OREGON DEPARTMENT OF ENERGY

Overview of Regional Power Markets

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Informational Hearing
House Committee on Energy & Environment

OREGON DEPARTMENT OF ENERGY

Leading Oregon to a safe, equitable, clean, and sustainable energy future.

Our Mission

The Oregon Department of Energy helps Oregonians make informed decisions and maintain a resilient and affordable energy system. We advance solutions to shape an equitable clean energy transition, protect the environment and public health, and responsibly balance energy needs and impacts for current and future generations.

What We Do

On behalf of Oregonians across the state, the Oregon Department of Energy achieves its mission by providing:

- A Central Repository of Energy Data, Information, and Analysis
- A Venue for Problem-Solving Oregon's Energy Challenges
- Energy Education and Technical Assistance
- Regulation and Oversight
- Energy Programs and Activities

2020 BIENNIAL ENERGY REPORT

Goal of the Report

Pursuant to ORS 469.059, provide a comprehensive review of energy resources, policies, trends, and forecasts, and what they mean for Oregon.

Scoping the Report

Shaped by a data-driven process, equity considerations, and input from stakeholders and the public.

Designing the Report

Shorter briefs on a wider variety of energy topics, tear-away style. Themes cross sections for general 101 or technology reviews and deeper-dive policy briefs.

Policy Brief: Evaluating the Resource Adequacy of the Power System

Background

The electric power system is unique, relative to other industry sectors, in that it has little to no capability to store electricity as an end-use fuel. As a result, the electric generation and transmission system must be built to satisfy the largest hourly requirements for electricity—called peak demands—even though consumers use less (oftentimes significantly less) during most hours of the year. This results in an electric generation and delivery system that is, by design, underutilized much of the time, especially when compared to the liquid fuels and natural gas sectors.[1] To evaluate the adequacy of the power system, utilities and grid planners must forecast customer demand for electricity and compare that to the ability of existing resources to meet that demand in real-time. If the capabilities of existing resources might fall short, then new capacity resources will need to be deve
years (or more) depending on the types of resources.

Suggested reading:

For more background on Resource Adequacy and why it's important for maintaining the long-term reliability of the power system, see the Energy 101 on Resource Adequacy.

Resource Adequacy (or RA) is the term that grid plar
evaluation of whether adequate generating capacity
over the next several years (typically from one to five

Resource Adequacy can be evaluated for individual loa
areas within their system. It can also be evaluated for b
regions. In any case, the following are several key techn
of an adequacy evaluation:

Table 1: Resource Adequacy Evaluation: Key Technic

Demand:
How much power will customers require in the future?

- **Energy effic** efficiency sa
- **Population** decline? And
- **Economic g** rate? Will it
- **Electrificati** adopt electri furnaces?

[1] Note that **Resource Adequacy** in this context focuses on long-te future power supplies, whereas the similarly-named **Resource Suf** the short-term management of existing resources and must be me time markets. (see Wholesale Electricity Markets Policy Brief for m

2020 Biennial Energy Report

Energy 101: Resource Adequacy

We consume energy daily: when we charge our phones, flip a light switch, turn up the furnace to heat our homes, or fill up our car at the gas station. In terms of total end-use fuels consumed by Oregonians, 31 percent of the energy comes in the form of liquid transportation fuels (e.g., gasoline and diesel); 42 percent is electricity; and 26 percent is direct use of fuel oil or natural gas (e.g., for home heating or industrial processes).

Storing End-Use Fuels: Gasoline, Natural Gas, and Electricity

Electricity must be generated and delivered across a large transmission and distribution system, just in time to meet consumer demand. This differs significantly from other end-use fuels (and differs from virtually all other commodities and consumer products) that can be produced at an operationally or economically optimal time, and then stored for consumption at a later point in time.

This section refers to "end-use fuels" because of the important differences between primary energy sources and the end-use fuels that consumers actually consume to power their everyday lives. For example, crude oil is a natural resource extracted from the earth. This primary energy source must be refined into gasoline before it can be used in a vehicle. That gasoline, once refined from the original energy source, can be (and is) stored in large volumes as the end-use fuel that Oregonians consume. Similarly, natural gas, once captured and processed for injection into storage tanks or pipelines, is the end-use fuel that Oregonians consume in their homes and businesses.

Electricity is quite different. The primary energy sources used to generate electricity vary considerably – from the gravitational potential energy stored in volumes of water at altitude, to the nuclear potential energy contained within uranium isotopes, to the thermal kinetic energy of solar energy. A wall outlet cannot use that water, uranium, or solar energy until it has been converted into electricity—the end-use fuel.

Think about gasoline. What does it look like? Chances are you are imagining a physical volume of a brownish-colored liquid. You can literally fill a jar on the table in front of you with gasoline or diesel fuel, the two liquid fuels that predominantly power our transportation systems. Liquids are easily stored in large volumes. Think about natural gas or propane. What does it look like? This one is a bit more challenging, but you might imagine filling a balloon in front of you with some volume of natural gas, or a propane tank attached to your grill. Pipeline networks and large tanks can store vast quantities of these gaseous end-use fuels.

Now think about electricity. What does it look like exactly? Where might you store it? You might imagine a standard AA battery, which stores approximately 3 watt-hours (or 0.003 kWh) of energy.[1] The average residential customer in Oregon would need 9,000 AA batteries to power their house for a single day.[1] So while there are ways to store electricity, those storage systems have historically been limited in their ability to efficiently store energy over a long duration or in

[1] In 2018, the average residential customer of Oregon's investor-owned utilities consumed 10,151 kWh of electricity over the course of the entire year, or approximately 27.8 kWh per day. (OPUC Utility Statistics Book)

2020 Biennial Energy Report *Energy 101 – Page 68*

https://energyinfo.oregon.gov/ber

Key Questions to Address

- What are power or energy markets?
- How do power markets differ from capacity planning and discussions of resource adequacy?
- How do power markets work in Oregon currently?
- How are they evolving?
- What is the Western Energy Imbalance Market (EIM)?
- And what is a Regional Transmission Organization (RTO)?

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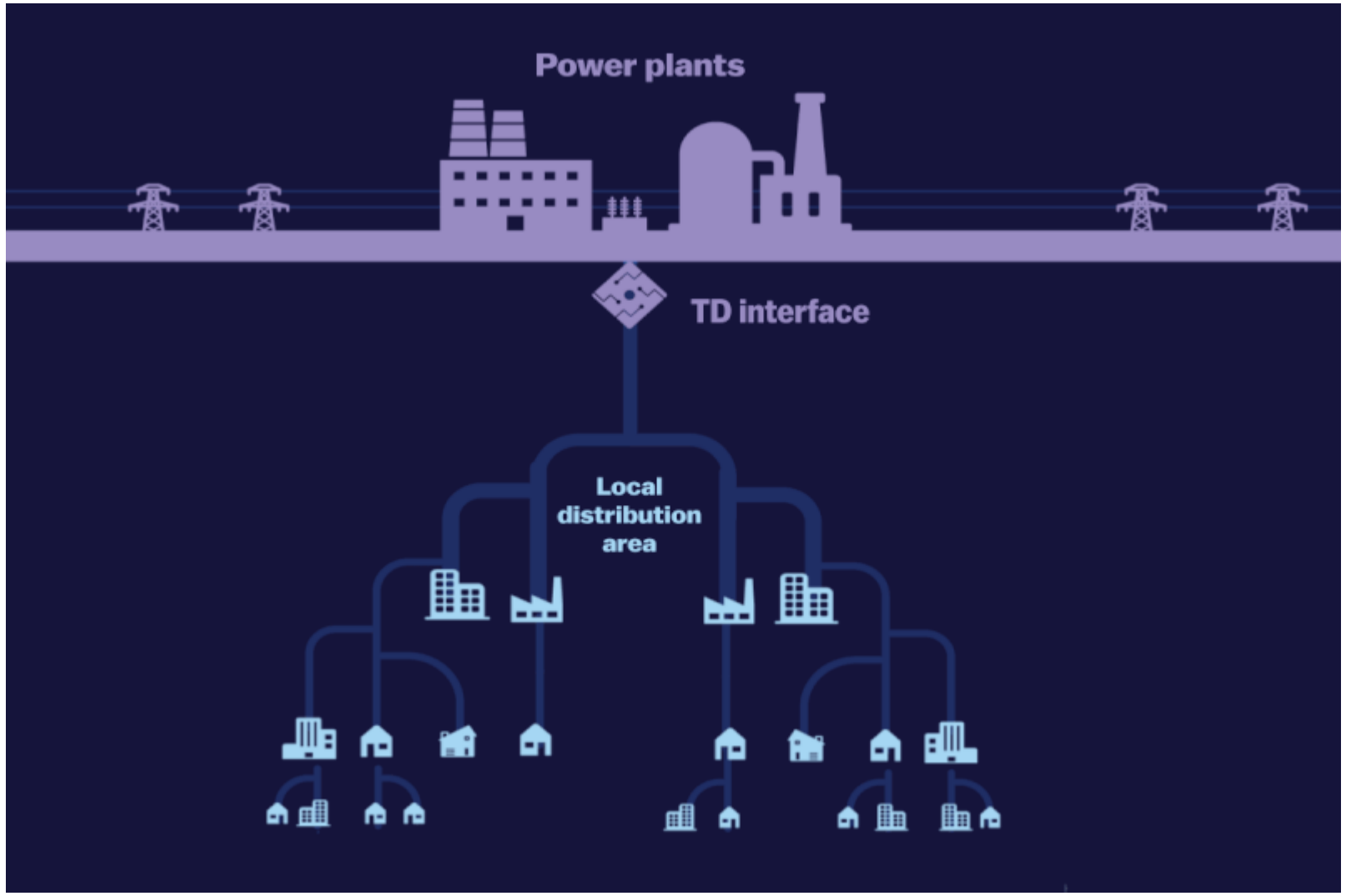
Matching Generation & Demand



