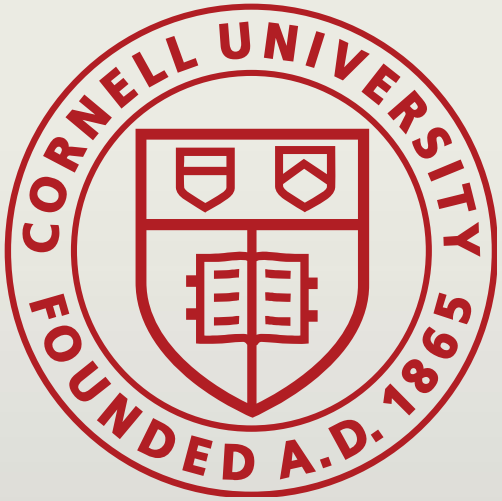

Electricity Markets under Deep Decarbonization

Jacob Mays

ESIG Fall Technical Workshop

October 24, 2024

Three elements of the “vision”

1. Full-strength spot prices
2. Mandatory contracting
3. Proactive transmission planning

Three elements of the “vision”

1. **Full-strength spot prices**
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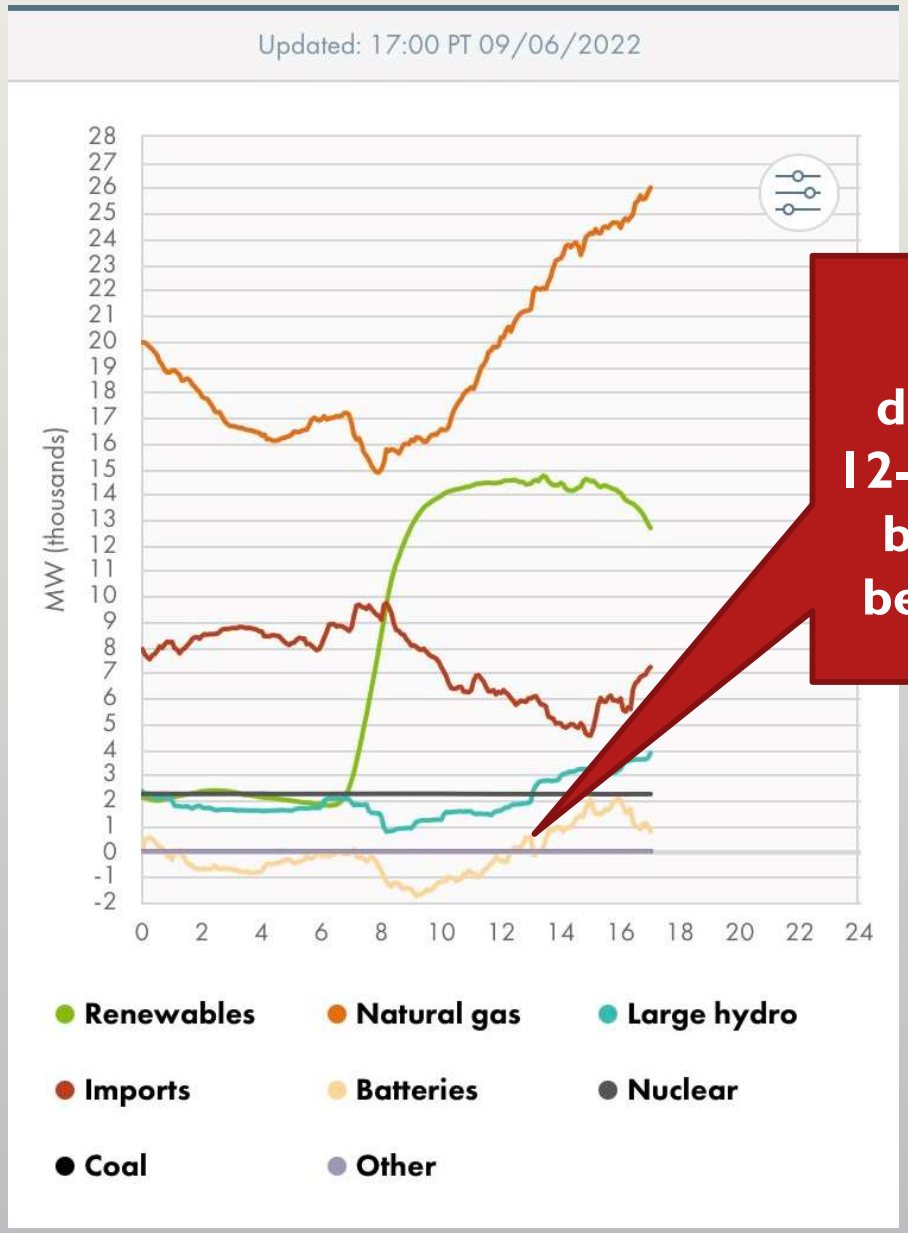
Near-miss in California: Part 1

