Electricity Market Design for High Renewables Systems

Brendan Pierpont - ESIG Webinar - April 9 2020

Quick note: this presentation doesn’t represent an official position of the Sierra Club or Beyond Coal Campaign. It’s intended as a discussion-starter around long-term market design concepts.

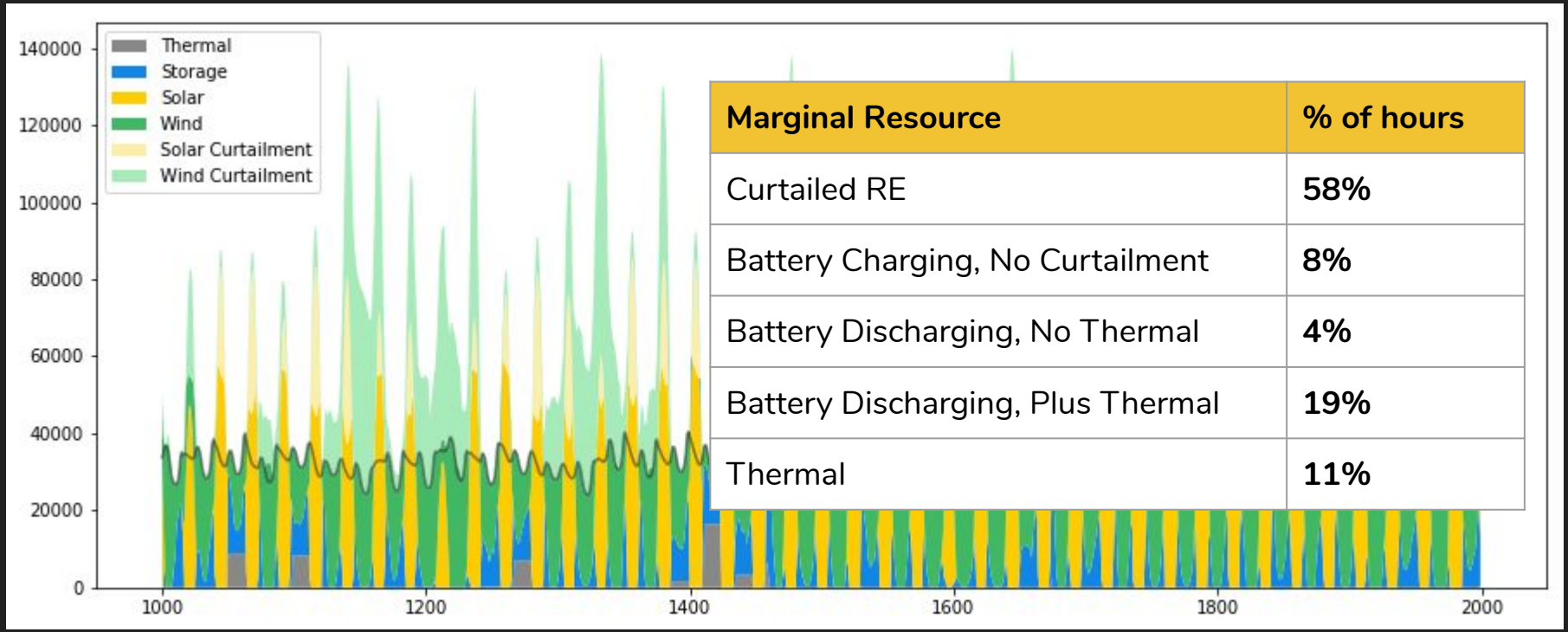
What should electricity markets be designed for?