Source: Vox

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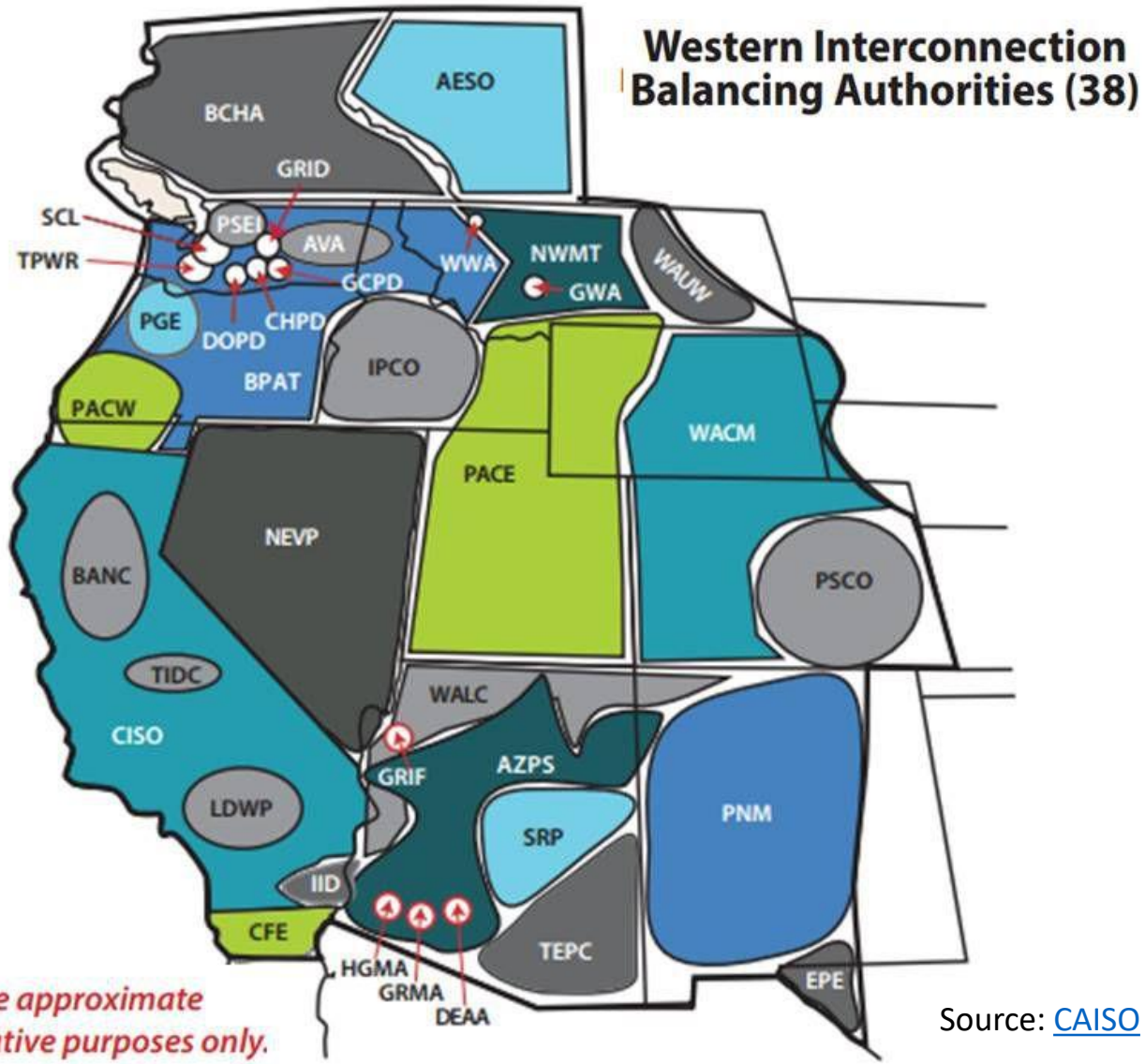
Balancing Authorities in the West

Responsibility of each Balancing Authority:

- Reliably planning and operating the high-voltage grid
- Matching generation with demand in real-time
- Managing imports and exports



Source: CAISO

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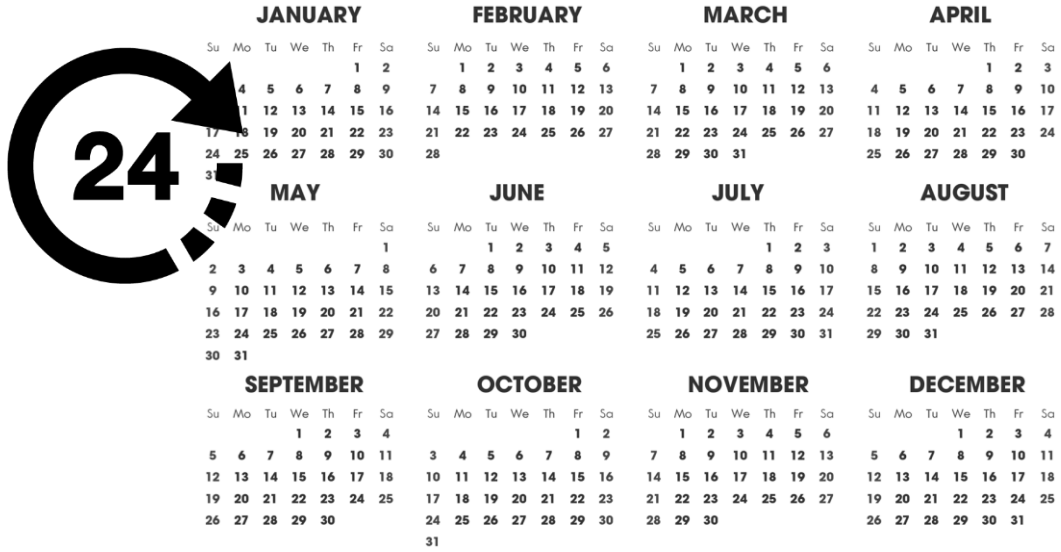
Capacity Planning vs. Power Markets

Capacity Planning within each Balancing Authority:

- Ensures sufficient resources are available when they're needed to maintain Resource Adequacy within the Balancing Authority
- Determines which generating resources are physically built
- Sets the menu for the meal

Capacity Planning vs. Power Markets



- Physical capacity will be there 24/7, all year…
- …whether it's **needed** or not
- …and whether it's actually **available** (e.g., solar) to generate power or not

Capacity Planning vs. Power Markets

Power Markets:

- Match buyers and sellers of wholesale power
- Utilize bilateral trades or an organized central market
- Power markets order the meal from the set menu—if it's not already on the menu, then the market can't order it!

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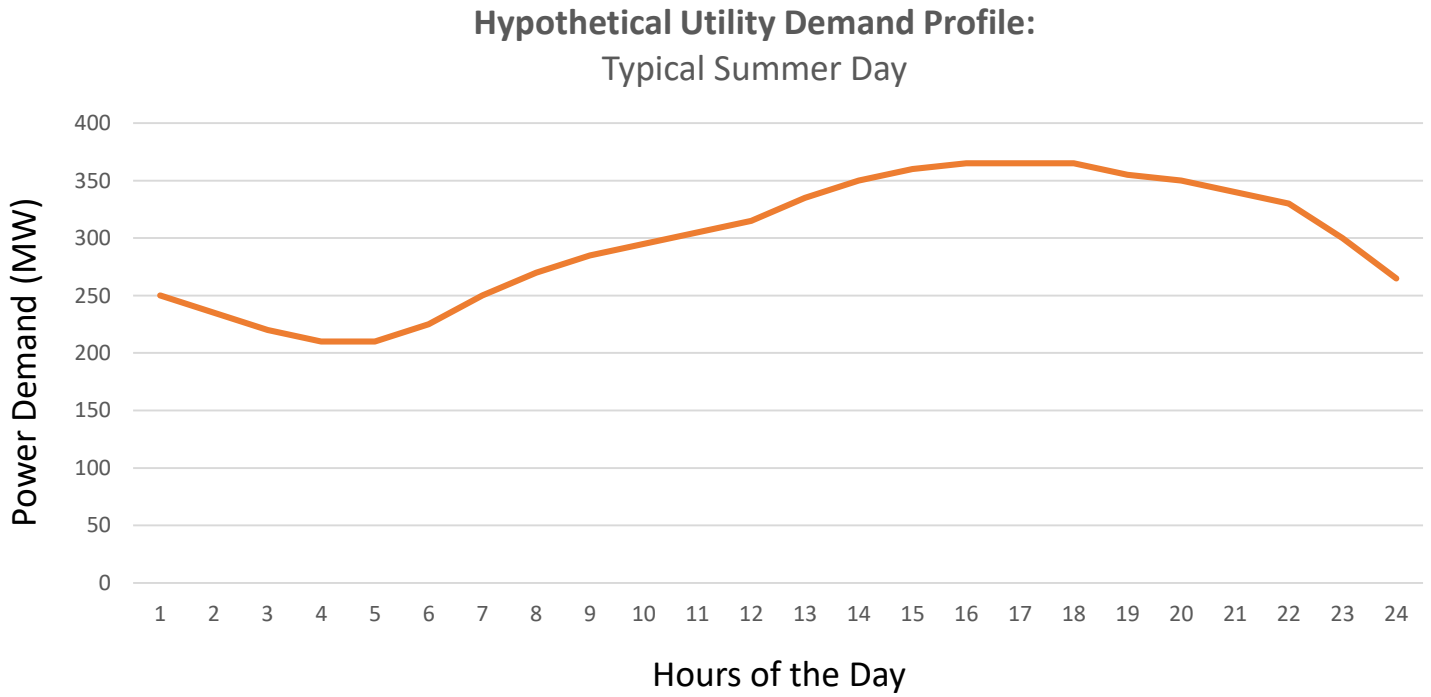
Capacity Planning vs. Power Markets



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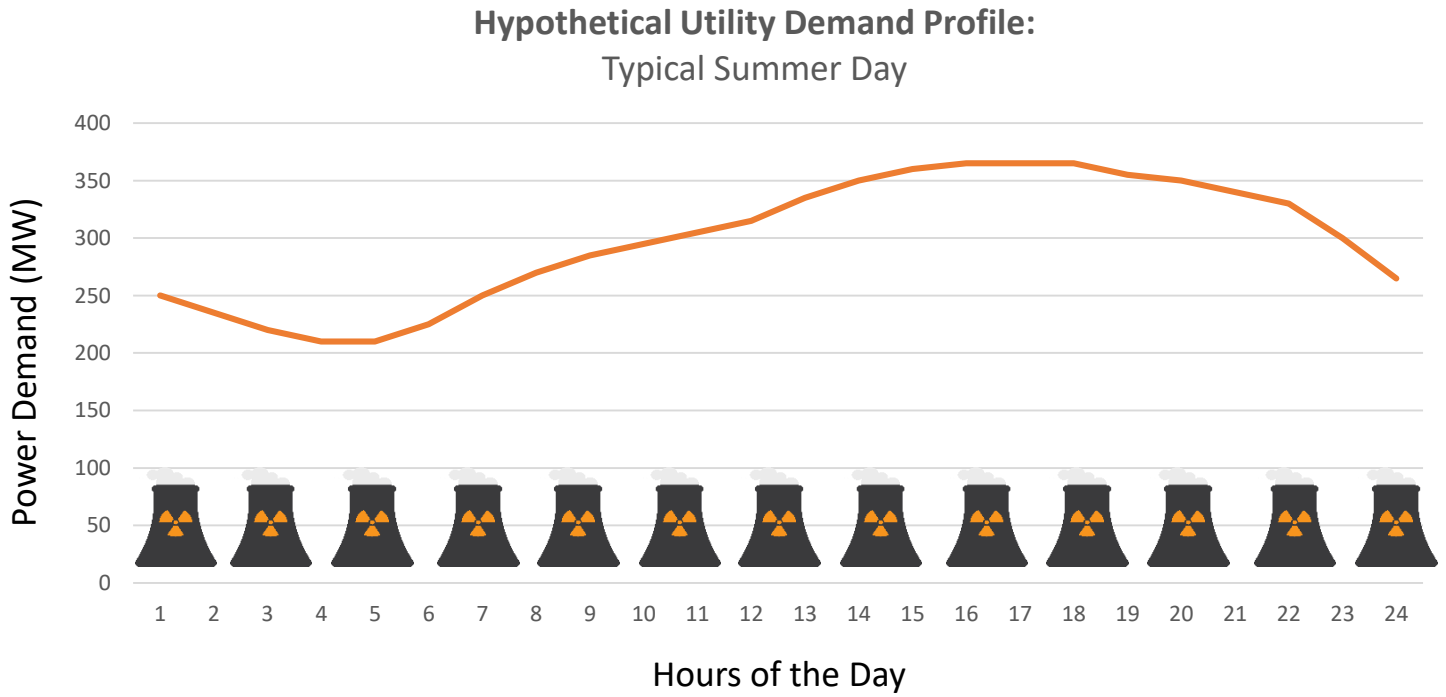

