# Hybrid Markets: Integrating Long Term Competitive Procurement Markets, Short-term Energy Markets, and IRPs

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# The Decentralized Competitive Wholesale Market Vision circa 1990s

- Organized competitive wholesale markets for energy and ancillary services
  - Restructure to separate potentially competitive segments (generation and retail supply) from regulated segments (T&D)
  - Generators compete to supply energy and ancillary services in organized wholesale markets that balance supply and demand continuously
    - Security constrained bid-based uniform price auction markets, co-optimization of energy, ancillary services supply, network congestion and associated (LMP) prices (in US)
    - Efficient retail pricing and demand response integrating competitive wholesale and retail markets
    - Scarcity pricing and demand response to ration generation deficiencies
    - Built on engineering-economic models of systems with dispatchable generators from the 1950s (Boiteux and Turvey) and 1970s (Schweppe)
  - Free entry (and exit) of generators based on expected prices, revenues and profits over their economic lives
  - Rely on the invisible hand of markets rather than the visible hand of integrated resource planning and regulation to guide private investment decisions

# This Vision Has Rarely Been Fully Realized

- Many vertically integrated utilities did not fully restructure and G+T+D continues to be bundled and regulated
  - IRPs
  - Build and/or buy under long term contracts with independent producers selected through competitive procurement
  - Some in and some out of ISO/RTOs
- Retail supply competition has been limited --- about 20% of retail sales
- Resource Adequacy ("security of supply" in the EU) and "missing money" concerns
  - Efficient scarcity pricing has not been implemented in the U.S. except in ERCOT (ORDC)
  - System generating capacity (RA) targets and capacity markets are more prevalent
  - Distribution utilities retain RA responsibilities in most states
  - Retail prices do not move with wholesale prices and reliability options arrangements have been slow to emerge to manage scarcity --- smart meters not used effectively
- Price caps (offer caps) to deal with generator market power concerns
  - Price caps well below VOLL even after Order 831
- Reliance on Non-market mechanisms to stimulate expansion of carbon-free energy in the context of varying state carbon mitigation goals
  - Federal and state subsidies of various kinds
  - Renewable Portfolio Standards in 29 states + DC with widely varying obligations and targets
  - Feed-in Tariffs
  - PURPA
- Mostly "blue" states restructured to support wholesale and retail competition

# Changing context in many countries

**Context of the 1990s and early 2000s**

- Policy : Focus on competition and market integration
- Market: Focus on day ahead wholesale market integration
- Technology: dominance of variable costs technologies ('dash for gas')
- Consumers: passive in absence of enabling decentralised technologies (decentralised generation, storage, DSR, etc.)
- Networks: focus on optimisation of the use of existing infrastructure

**Current context**

- Policy : focus on decarbonization and security of supply
- Market: focus turning to intra day and real time markets to integrate variable renewables
- Technology: dominance of fixed costs (CAPEX) / decentralised technologies
- Consumers: rise of prosumers require rethink of articulation of retail and wholesale markets
- Networks: Need to reinvest to adapt / upgrade grid to decentralised generation and growth of RES in some locations

- **Current EU wholesale 'Target Model' was designed in a different policy, market and technology context …**
  **… and needs to evolve to provide adequate price signals for the power system decarbonization**