Near-miss in California: Part 2



Batteries start discharging around 12-1pm, positioning to be fully discharged before critical hours

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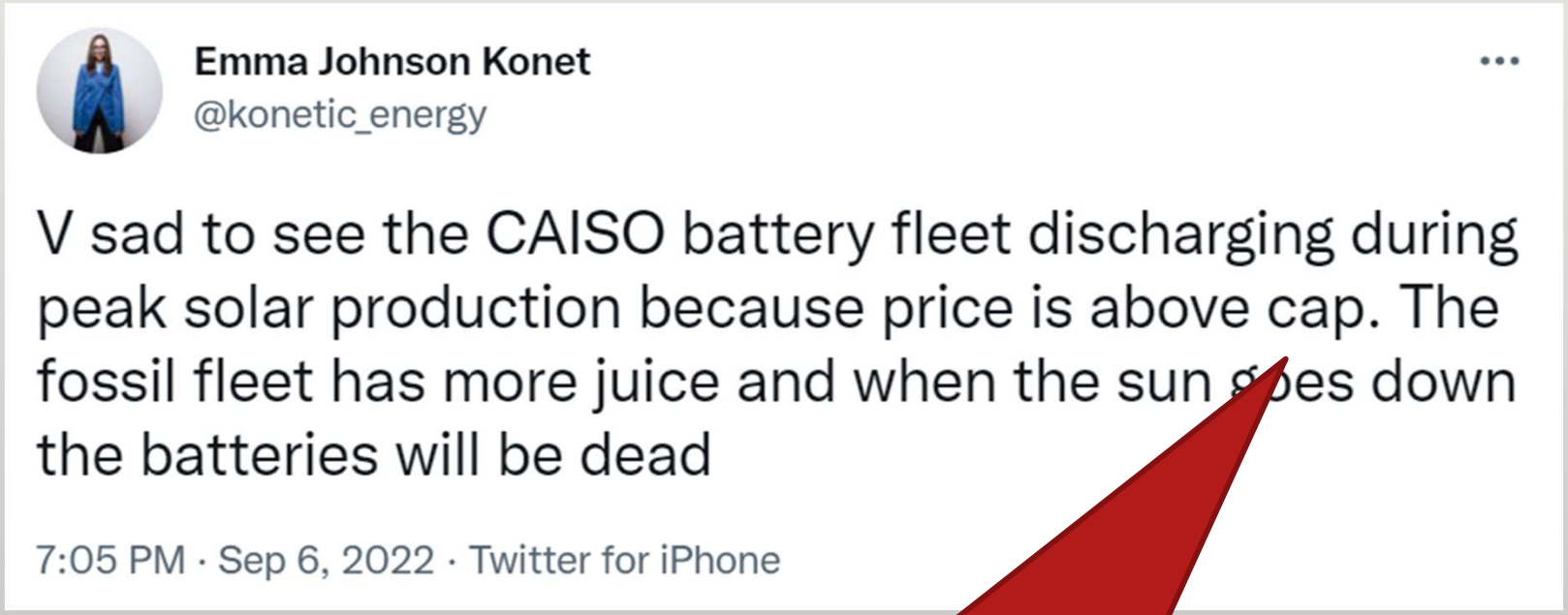
Near-miss in California: Part 3