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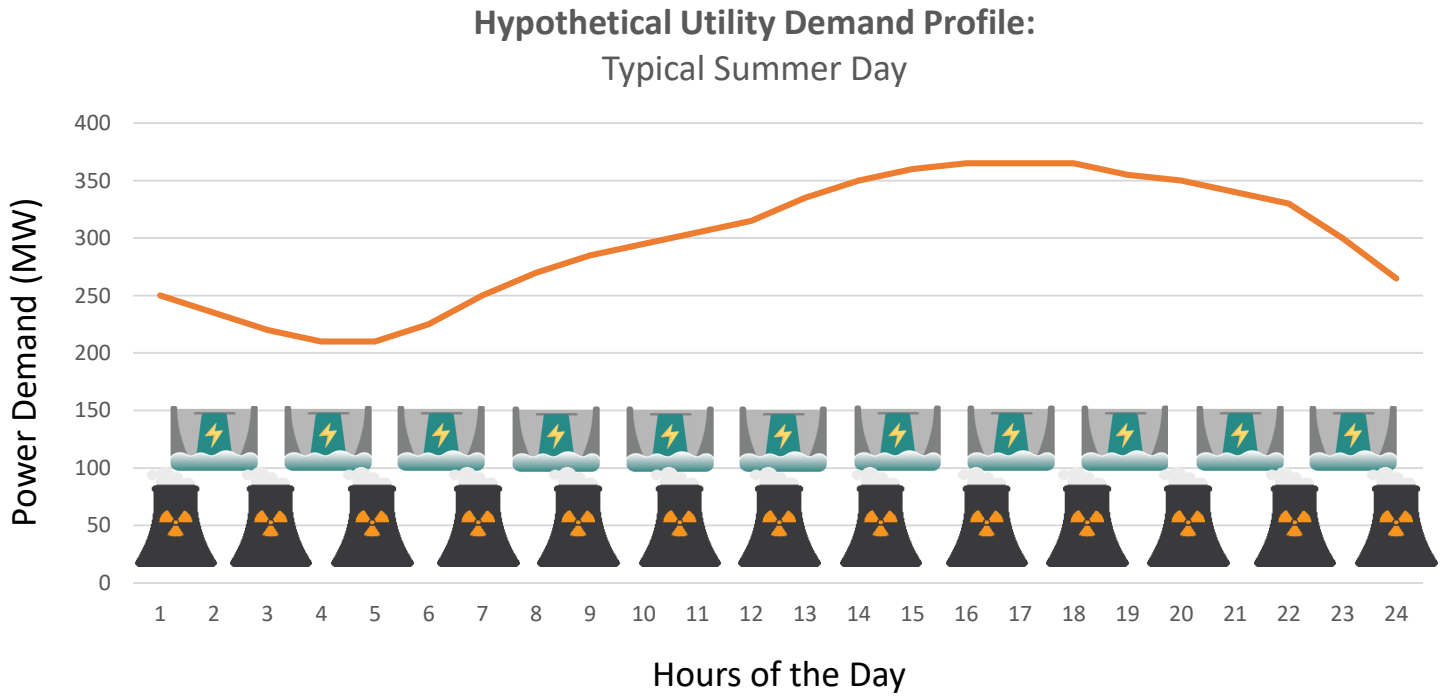

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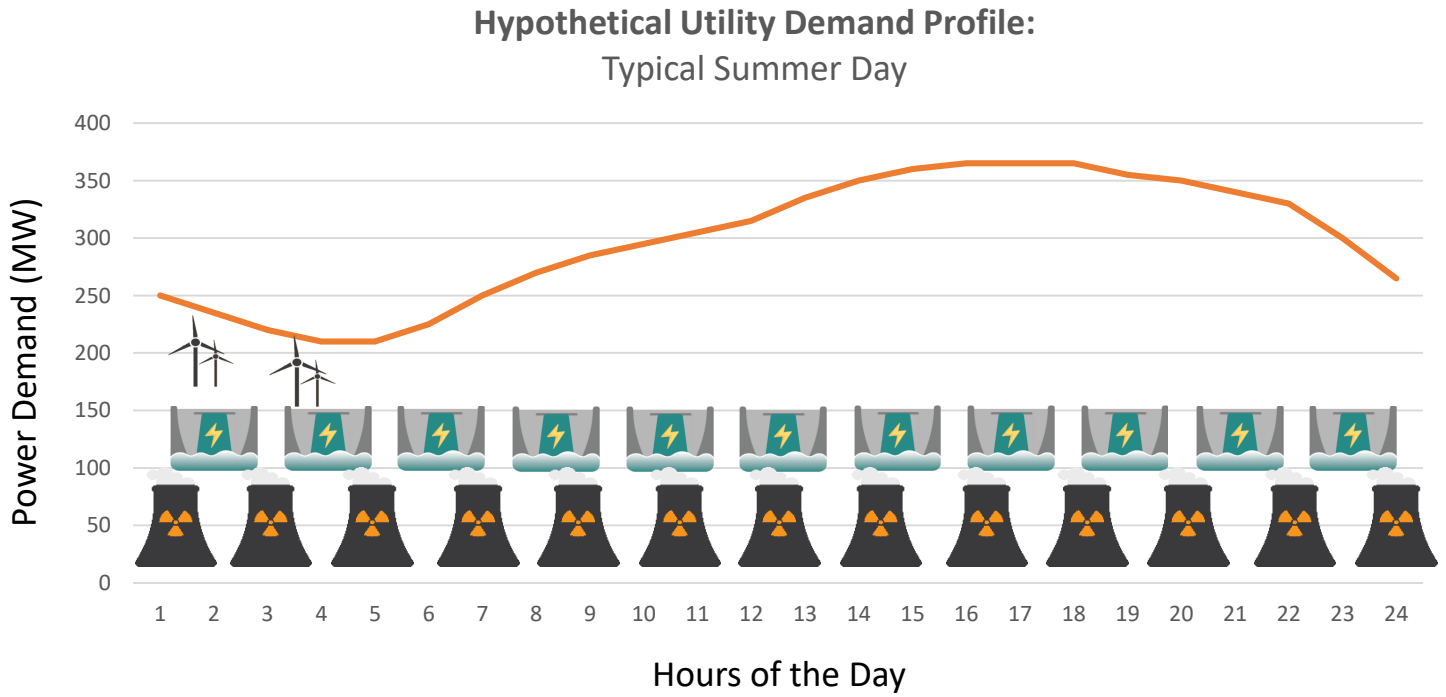

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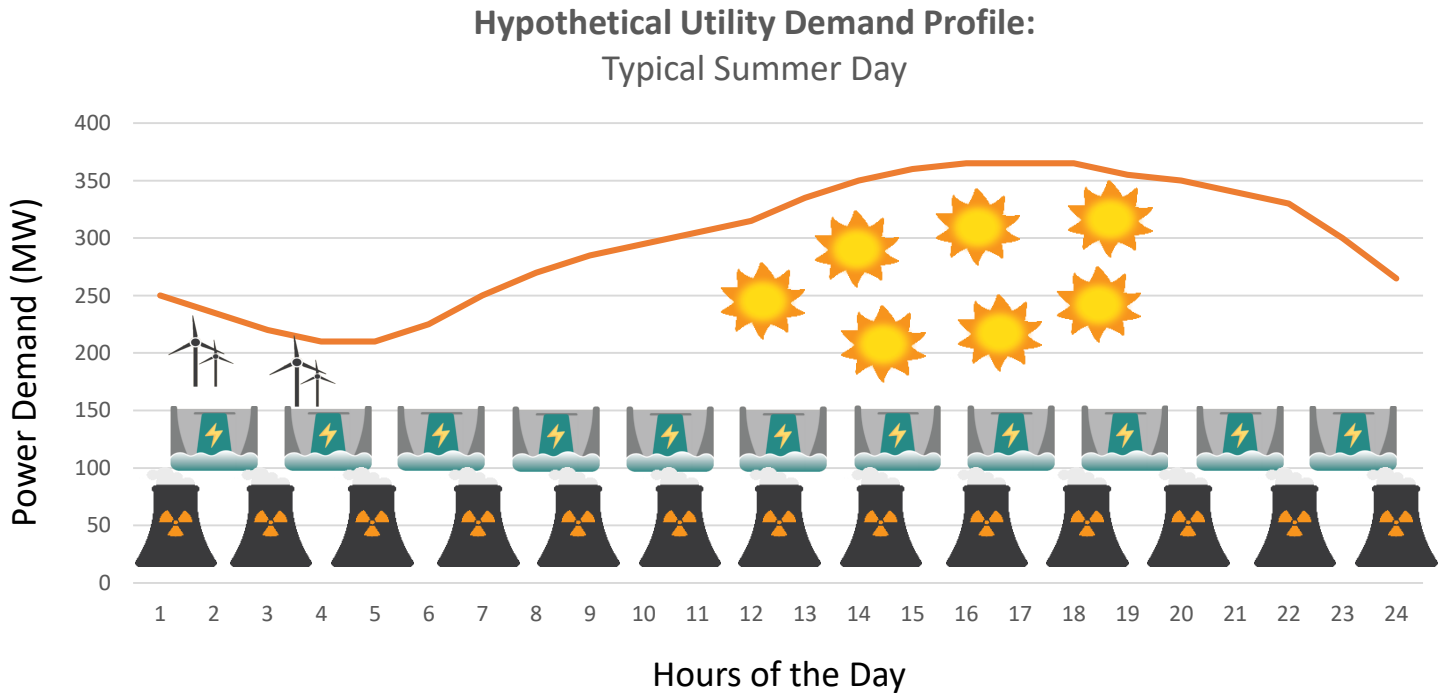

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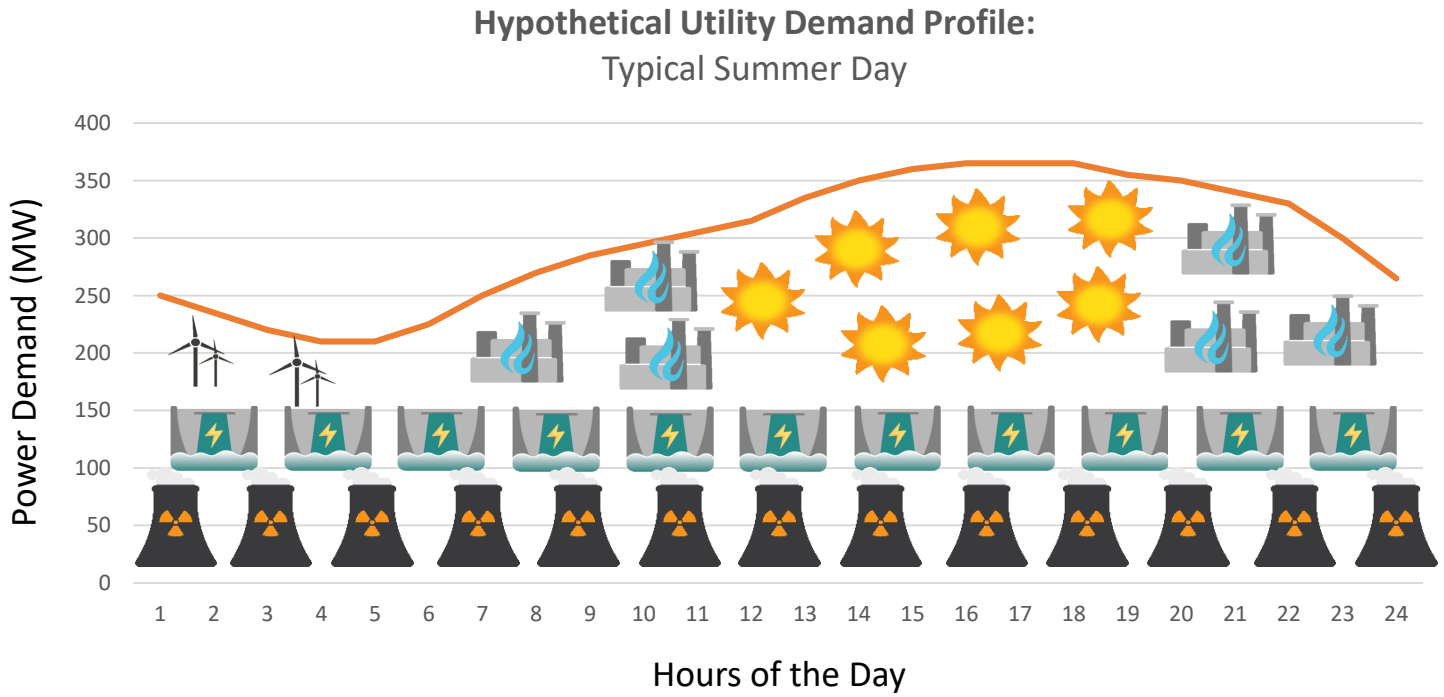

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How do power markets operate?