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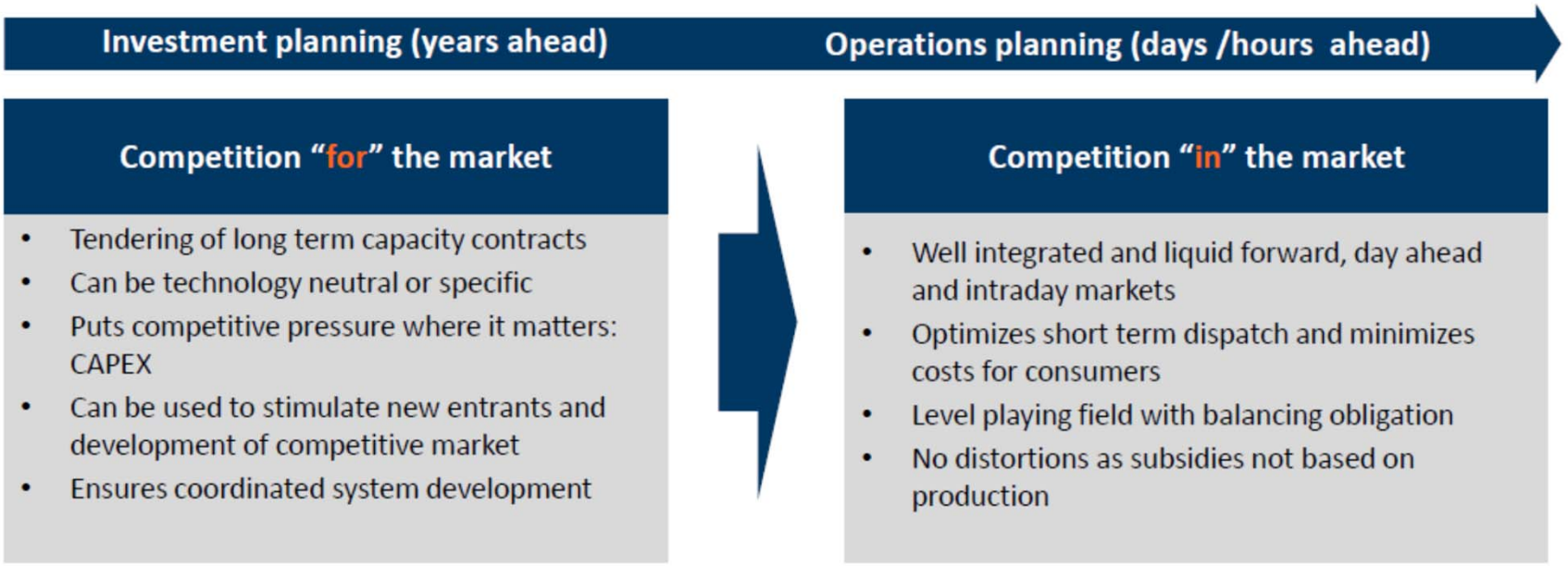
# What are Hybrid Markets?




- **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.)

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# State Sponsored Competitive LT PPA Procurement of Wind, Solar and Storage, Why?

- Growing use of competitive procurement of wind, solar, storage via long term contracts (~ 20 years) mandated by state government policy makers --- groping in an ad hoc way toward a de facto hybrid market --- Why??
- Under current institutional arrangements systems will not naturally meet aggressive (ambitious?) state GHG mitigation target (e.g. 100% carbon free) or the time schedule set to get there
  - Absence of comprehensive U.S. GHG mitigation targets and supporting mechanisms to get there by 2050
  - Rent seeking activities by various interest groups (promote new and protect old)
- Increasing concerns about investment incentives for resource adequacy (security of supply) **and** to meet decarbonization goals in systems seeking to move to deep penetration of wind and solar to decarbonize electricity
  - Long run price risks and price volatility are expected to grow and are hard to predict or hedge now over the long term
    - Absence of a full set of contingent claims contracts to hedge risks
  - Investment incentives are very sensitive to efficient scarcity pricing and demand response which are still quite imperfect and have an uncertain future
  - Future changes in wholesale market price distributions as solar, wind, storage expand
    - More zero and very low-price hours and increased concentration of net revenues in a small number of high-priced hours --- if “energy-only” market and Li-ion is storage technology
    - Very sensitive to cost and technology trends for wind, solar, storage, etc.
  - Challenges to adapting capacity obligations and capacity markets to systems support deep penetration of intermittent resources
    - Applications of ELCC evolving

# Examples

- State mandated procurement of hydro, wind, solar, and storage pursuant to LT contracts in “restructured” market areas
  - Maine
  - Massachusetts
  - Connecticut
  - New York (and NYC)
  - New Jersey
  - Maryland
  - DC
- Via Contracting requirements attached to RPS
  - California (including CCAs)
  - Nevada
- Via PURPA
  - Arizona
- Via IRPs in states that have not fully restructured
  - Many
- As an alternative/follow-on to Feed-in tariffs (EU)
  - Germany
- Via financial support by PPAs from government
  - Spain