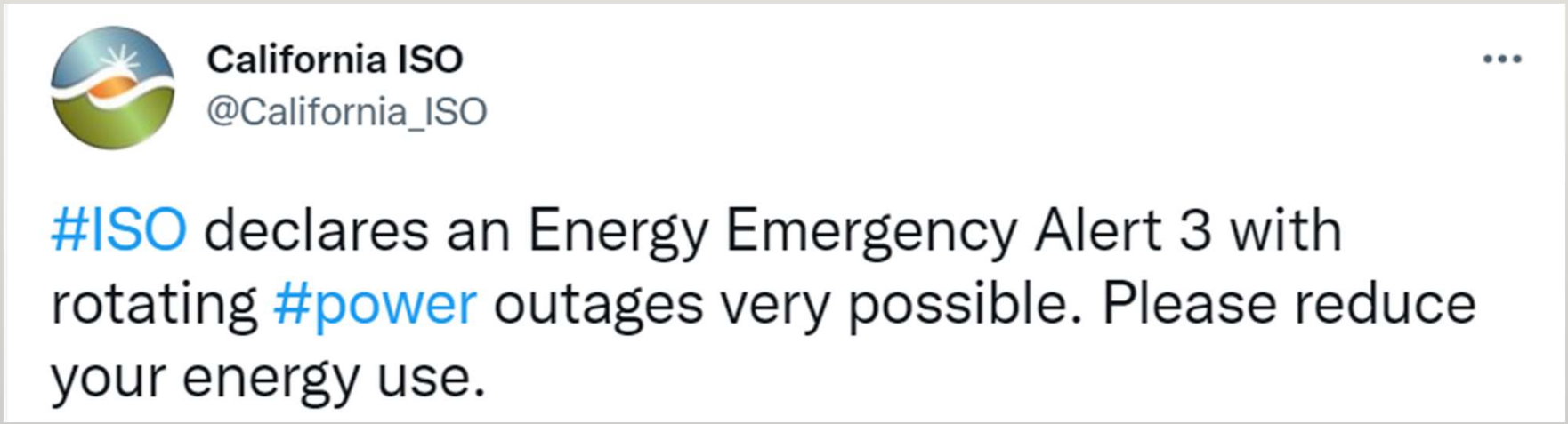
Emma Johnson Konet
@konetic_energy

V sad to see the CAISO battery fleet discharging during peak solar production because price is above cap. The fossil fleet has more juice and when the sun goes down the batteries will be dead