Fundamentals

- **Demand:** Estimate future customer demand on over various time horizons
  - Months to years ahead (for capacity planning and Resource Adequacy)
  - Day-ahead
  - Hour-ahead
- **Supply:** Account for capacity resources available over these time horizons
  - Utility-owned power plants
  - Long-term contracts for power from third-party projects
  - Assess the availability of excess power for purchase in the short-term

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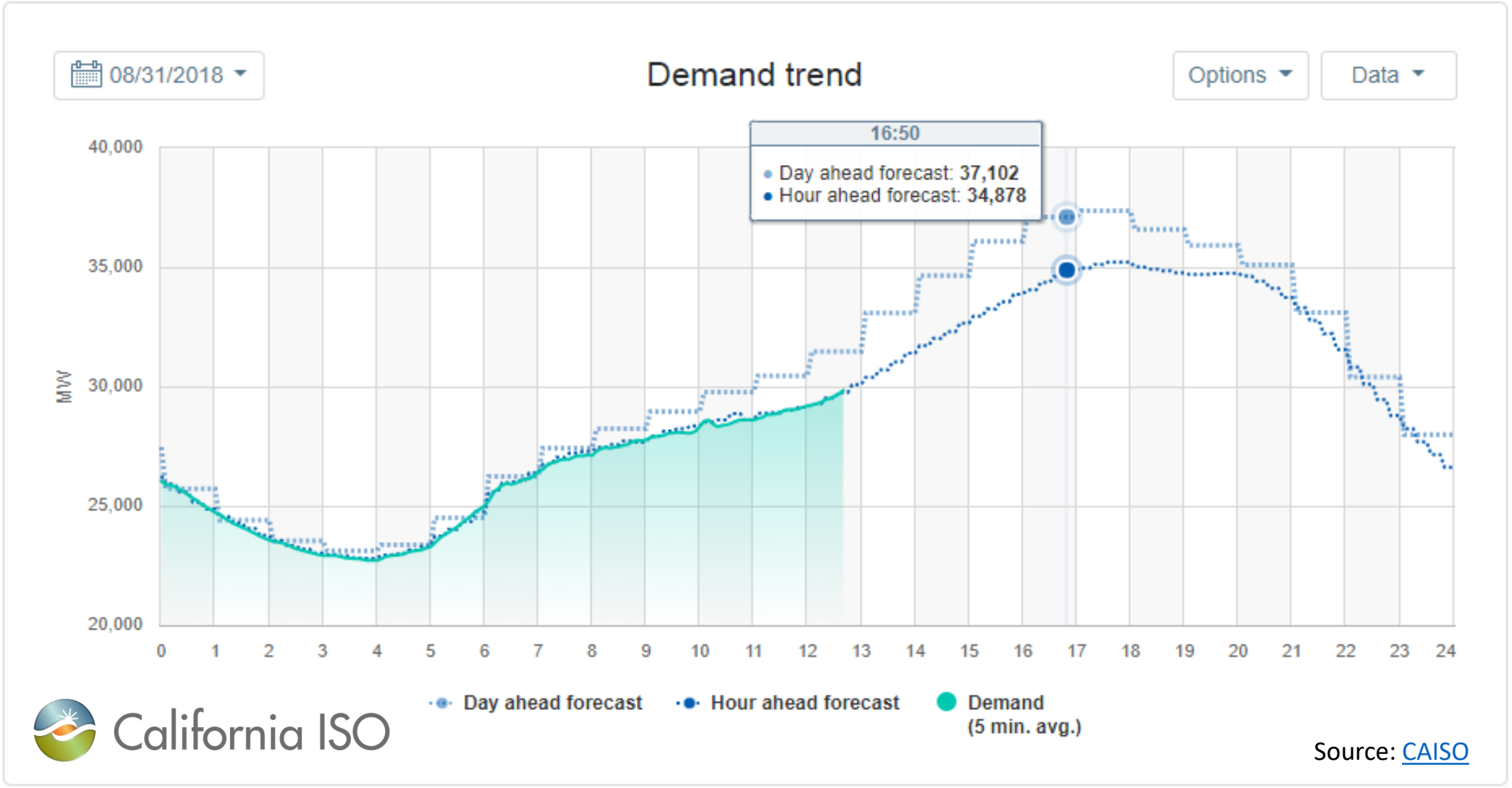

Source: CAISO

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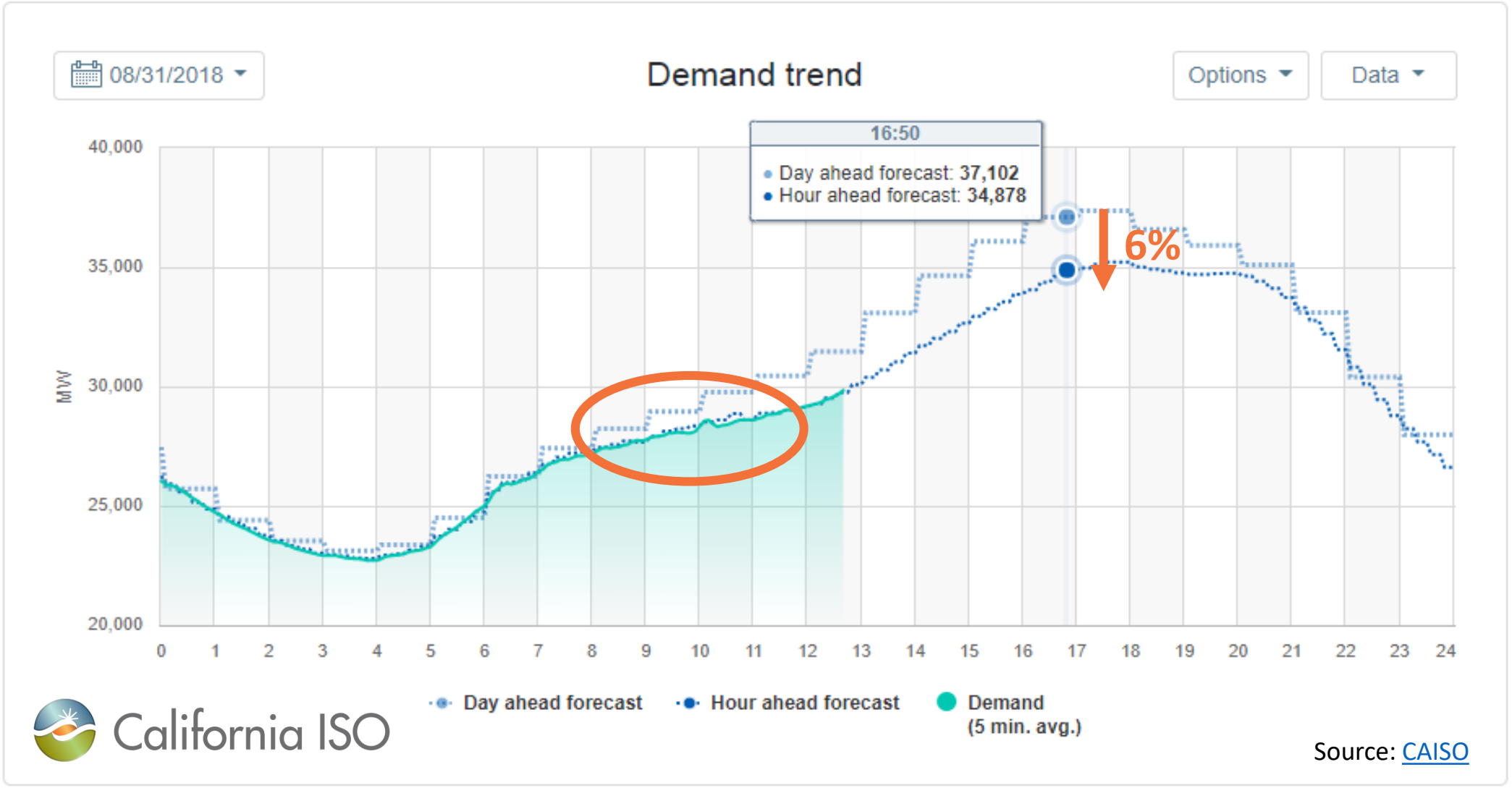

Source: CAISO

Bilateral Markets vs. Organized Markets

	Bilateral Markets (ex: Oregon)	**Organized Markets** (ex: CAISO)
Day-Ahead	**Utilities** forecast demand for power tomorrow	
	▪ **Utility** identifies resources available to meet day-ahead demand for each hour ▪ **Utility** engages in bilateral deals to buy (or sell) additional resources, if needed	▪ **Generators** submit bids into CAISO's Day-Ahead Market for each hour ▪ **Market** identifies a single "clearing price" needed to commit units to meet demand
Hour-Ahead	▪ **Refine forecast** for the next real-time hour ▪ **Identify surplus/deficit** of committed resources to meet demand the next hour	
Real-time	▪ **Utility** increases/decreases output from resources as real-time demand fluctuates ▪ **Utility** engages in bilateral deal to buy (or sell) additional resources, if needed	▪ **Generators** submit bids in 15-minute and 5-minute intervals to CAISO market ▪ **Market** identifies single clearing price needed to commit units to meet intra-hour deviations from day-ahead

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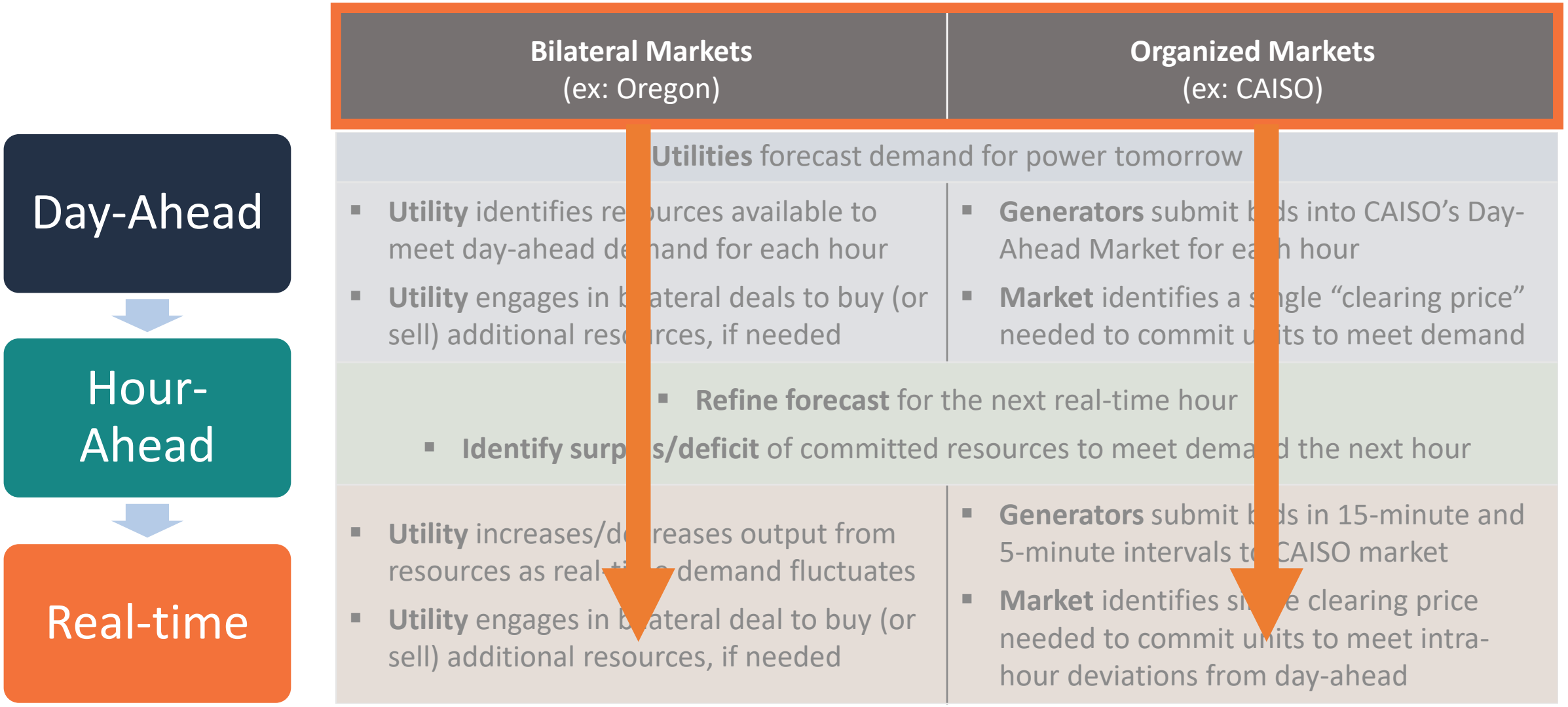

