September 2022 Heat Wave – CAISO

Adjacent Balancing Authorities (BA) – Market Fundamentals

9/12/2022

Adjacent BA– Market Fundamentals

- Power Demand
- Pacific Northwest Hydro
- Transmission Flows
- CAISO Thermal Fleet
- Future Factors

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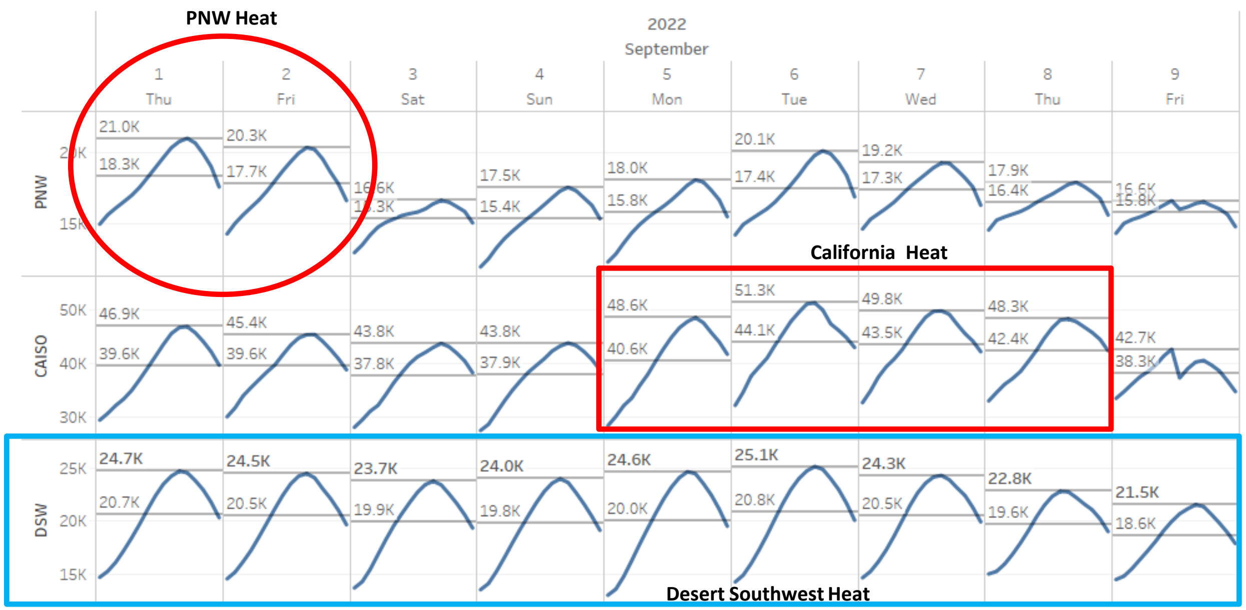
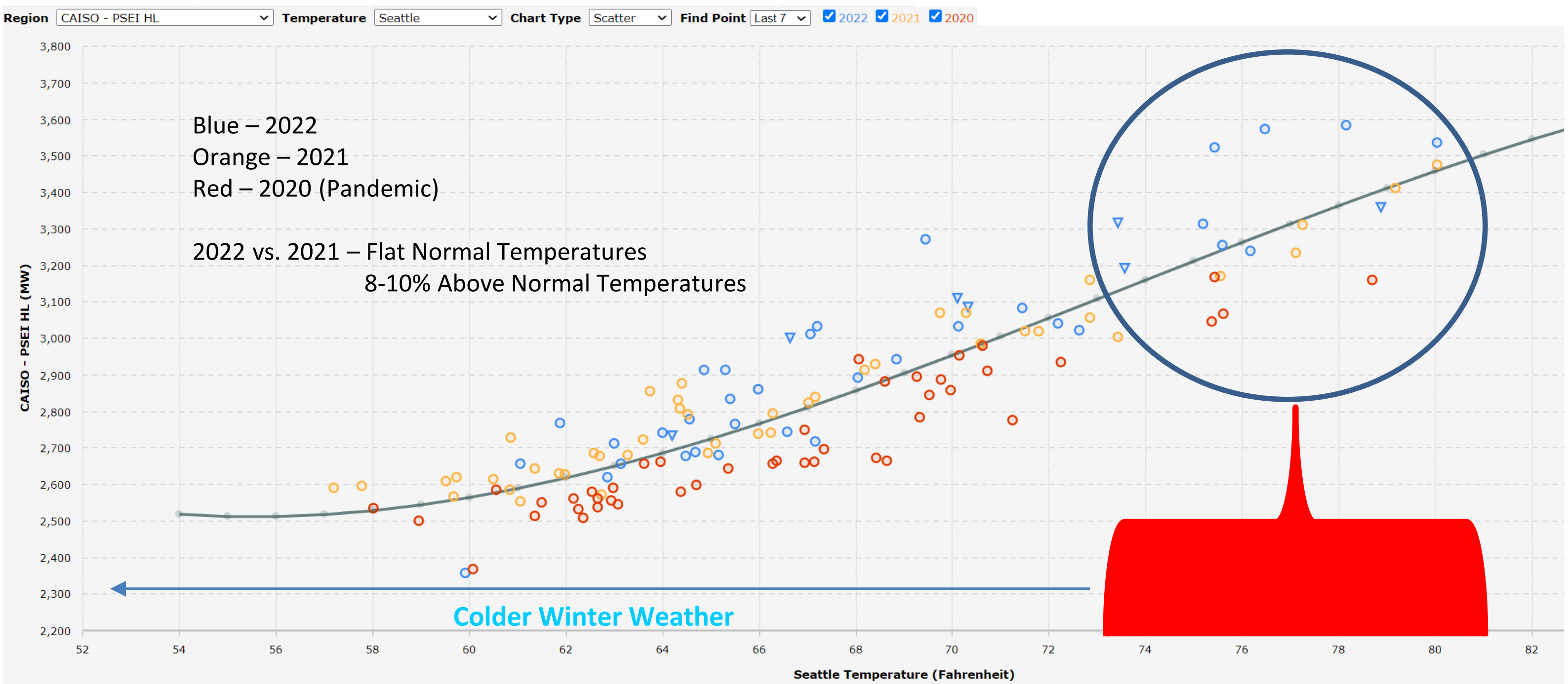
Power Demand – West Sub-Regions