7:05 PM · Sep 6, 2022 · Twitter for iPhone

Price cap causing poor incentives for operation

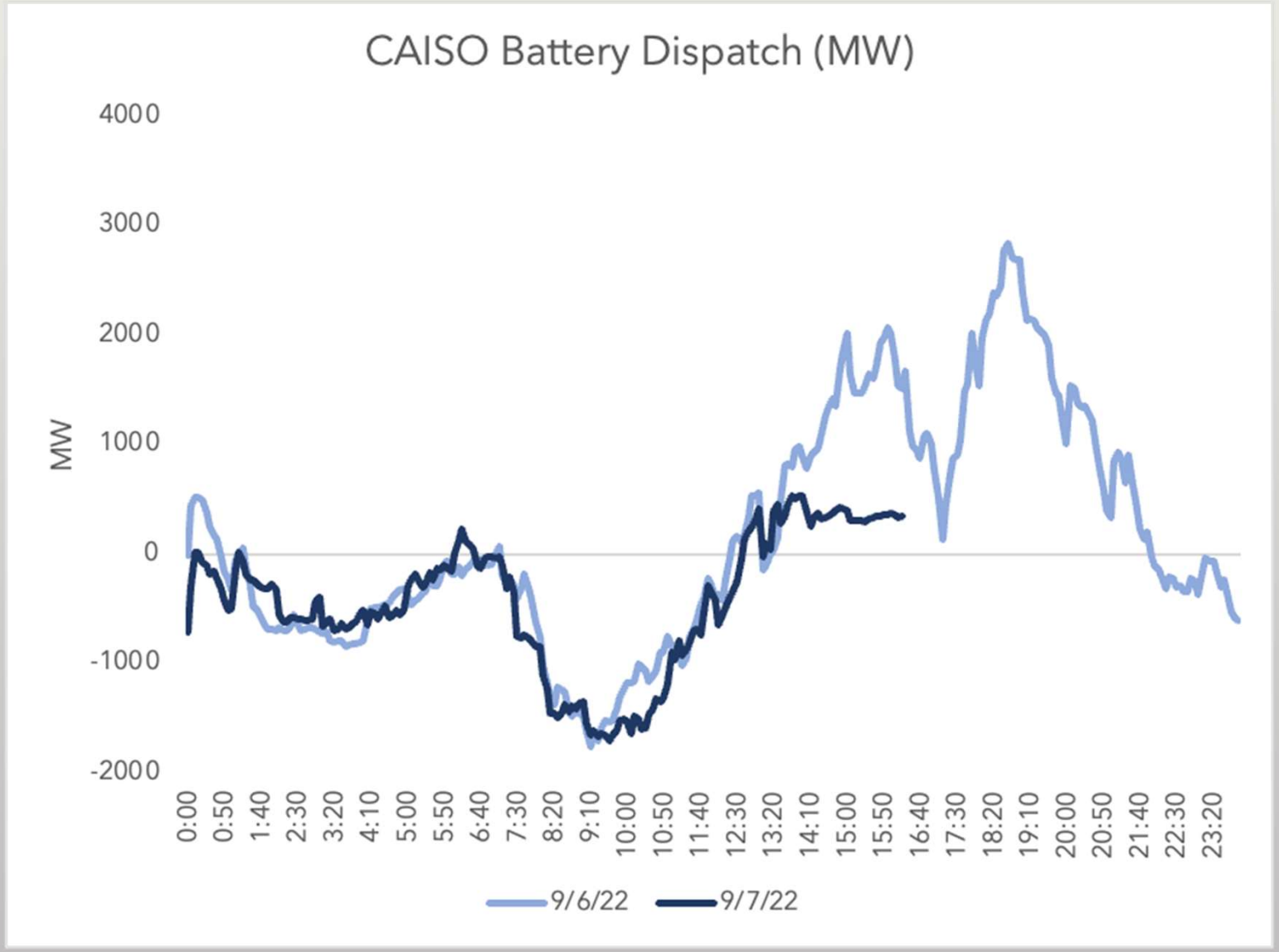
Near-miss in California: Part 4



Pricing problems can become reliability problems

Near-miss in California: Part 5

Near-miss in California: Part 6



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Near-miss in California: Part 7

Cody Hill
@cody_a_hill

Replying to @brendanpierpont

CAISO operators have been using Exceptional Dispatch, forcing batteries to sit back and wait for the absolute peak. Clearly reacting to yesterday's too-close call.

7:56 PM · Sep 7, 2022 · Twitter Web App

- **Pricing problems create need to override the market**

Element 1: full-strength spot prices

- **Want consistency between resource adequacy targets and operational expectations**
- **Mismatch becoming more important as energy-limited resources grow (also relevant for gas)**
- **Also enables demand-side and distribution-level resources to monetize value without administrative accreditation**

Failure to produce full-strength prices for energy and ancillary services leads to reliability issues and need for out-of-market interventions

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Political economy

Contracts shift exposure to high spot prices from load to generation and could contribute to a more durable market design

Winter Storm Uri	Winter Storm Elliott
• Significant political backlash to high prices despite most retail customers being hedged • Substantial market design changes in ERCOT without sound basis	• Significant complaints about non-performance penalties within industry, but no major political response • Sound reforms to accreditation implemented in PJM

Market power

THE SACRAMENTO BEE

California power prices have skyrocketed. Is this normal — or more Enron-style 'manipulation'?

- **Contracted generators have little incentive to exercise market power in spot market**
- **While market power concerns persist in longer-term markets, contracting can be part of an overall mitigation strategy**