# Relying More on Voluntary "Corporate" PPAs as well to Meet Organization's GHG Mitigation Targets

- Examples
  - Google (multiple contracts 7-20 years)
  - Apple (multiple contracts 8-10 years)
  - Microsoft (multiple contracts 10-24 years)
  - Walmart (multiple contracts 7-15 years)
  - Kaiser Permanente ( multiple contracts 20 years)
  - Stanford University (2 contracts 24-25 years)
  - State of California (many contracts typically 20 years)
  - MIT --- with BMC and POSDC (one contract, 25 years)
  - Emerging in EU with broader set of large industrial customers in Sweden, Finland, Spain, Italy, Germany
- Types of purchase arrangements
  - Physical
  - Financial (virtual)
  - Special Utility Tariff
- Long Term PPAs are viewed by these organizations as the most economical way of purchasing wind and solar to meet organizational GHG mitigation goals/obligations
  - Buyers have excellent credit ratings and developers can finance the project with low cost of capital
  - Buyers get a long-term contract for CO2-free energy to meet their internal GHG goals
  - Sellers can mitigate most market risks and must focus on cost containment and meeting performance criteria
  - Risk allocation depends on contract design and interaction with energy and AS markets
  - Overall lower cost of capital and less costly way for buyers to achieve GHG goals
  - In U.S. today largely based on minimizing the cost of meeting internal organizational GHG goals without regard to matching internal supply and demand or considering system effects

**Driving scale through long-term power purchase agreements (PPAs).**
To date, we have found the Power Purchase Agreement (PPA) to be a highly effective model for Walmart to leverage our scale and buying power to accelerate renewables. Under these arrangements, Walmart agrees to buy renewable power from an energy provider over a long period of time – often 5, 10, 15 or more years. Long-term PPAs have unlocked enormous renewable potential, but have also required a new way of thinking. Prior to 2006, the renewable energy industry sought 20-25 year PPAs, while Walmart was accustomed to buying power in 1-year or less contracts.

**PPAs are mutually beneficial for Walmart and the energy provider.**
Under PPAs, the energy provider also owns, installs, and operates the renewable energy systems, relieving Walmart of that operation and maintenance responsibility. For project developers, PPAs provide a predictable stream of income, which is what financiers and banks say is the key to the low cost of capital and preferred financing arrangements. When Walmart promises to buy the electricity, the project can be built with low-cost financing and deliver electricity at or below non-renewable power prices.

Walmart:
https://cdn.corporate.walmart.com/eb/80/4c32210b44ccbae634ddedd18a27/walmarts-approach-to-renewable-energy.pdf

