixed price per MWh for contracted profile, net of real-time electricity price applied to the contracted shape
- Buyers bear price risk, but seller bears production risk relative to contracted profile



GIMON OLTM – "ENERGY MARKETS CASCADE"



(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) Participation in the derivative longer-duration markets should be *voluntary*.

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

GIMON OLTM

Does not aim for Resource Adequacy

Goals:

- **Connects energy sellers with heterogenous technology characteristics and production profiles.**
- **Assembles in portfolios optimized around buyer criteria (least-cost, production shape, emissions).**
- **Creates standardized long-term energy contracts that buyers can buy and trade.**

Not run by RTO, but by one or more ‘Optimizers’

- **An Optimizer recruits bids from resources, assembles desirable portfolios, and makes them available to buyers**
- **Create a long-term contract exchange that keeps track of obligations, types, vintages, and allows secondary sales**

TIERNEY OLTM

Builds on existing concepts of capacity markets.
Current designs define Resource Adequacy (RA) in terms of meeting a system peak load. This OLTM would define and create three types of RA products:

- **System RA – reflecting amounts of capability to meet peak load (with varying capacity value by technology type) and states' "attribute requirements" (e.g., emission targets, support for emerging technologies)**
- **Flexible RA – reflecting amounts of capability to provide ramping & other flexibility/balancing services**
- **Local RA – reflecting amounts of capabilities needed for reliability in load pockets**

The RTO would conduct long-term planning that identifies resources that provide aggregate RA needed while meeting:

- **State and LSE clean energy attribute requirements , including local (and distributed) resources**
- **Transmission needs (and non-wires alternatives)**

The plan would inform the amounts and types of capacities the RTO would procure, and the cost allocation to LSEs

TIERNEY OLTM

The RTO would conduct annual procurements of the three types of RA capabilities, soliciting bids sequentially for Local RA (if needed), Flexible RA, and then System RA.

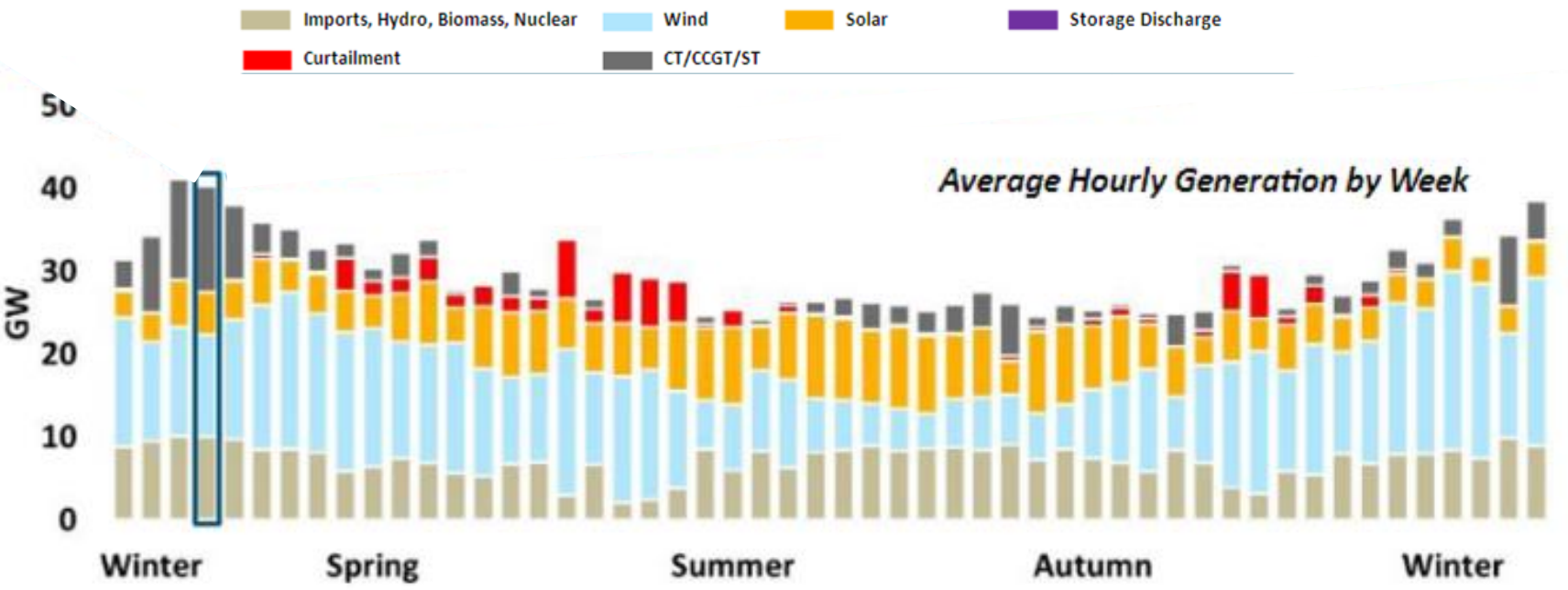
- **Bidders would make $/MW offers for long-term contracts, accounting for their expected future revenues in the energy and ancillary services markets.**
- **Start dates would be flexible up to 9 years ahead to allow for varying lead times**
- **Contract lengths would be minimum 10 years (longer than current capacity markets)**

A sophisticated system planning model would evaluate combinations of bids.