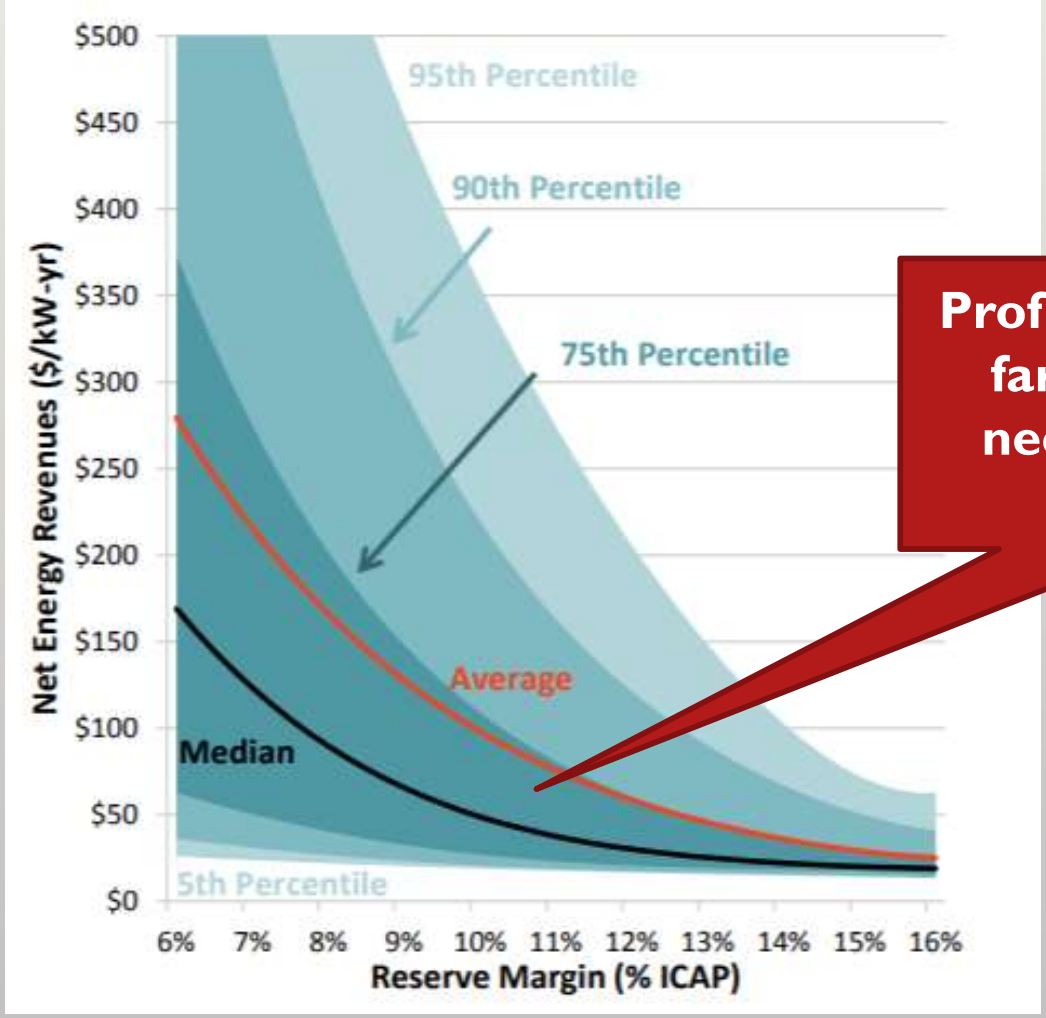
Financial risk, demand side

Britain faces 'massacre' of 20 more bust energy suppliers, Scottish Power says

- **Volatility creates significant risk for retailers and users of electricity**

Financial risk, supply side

Distribution of operating profits in ERCOT



Profit in median year far below what is needed to sustain generators

Source: Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region (The Brattle Group)

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Preconditioning risk

Two routes for policymakers, regulators, and market operators to manage risk

1. **Suppress volatility in spot prices**

2. **Mandate contracts**

My opinion: avoid the former, pursue the latter

Element 2: mandatory contracting

Can require that load serving entities contract with suppliers, with several high-level design choices:

- **Full-strength spot prices?**
- **State, market operator, or combination?**
- **Centralized or bilateral?**
- **What contractual form?**
- **Financial or physical?**

Workable configuration likely dependent on market structure and existing mechanisms

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Planning and economic issues

- **Very long-lived assets**
- **Long lead times for construction**
  - **~3x that of generation**
  - **~10x that of load**
- **Economies of scale (=> non-convex cost functions)**
- **Complex physics (=> network externalities)**

These features militate toward a centralized solution for transmission

Paying and cost allocation

Challenge is determining "how proactive" to be:

- **Significant uncertainty**
- **Different beliefs and risk preferences**
- **Potential to "crowd out" less expensive solutions from generation, demand, storage**
- **Difficult to converge on mutually agreeable scenarios and benefit estimates**

In principle planning models can be used to assess who beneficiaries are likely to be, including the effect of different policies in different jurisdictions

Element 3: proactive transmission

- **Cost of transmission a relatively small component of overall system costs at the wholesale level**
- **Issues with spot price formation and contracting exacerbated with transmission underinvestment**
  - **Market power**
  - **Effect of (unpriced) voltage and system strength issues**
  - **Frictions to market entry in interconnection**
  - **Partially unhedgeable basis risk**

Transmission best viewed as a platform on which efficient price formation and contracting can occur

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Addendum: what about policy?

- **ISO/RTO market design subordinate to policy**
  - **Avoid subsidies "within" the market design**
  - **Do not try to "correct" subsidies coming from outside the market**
- **Policy threat to reliability?**
  - **Business case for "clean firm" dependent on strong, consistent carbon policy**
  - **Business case for "conventional firm" dependent on lack of carbon policy**
  - **Uncertainty in policy can lead to underinvestment in both**

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