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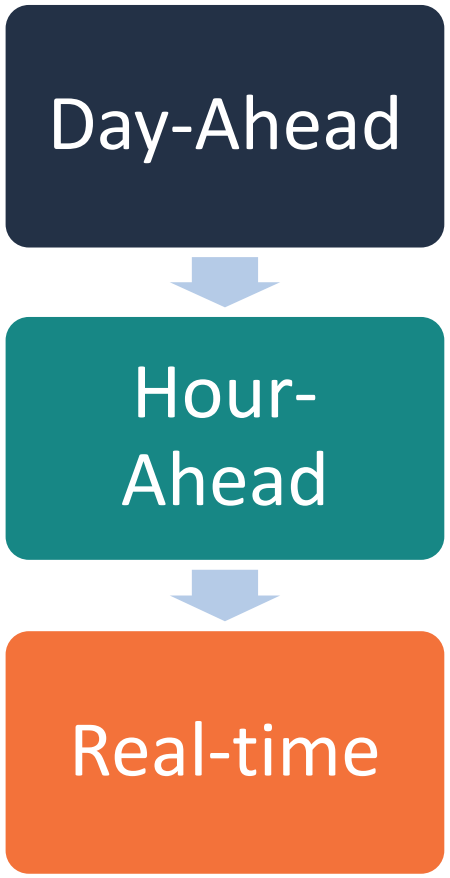

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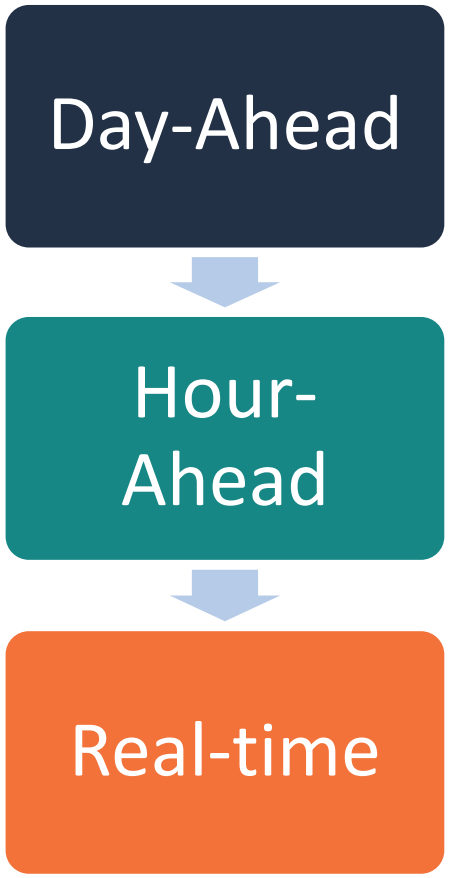

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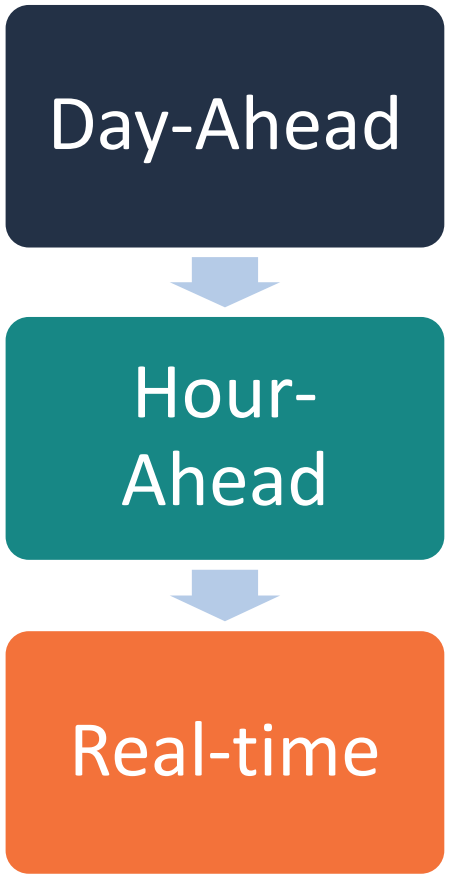

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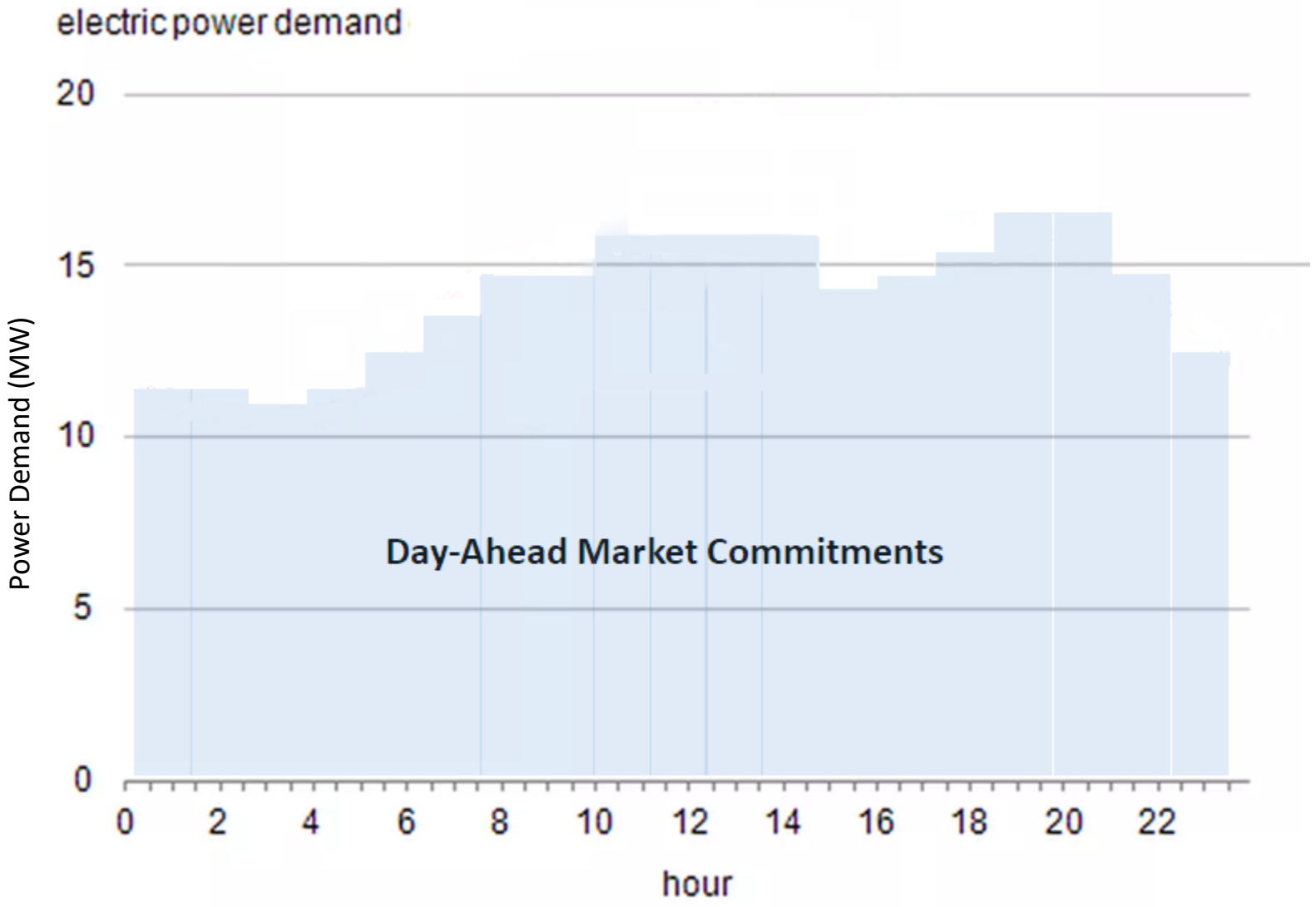
Hypothetical: Day-Ahead Unit Commitment



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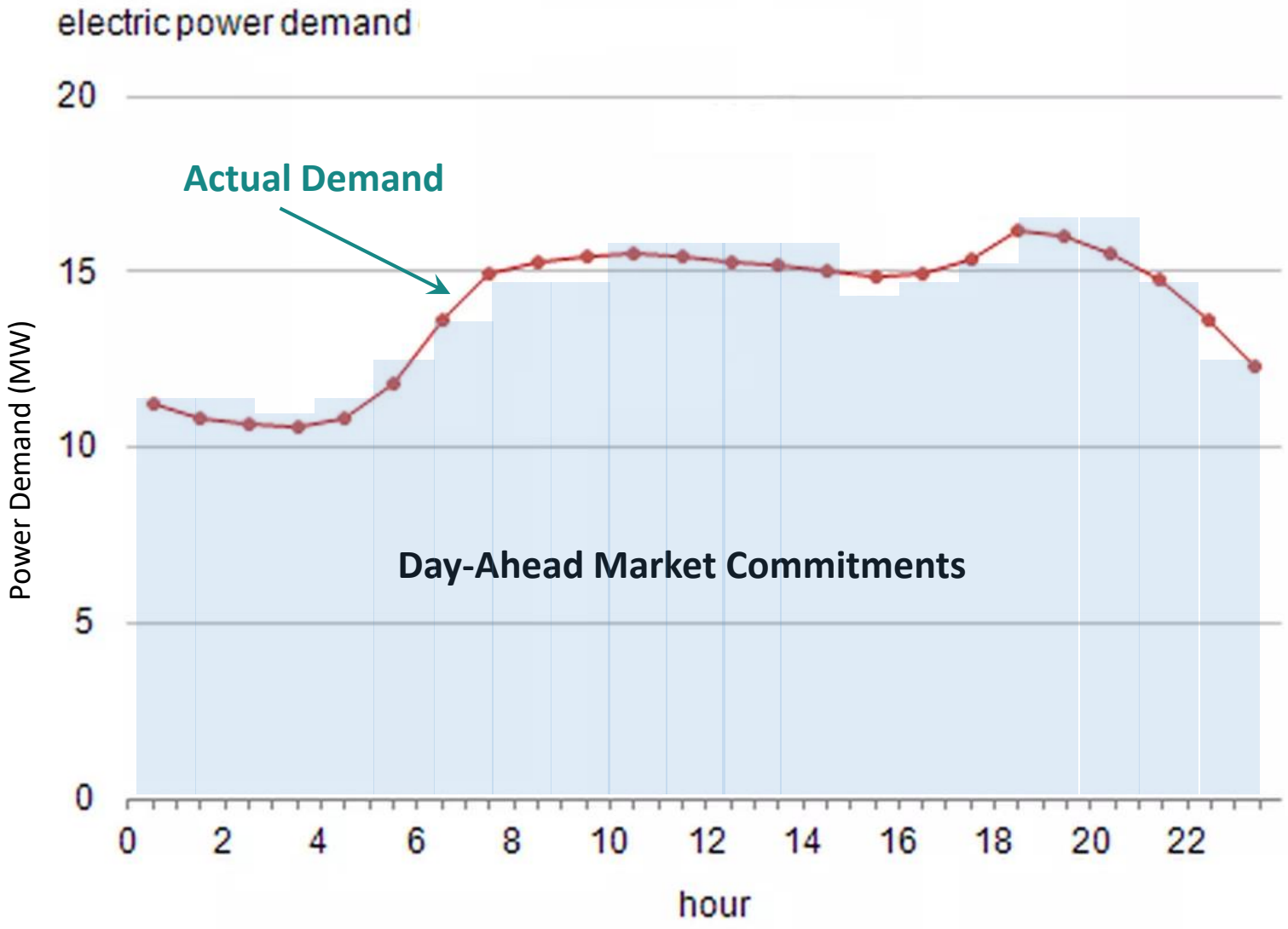
Hypothetical: Actual Demand