- **The RTO would select winners based on a best-fit/cost-minimized portfolio.**
- **LSEs would have the option of directly contracting for some or all of their System RA obligations**

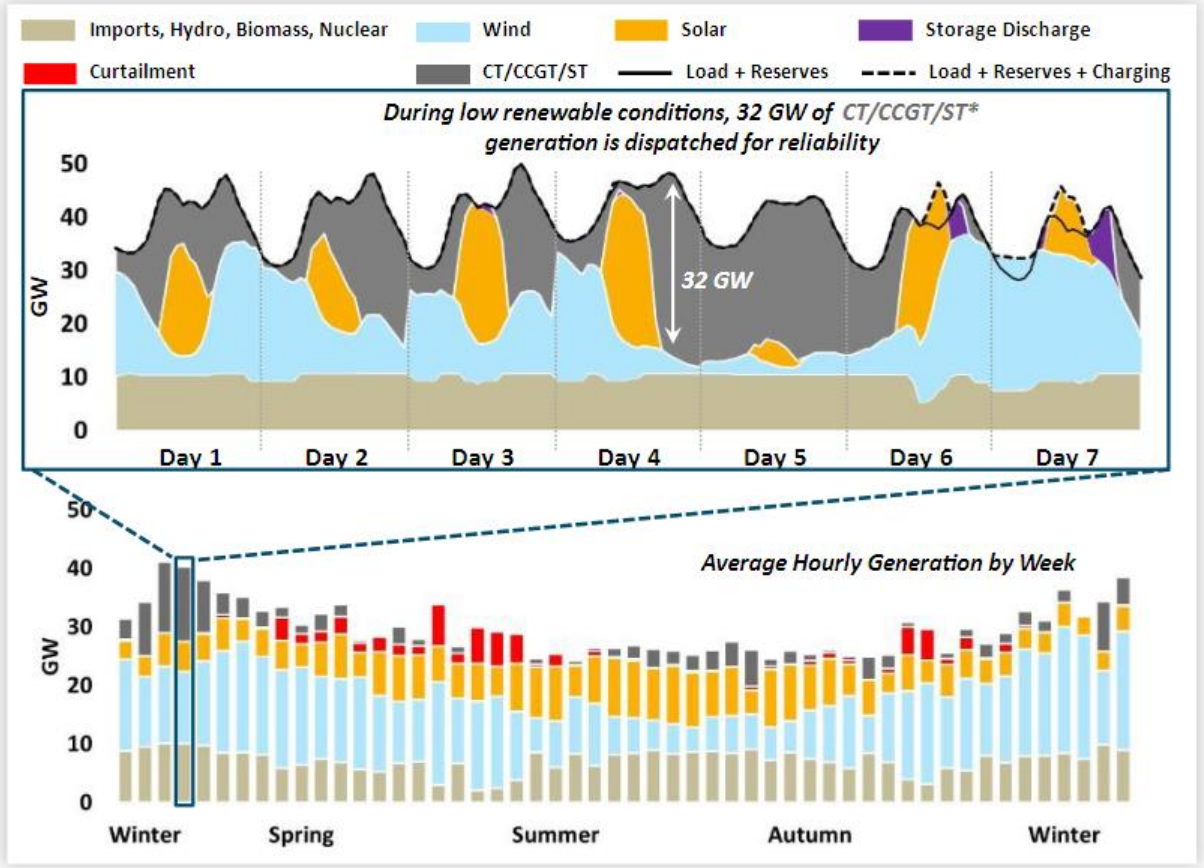
CORNELI OLTM

Most decarbonization analyses use precise renewable input system expansion modeling (PRISM) tools to find the most efficient, reliable combinations of clean energy resources.