Power Demand

- **Pacific Northwest (PNW) -** tapered off compared to the first couple days of September
- **CAISO -** saw substantial increase on Labor Day that carried over the next three days
- **Desert Southwest (DSW) -** continues to display moderate demand as temperatures were modest

Power Demand – PNW Growth (Seattle/Tacoma)



PNW Growth Conditions

- **Air Conditioning –** fallout from 2020 Heat Dome Weather Event
- **Pandemic –** work from home, heating and air conditioning equates to electricity demand
- **Electric Vehicles (EV) –** big projections in the coming years
- **Commercial Growth –** distribution, cannabis, bitcoin mining

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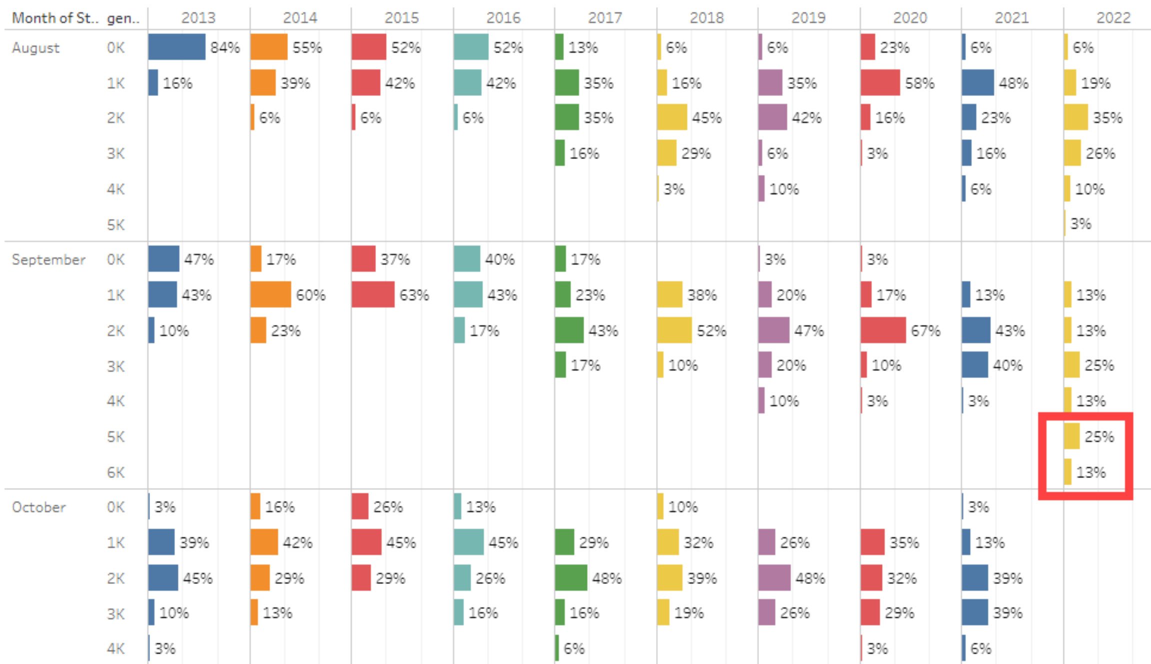
Pacific Northwest Hydro

PNW Hydro - 2022 Water Year (August and September)

- Bookend Atmospheric River System (ARS) – Nov/June
- Cold Spring – Late Runoff
- Plenty of Regulated (Storage Water) for high priced days

Pacific Northwest Hydro – Flex Ramp



<u>Pacific Northwest Hydro Flex Ramp</u>

- Flex Ramp Definition – Delta Volume between HE19 and HE13
- Beneficial to following load – 2022 September (days 1-9) shows massive flex
- Blessed to have second ARS, cold spring

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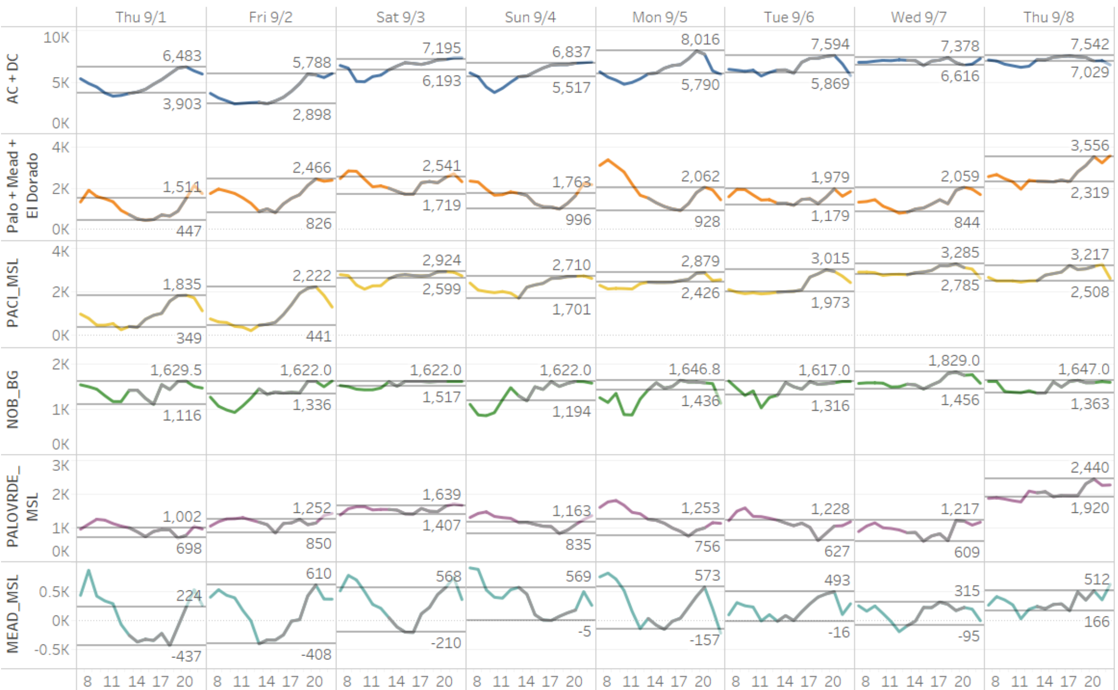
Transmission Flows – Real Time