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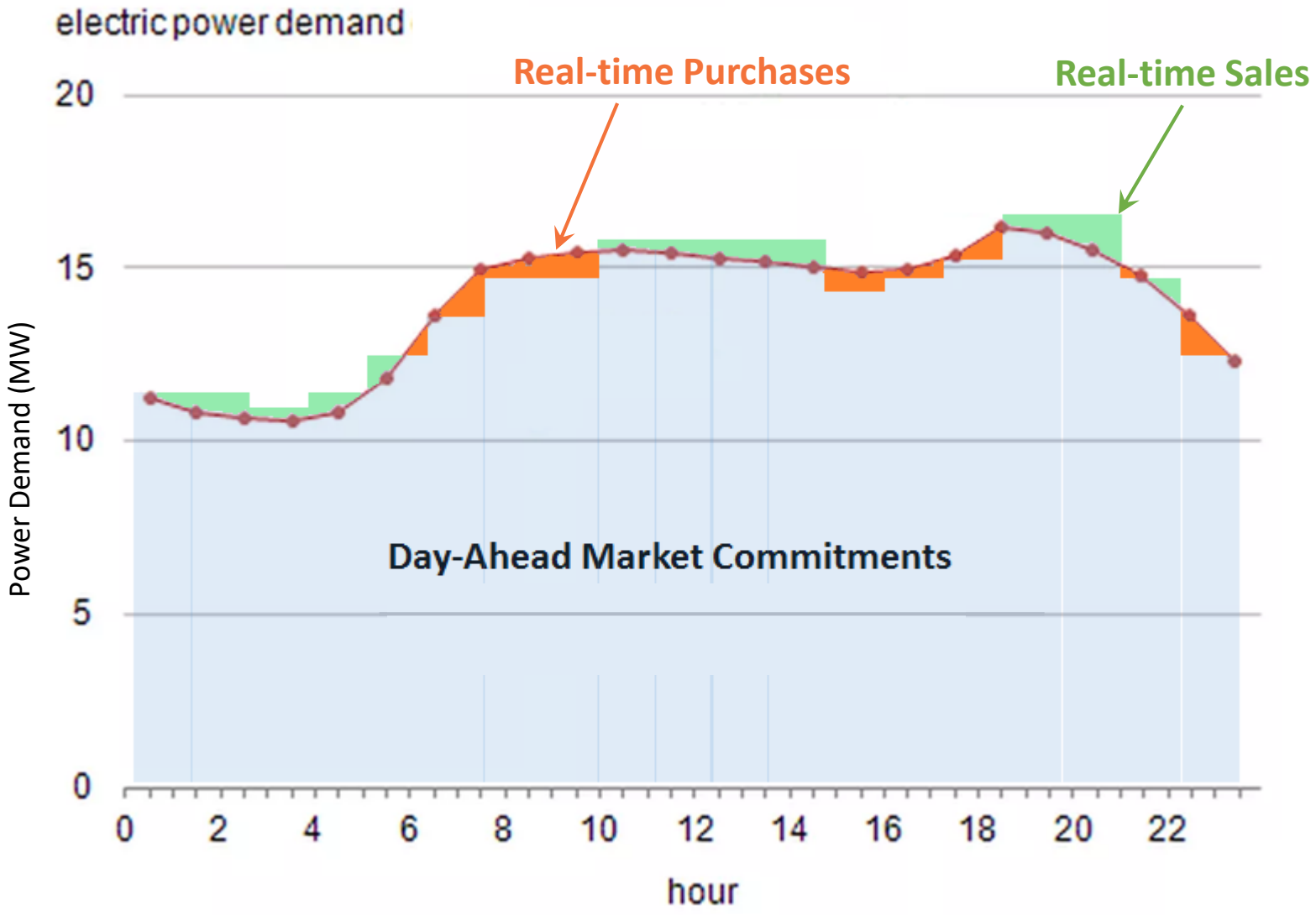
Hypothetical: Real-time Transactions



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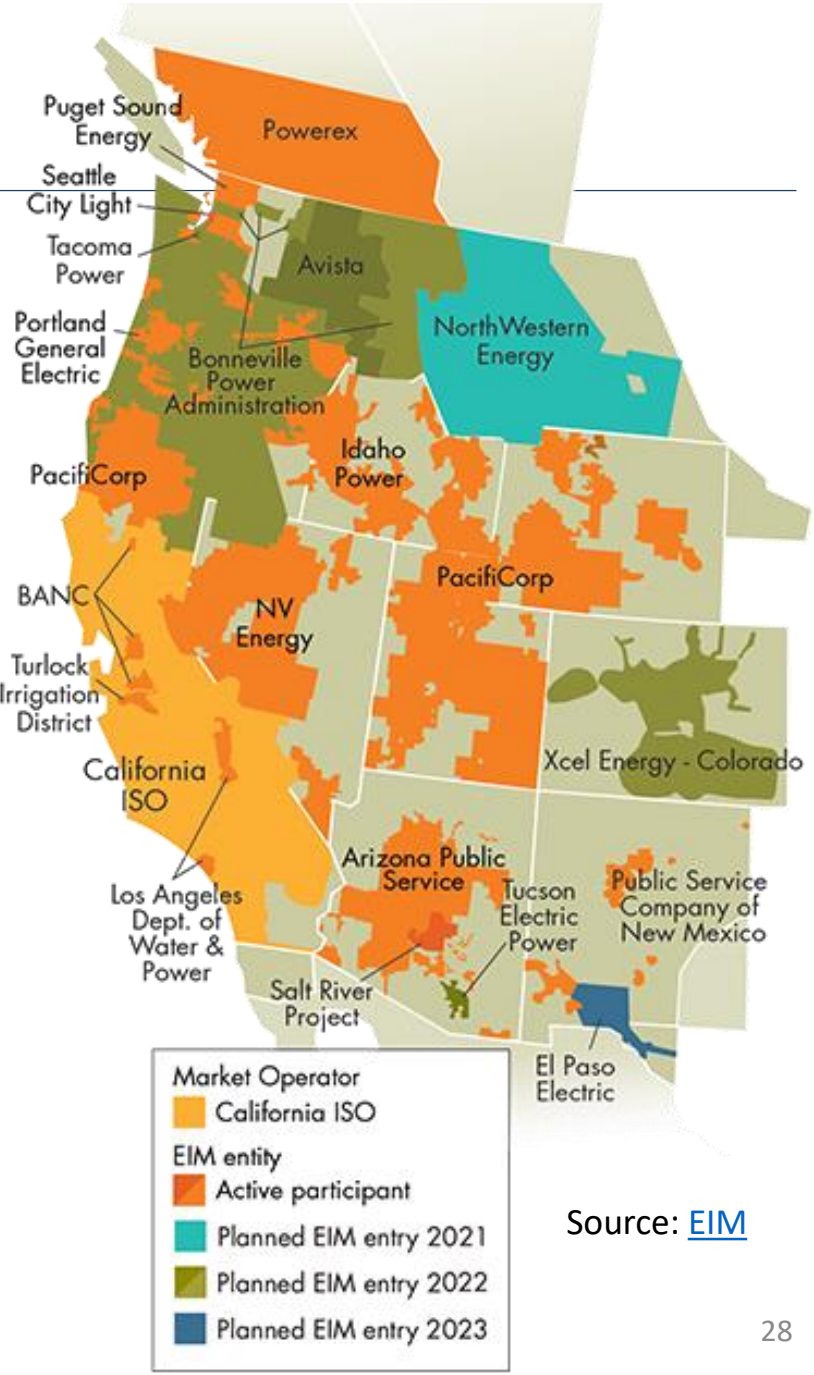
What is the EIM?

- Western Energy Imbalance Market (EIM) launched in 2014
- Operated by the CAISO out of its real-time dispatch center
- Allows participants who have sufficient resources to **voluntarily bid resources** to be shared across wide geographic region—the EIM market then identifies the most cost-effective resources
- PacifiCorp, PGE, and Idaho Power have joined
- BPA is scheduled to join in 2022

Optimized sharing of resources through EIM has resulted in **$1.1 billion** in gross benefits to participants since 2014.

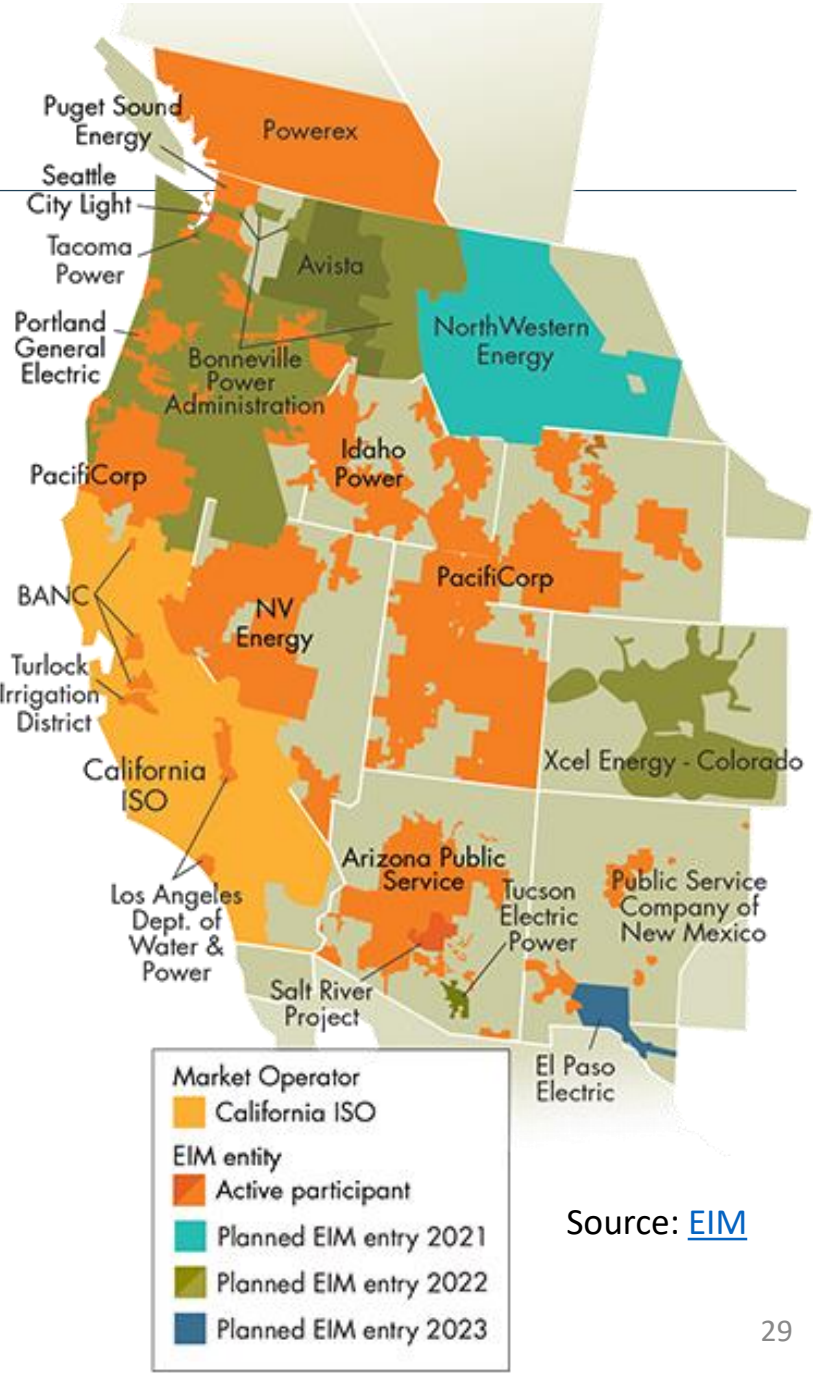
Source: EIM (as of Jan. 2021)