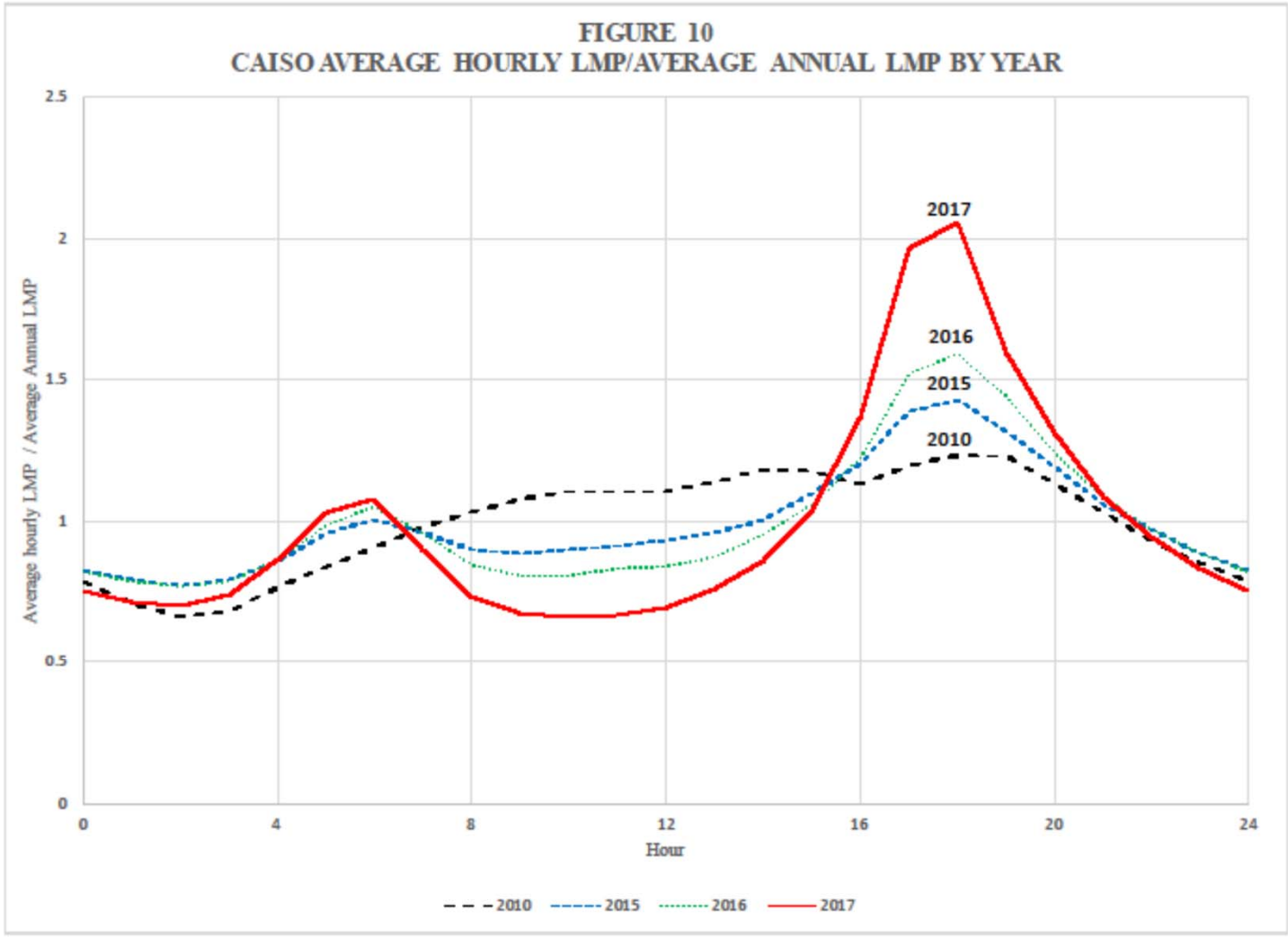
FIGURE 10
CAISO AVERAGE HOURLY LMP/AVERAGE ANNUAL LMP BY YEAR
Average hourly LMP / Average Annual LMP
2.5
2
1.5
1
0.5
0
0
4
8
12
16
20
24
Hour
2017
2016
2015
2010
2010
2015
2016
2017