Source: E-three / EFI *Net-Zero New England,* November 2020

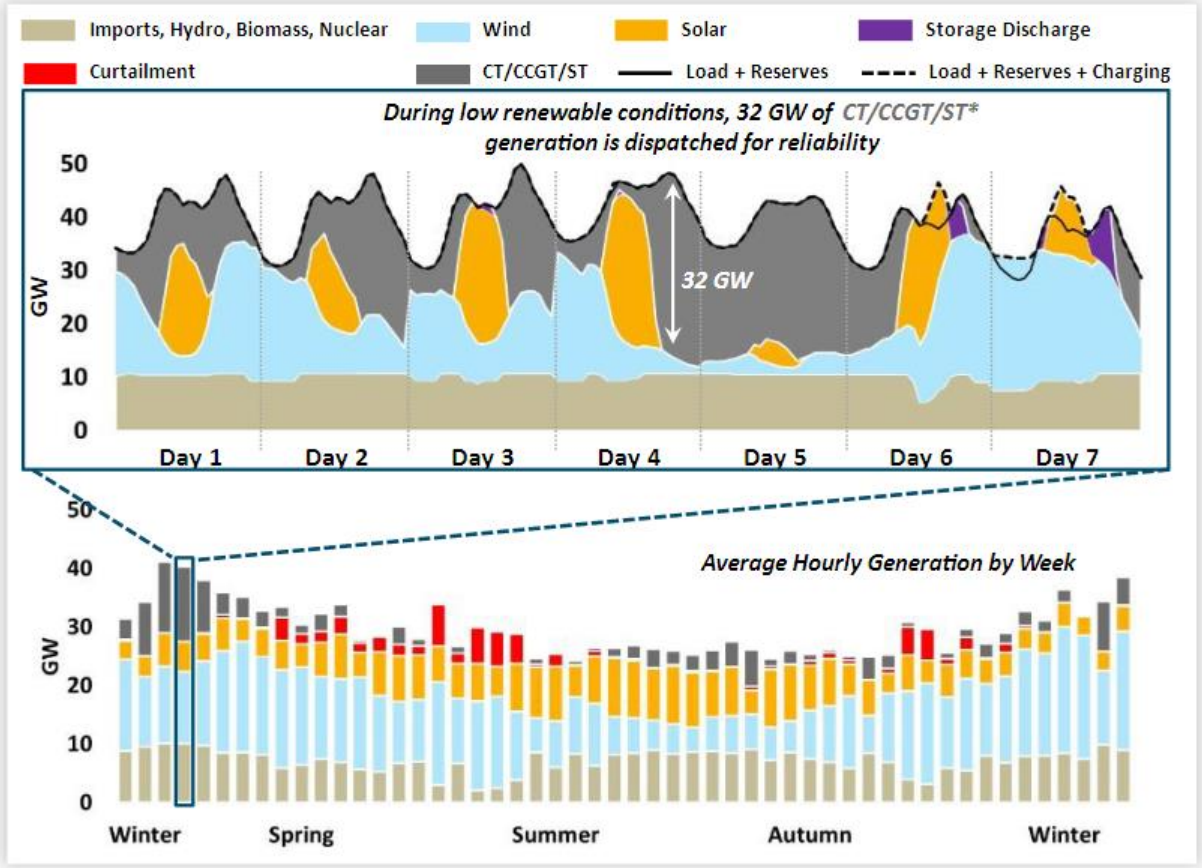
Figure 4-10. Illustrative Dispatch over a Critical Week in 2050 (High Electrification Scenario)



This approach identifies the optimal mix of clean energy to reliably serve load, in all hours, under a wide variety of possible wind, sunshine availability at all potential resource sites.

Source: E-three / EFI *Net-Zero New England,* November 2020

Figure 4-10. Illustrative Dispatch over a Critical Week in 2050 (High Electrification Scenario)



Couldn't a procurement market that is "cleared" by PRISM tools

- **Identify the most efficient combinations of clean energy resources**
- **That are really available,**
- **At their real competitive costs, and**
- **Able to meet declining carbon budgets while maintaining reliability?**

Source: E-three / EFI *Net-Zero New England,* November 2020

A PRISM-based Configuration Market: overview

Market hosting, timing and targeted resources

- **Hosted by RTO, a joint state board under FPA S. 209, or other regional entity (e.g., like EIM).**
  - **New procurement auction every three years.**
  - **Clean resource developers invited to submit sealed bids for amortized all-in project cost, based on a technology-specific, pro-forma draft contract.**

Winner selection process

- **PRISM-based tools select combination of projects that, *in combination with existing resources*:**
  - **Have GHG emissions within PRISM declining carbon constraint (reflecting IPCC GHG reduction goals).**
  - **Ensure system can balance generation and load every five minutes.**
  - **Meets above constraints at lowest cost.**

Payment to winners and settlement

- **Winning bidders are awarded financial swaps with load (similar to tolling agreements).**
  - **Load pays as-bid prices to projects, projects must offer energy in spot market, and pay load spot revenues.**
  - **Penalties subtracted from fixed cost payments for failure to meet contract performance requirements.**
  - **Swap tenor may vary with resource types, depending on financing needs.**

Goals

- **Ensure development of least cost, reliable mix of clean energy resources needed for rapid decarbonization**
  - **Provide revenue certainty needed to ensure low cost financing for truly massive clean energy investment.**
  - **Support innovation and rapid deployment of new, efficiency-enhancing technologies.**
  - **Co-exist with and support efficiency of existing LMP-type spot energy markets.**

Roles of Configuration Market and spot energy market

Think ***Moneyball*** –

- SABRmetrics, using big data and algorithms, identifies the players with the most win-enhancing skills so the team can hire them at competitive compensation.

- The coach makes sure they are in the right batting order and positions and motivated to play their best.

In the same way,

- The PRISM tools, using big data and algorithms, identify the best mix of resources and get them on the power team at the most competitive compensation levels.

- The SCED market is the coach that makes sure they operate in the right order and combinations to match load and minimize operating costs.

*Big lesson from **Moneyball** – you don't want the coaches hiring the players.*

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THANK YOU

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WRI/RFF 2020 Workshop materials (papers, PPTs, videos) available at:
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