- Efficient real-time energy dispatch and balancing over a broad geographic area
- Efficient use of transmission
- Price transparency
- Price discovery to drive entry and exit
- Provide and price operational reliability services (flexibility, ancillary services)
- Facilitate long term, competitive contracting for clean energy
- Increase renewable penetration at lower cost to serve climate objectives

Today: Low-moderate shares of wind and solar, fossil generation on the margin most of the time

Long-Term Goal: Near-100% clean energy system, large shares of wind, solar and storage

Illustrative 90%+ Renewables System (Toy Model)



Marginal Resource	% of hours
Curtailed RE	**58%**
Battery Charging, No Curtailment	**8%**
Battery Discharging, No Thermal	**4%**
Battery Discharging, Plus Thermal	**19%**
Thermal	**11%**

Looking forward there are big challenges to solve

Getting the **right mix** that minimizes clean energy system costs, when short term price ≠ long-term value

Enabling **low-cost finance** for capital-intensive clean energy, when financing cost is a function of price risk

Balancing **competing state interests** and diverging levels of clean energy ambition

Plus: planning, forecasting, operational challenges and new system services

Getting the right mix

- Building new zero marginal cost resources pushes higher-cost resources off the margin, lowering prices. A resource might erode its own price signal and not be able to capture much or all of its value to the system without a long-term contract.
- At the limit, a clean energy system has curtailed or stored renewable energy on the margin many hours of the year. Everyone is counting on a small share of hours a year to earn enough revenue to cover fixed costs.
- **Result:** Short-term market signals alone may place extreme value on one type of resource and not reflect the system value of all resources that work together to minimize system costs.

Enabling low-cost finance

- Clean energy resources are capital-intensive, financing costs are a big driver of levelized costs and ultimately system costs.
- Financing costs are primarily driven by revenue uncertainty. When revenues are highly uncertain, finance may not be available at all, or only at an extremely high cost of capital.
- Wind and solar availability varies with weather, storage availability varies with energy adequacy and state of charge, creating more uncertainty around capturing high prices.
- If resources lack certainty that they'll be able to capture high prices, they won't get built based on short-term market prices.

Balancing competing state interests

- Today, state policy is a primary driver of clean energy progress.
- Regional markets are important in the long run to diversify demand and renewable energy resource profiles, ensure full use of transmission, tap into a wide range of flexibility sources.
- Different state policies across a multi-state markets risks leakage, resource shuffling, and policy conflicts from states with competing interests.
- Market governance needs to ensure that market rules support (and not undermine) state clean energy policy objectives.

Long-term contracting markets

Basic concept: procure clean energy and complementary resources through competitive auctions for credit-worthy long-term contracts. Short-term market retains its role for efficient dispatch, operational flexibility and reliability.

Option 1: Independent, market-based IRP	Option 2: “Configuration market”
Independent resource planning process that incorporates clean energy policy objectives, and relies on offers from market participants (not engineering assumptions) as inputs	System optimization engine clears a long-term market, based on clean energy policy objectives and bids from resources with different costs and performance characteristics

Some open questions

Added value over bilateral contracting based on short-term prices?

- Avoids settling against a price that doesn't reflect total system value
- Avoids high implicit cost of hedging volatile short-term prices
- Incorporates state policy objectives into competitive procurement

Who is the counterparty to long-term contracts, and are they creditworthy?

- Direct contracts with load serving entities, or with state entity?

How often and how much?

- Once per year? Procurement of incremental needs / economic replacement?

Closing thoughts

Market design needs to do more than solve the operational challenges of high renewable energy systems.

Electricity markets also need to address revenue sufficiency and financeability for the resources that are part of a least-cost low carbon mix that reflects state policy objectives.

Long-term contracting markets are one potential approach to resolving these problems, and could take many forms.

Thank You!

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Resources:

Energy Innovation, “Wholesale Electricity Market Design for Rapid Decarbonization”, 2019, https://energyinnovation.org/publication/wholesale-electricity-market-design-for-rapid-decarbonization/

Climate Policy Initiative, “Markets for Low Carbon, Low-Cost Electricity Systems,” 2017, https://climatepolicyinitiative.org/publication/markets-low-carbon-low-cost-electricity-systems-working-paper/