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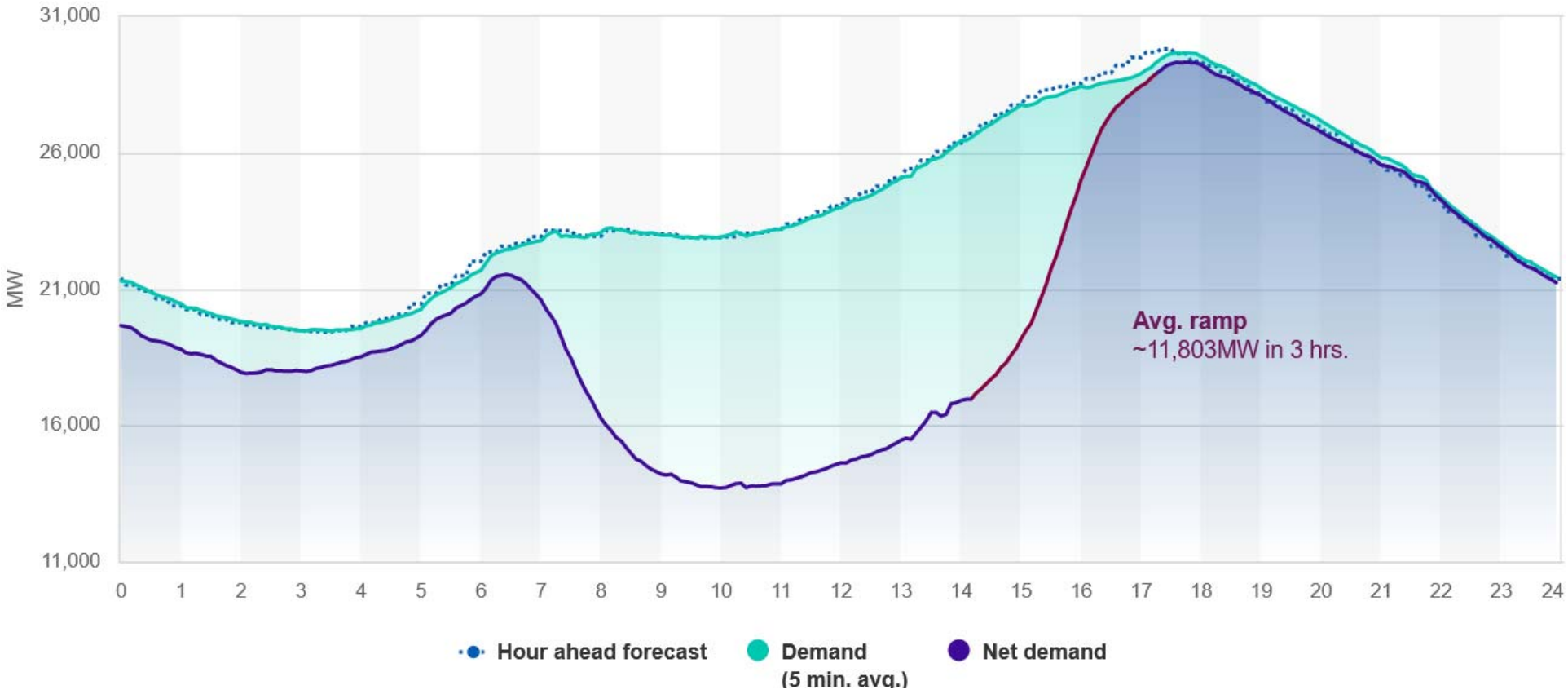
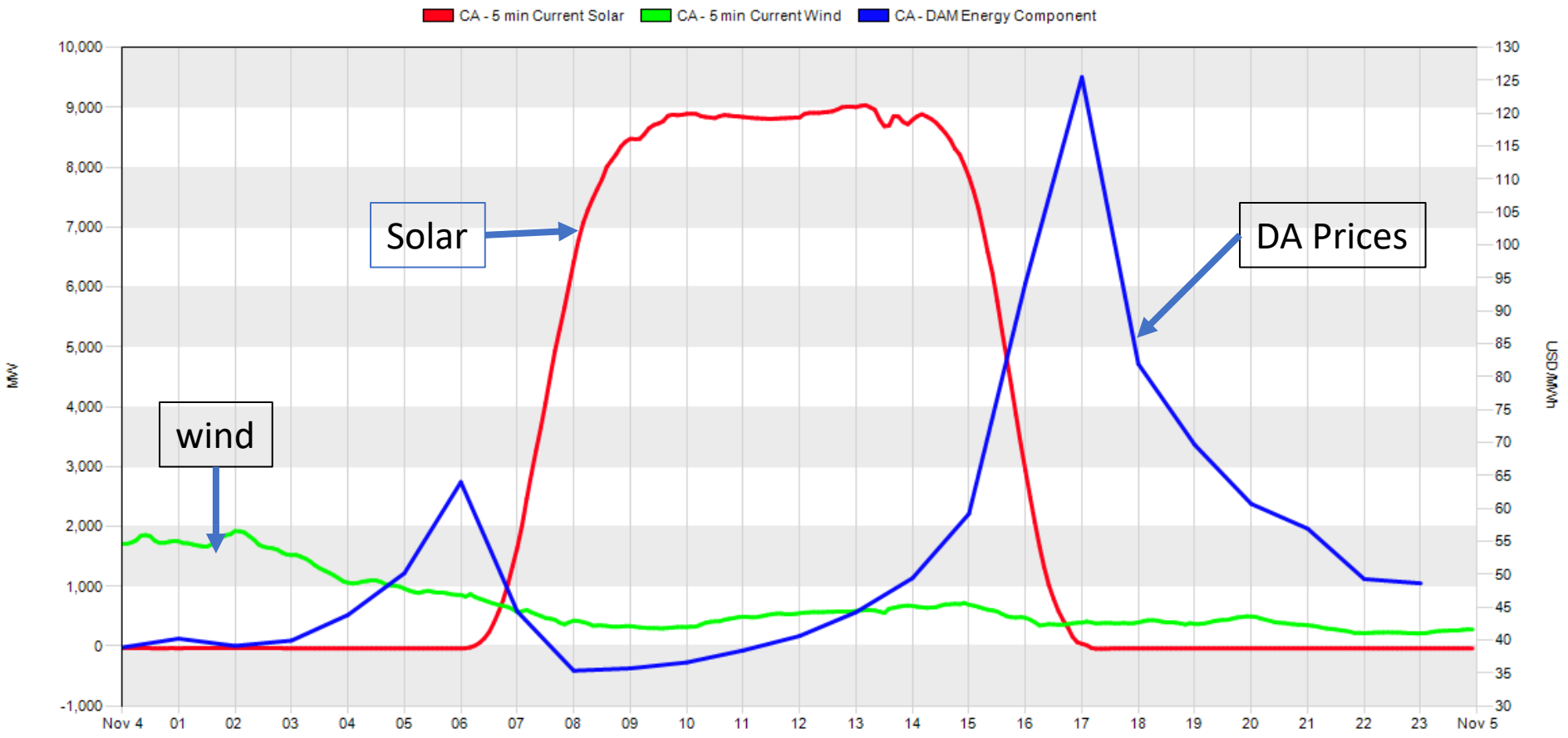
# CAISO DEMAND AND NET DEMAND
# November 4, 2029