Source: EIM

EIM Governance

- 5-member body selected by a stakeholder nominating committee that includes: utilities, state regulators, transmission owners
- Governance Review Committee formed to review key issues identified by stakeholders
- Draft proposal on revised EIM governance released in 2020
- Adoption of changes to governance expected later in 2021



Source: EIM

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Evolving Day-Ahead Energy Markets

- **EDAM (Extended Day-Ahead Market): Scheduled Launch in 2022**
  - Would extend CAISO's existing Day-Ahead Market to EIM participants
  - Likely to incorporate new market enhancements (expected in 2021) including shorter forecast intervals and the ability to bid a flexible product
  - Transaction volume likely significantly larger than EIM's real-time market
  - Transmission allocation would be more complex

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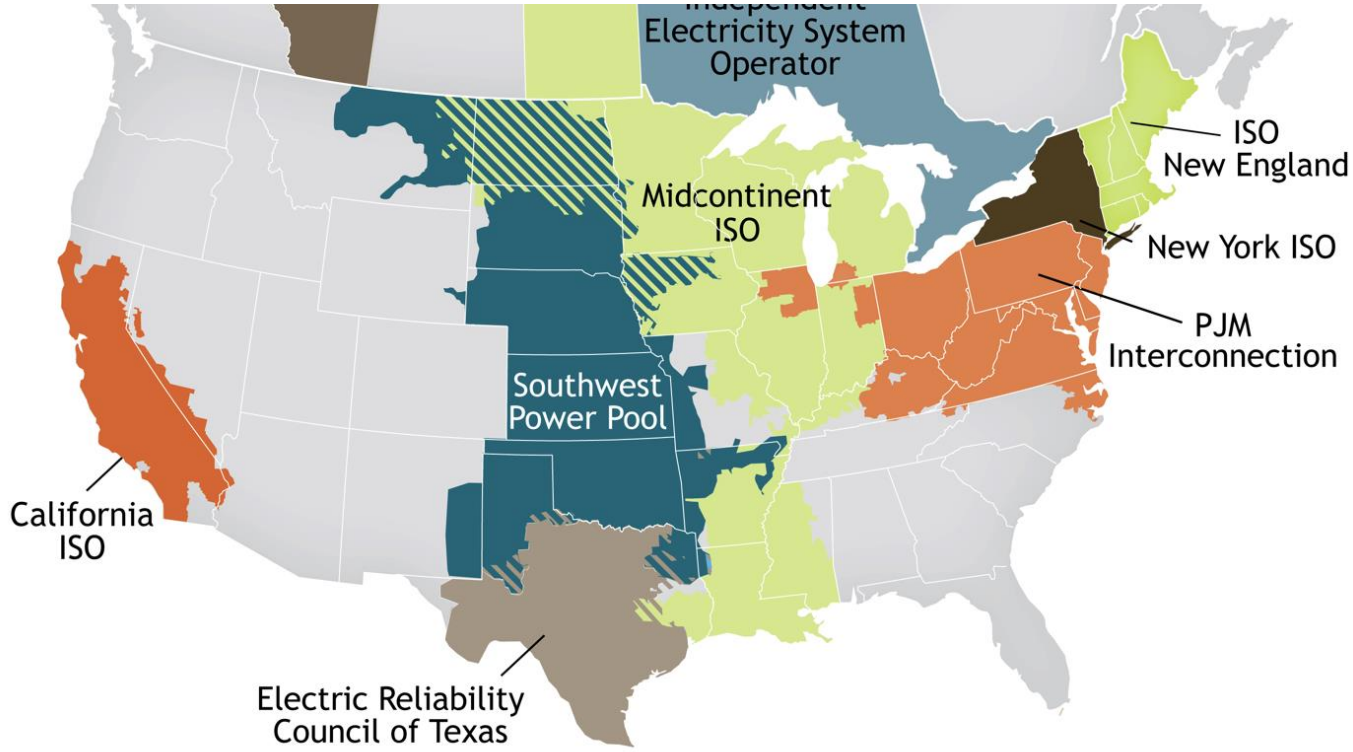
What is a Regional Transmission Organization?

- **Transmission:**
  - Utilities maintain ownership of transmission, but turn over operation to RTO
  - RTO operates transmission system on the basis of least cost and to manage congestion
- **Manages Organized Markets:**
  - Day-ahead market
  - Real-time market (15-min / 5-min) **EIM**
  - Other markets for grid services
- **Other Key Functions:**
  - Market monitoring and oversight
  - Outage management
  - Network modeling and planning



Source: FERC

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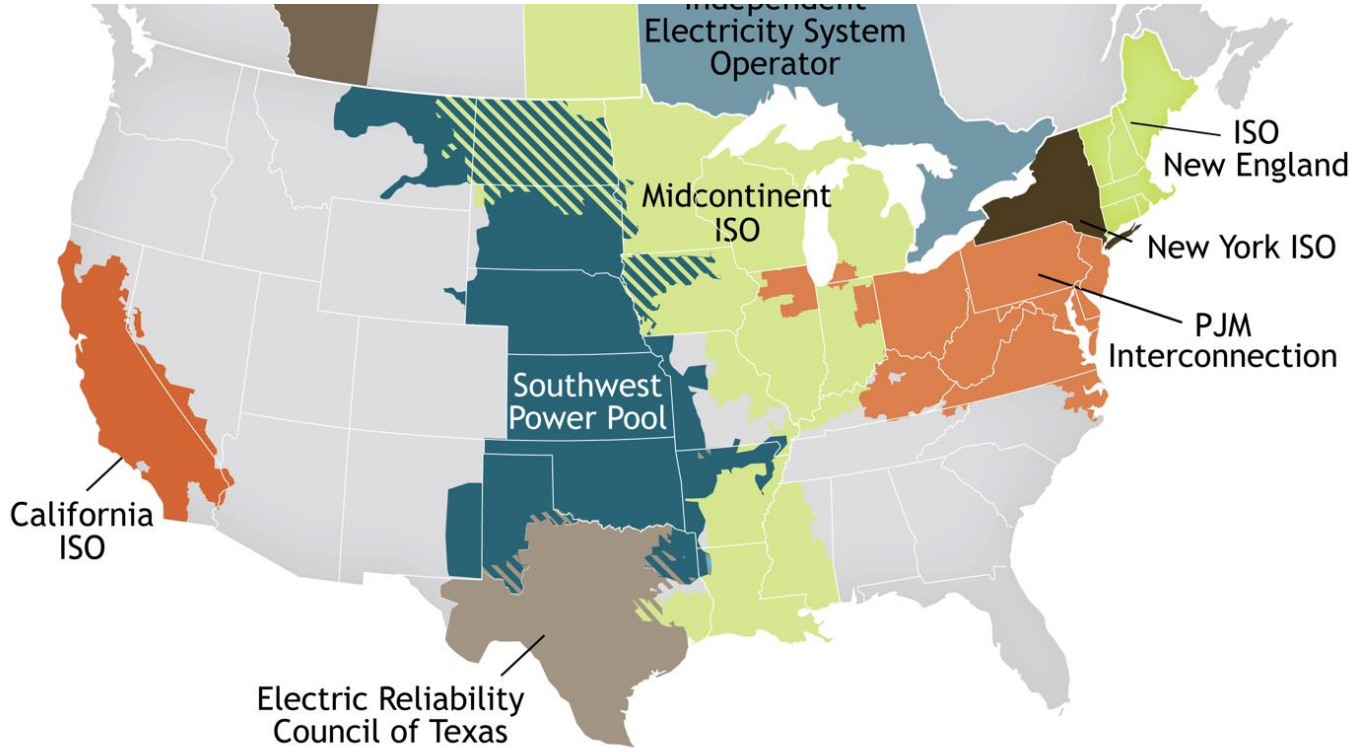

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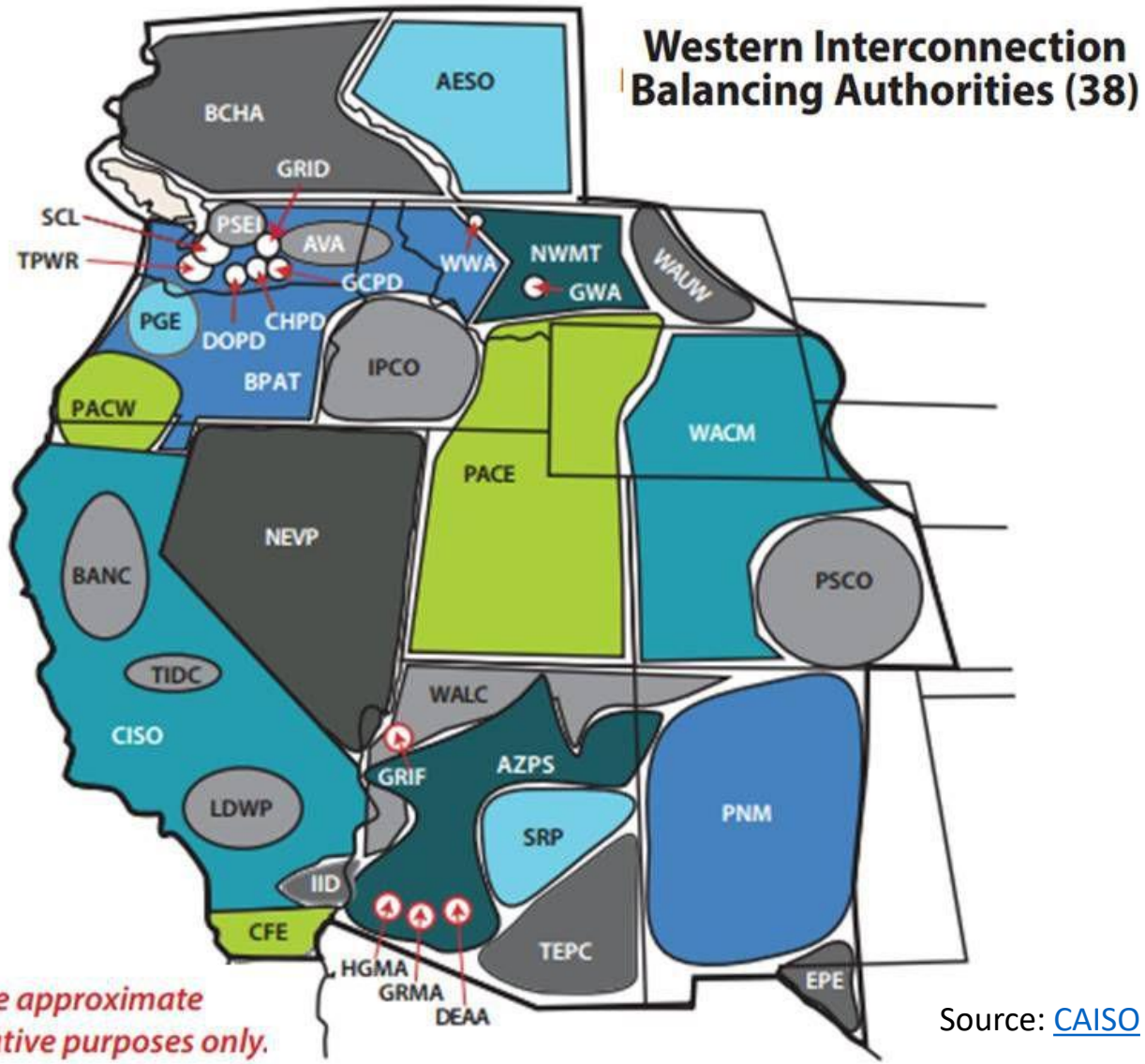