<u>Transmission Summary</u>

- **AC + DC** - handles both CAISO and Non-CAISO regions – early look is that substantially more megawatts were showing up during CA heat wave
- **DSW** – did not provide incremental megawatts to CAISO during heart of heat, not until Thursday, September 8th
- **Paci/Nob (CAISO Portion of AC/DC)**
  - Peak Volume increased on Paci, flex ramp decreased, congestion N to S within CAISO went away
  - Nob flows were basically unchanged when compared to the PNW heat on 1st/2nd and CAISO heat post-Labor Day

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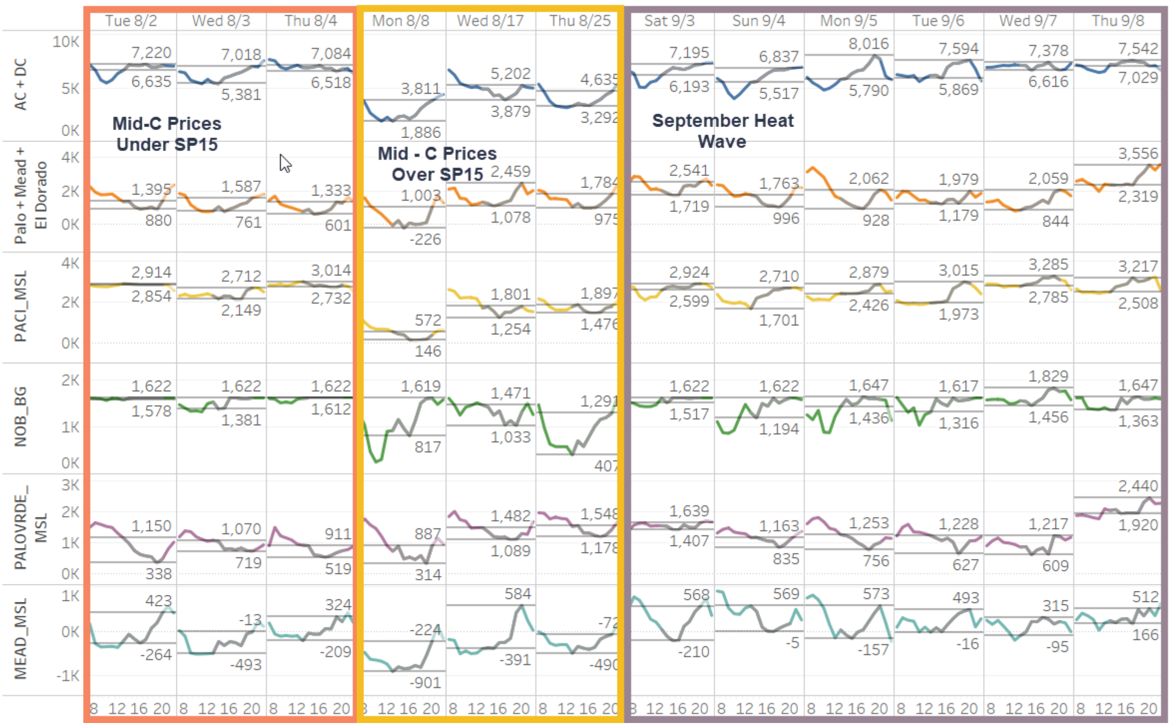
Transmission Flows – PNW