# CAISO Day-Ahead Prices
# Wind and Solar Generation
# November 4, 2020

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# Future Wholesale Price Distributions are Sensitive to Uncertain Future Policy and Technology Choices

- Speed and depth of decarbonization
- Developments in long-term storage technologies
- Developments in Zero or Near Zero Carbon generation technologies
  - Gas with CCS
  - Hydrogen
  - Legacy and Advanced nuclear

# If this is where policy makers are going then we need to focus on getting this model to work as efficiently as possible

- Competition for the Market --- LT Contracts
  - Harmonize reliability (resource adequacy) and decarbonization goals
  - Voluntary via RPS vs. state mandated or state subsidized PPAs
  - Regional vs. state-by-state procurement and planning --- expanding interregional transmission would expand market areas and reduce costs
  - Auction design and evaluation criteria (AURES II)
  - Contract design
    - Compatible with efficient short-term markets
  - Technology Neutral or Technology-Specific Contract Markets ?
    - Wind and solar have very different supply attributes
    - Capacity values vary (CPUC ELCC analysis)
  - Supported by a well-developed indicative plan (IRP) guided by appropriate modelling
  - Continue to allow voluntary entry/contracting consistent with GHG policies
- Competition in the Market (short term energy and AS markets)
  - Continue market design evolution for energy and AS to be compatible with deep penetration of VRE
  - Efficient scarcity pricing becomes more important in order to stimulate efficient demand response, storage dispatch, and electrification of transportation, buildings, etc.
  - Broader participation of demand response
  - Expand retail real time pricing and demand response options
  - Storage products and pricing recognizing multiple potential services
  - Management and pricing during curtailment conditions