Source: CAISO

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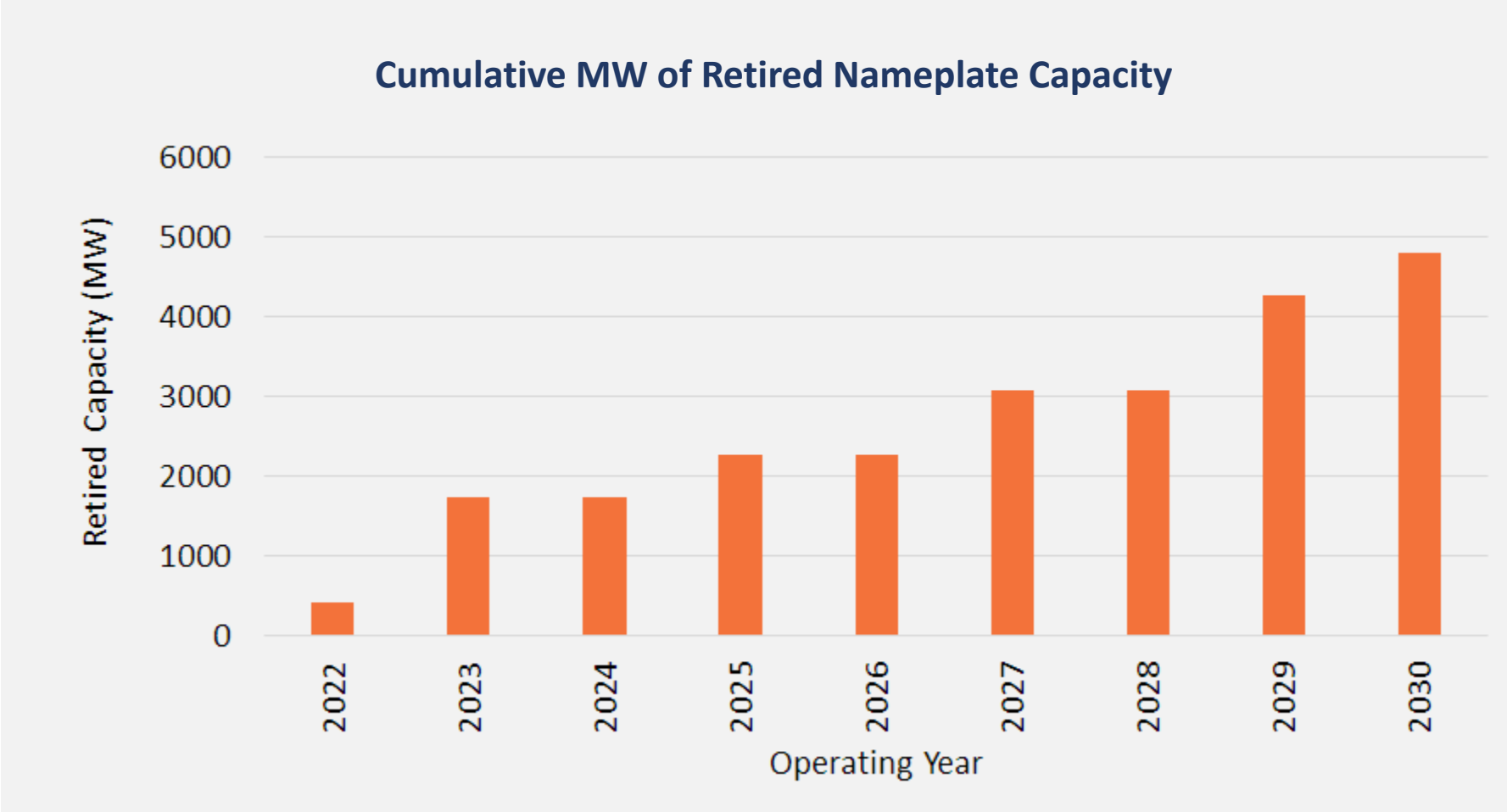
Why are these issues coming up now?

Announced Coal Plant Retirements in the Region



Source: NW Power Council

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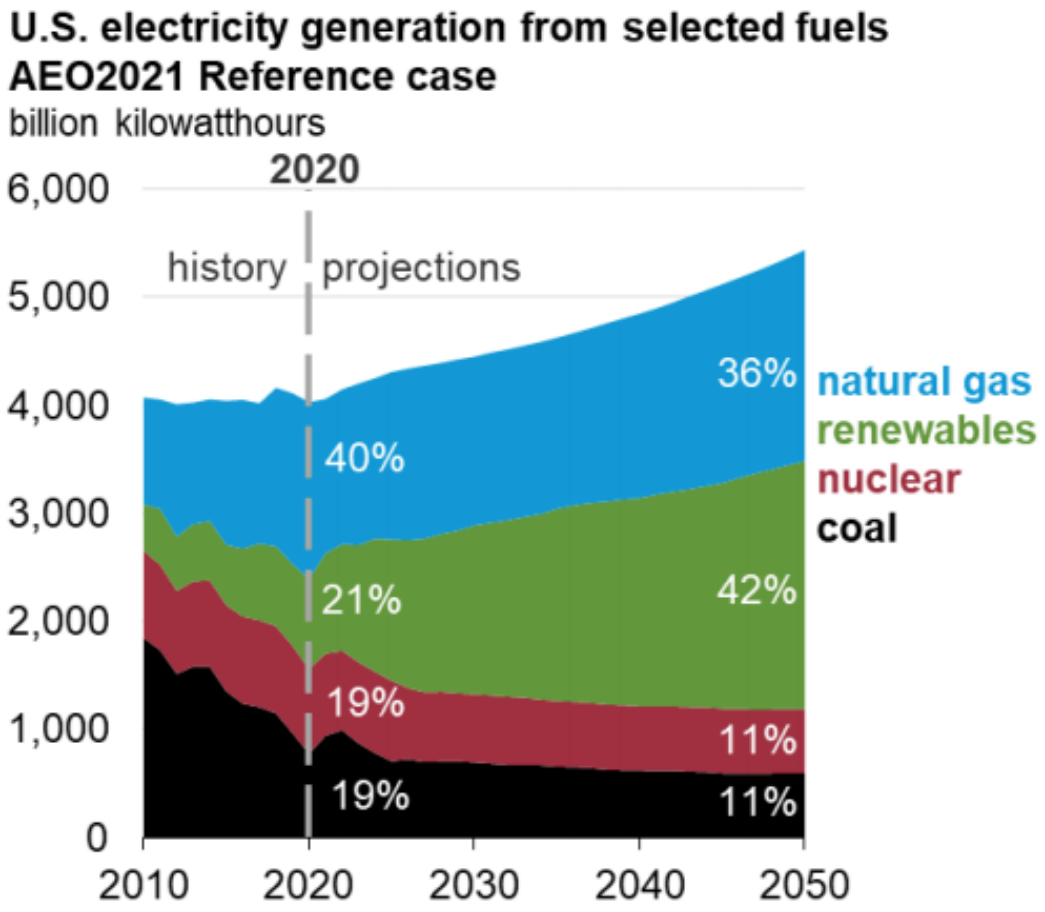

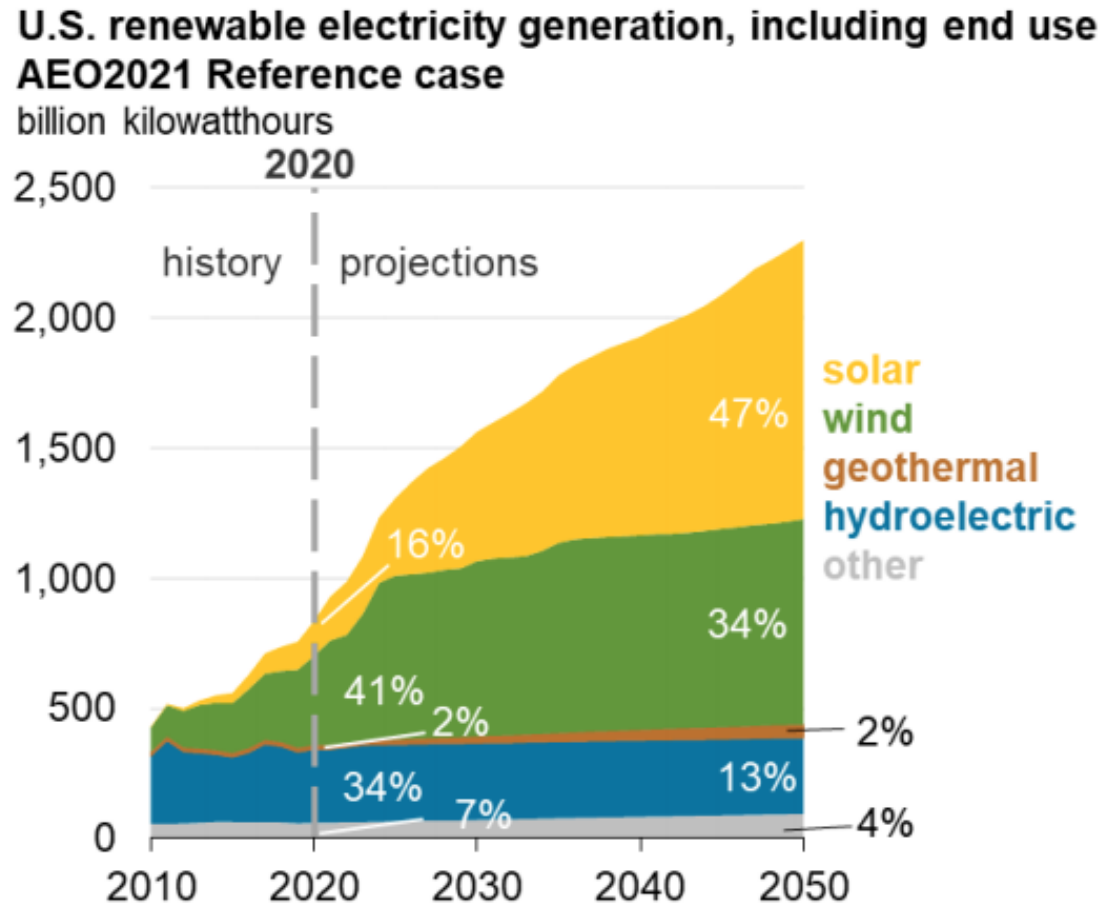

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021) Reference case

Source: EIA

Questions/Comments?

Biennial Energy Report online:
energyinfo.oregon.gov/ber

ODOE's website: www.oregon.gov/energy

Contact us: Adam.Schultz@oregon.gov

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