PNW (Pacific Northwest) Flows

- **Mid-C Pricing Under SP15**
  - AC + DC Peak 7.1 GW peak average in August, 7.5 GW during CA Heat Wave
  - No Flex Ramp Gained (in fact lost) during CA Heat Wave
- **Mid-C Pricing Over SP15**
  - Peak flow decline by 12.8 to 2.8 GW
  - Exception was on Tuesday 9/6/2022 when bilateral day-ahead had Mid-C over SP15 but real-time flows hit 7.594 GW HE 19
- **DSW Pricing Over SP15**
  - Capacity is available East to West (into CAISO) – at least 1.2 GW when looking at 9/8 vs. 9/7 Palo Verde Flows
  - Mead E-W (into CAISO) has capacity available as well

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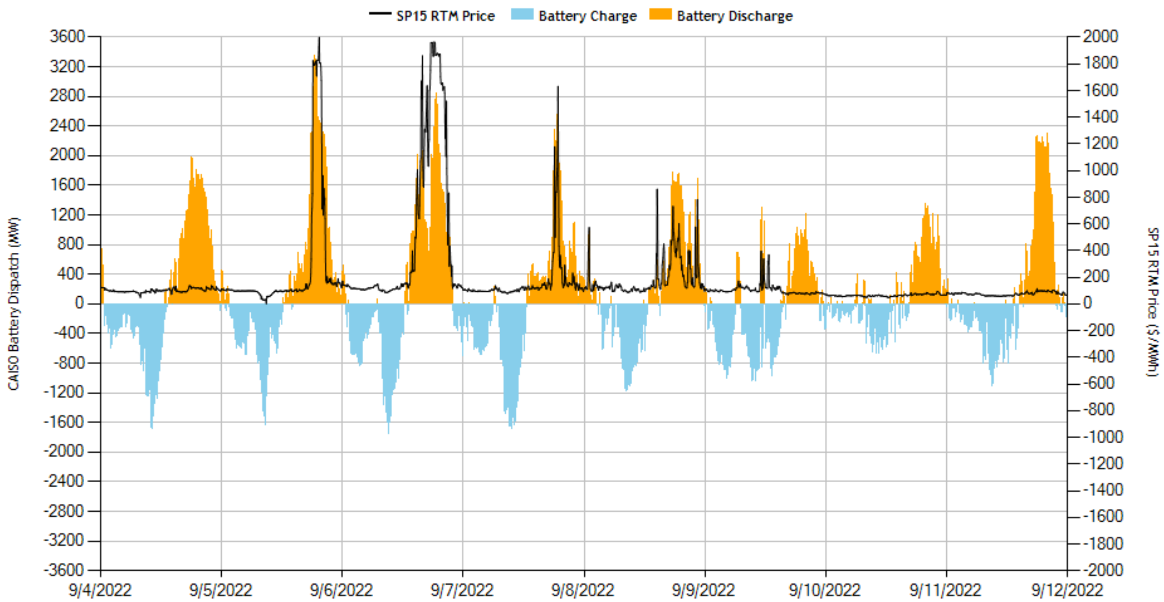
CAISO Thermal Fleet – Shout Out to Batteries



CA Batteries

- **Year on Year Capacity Increase**
- **Volume During Crucial Periods – 9/5 Peak Volume 3.25 GW, 9/6 2.8 GW, 9/7 2.4 GW**

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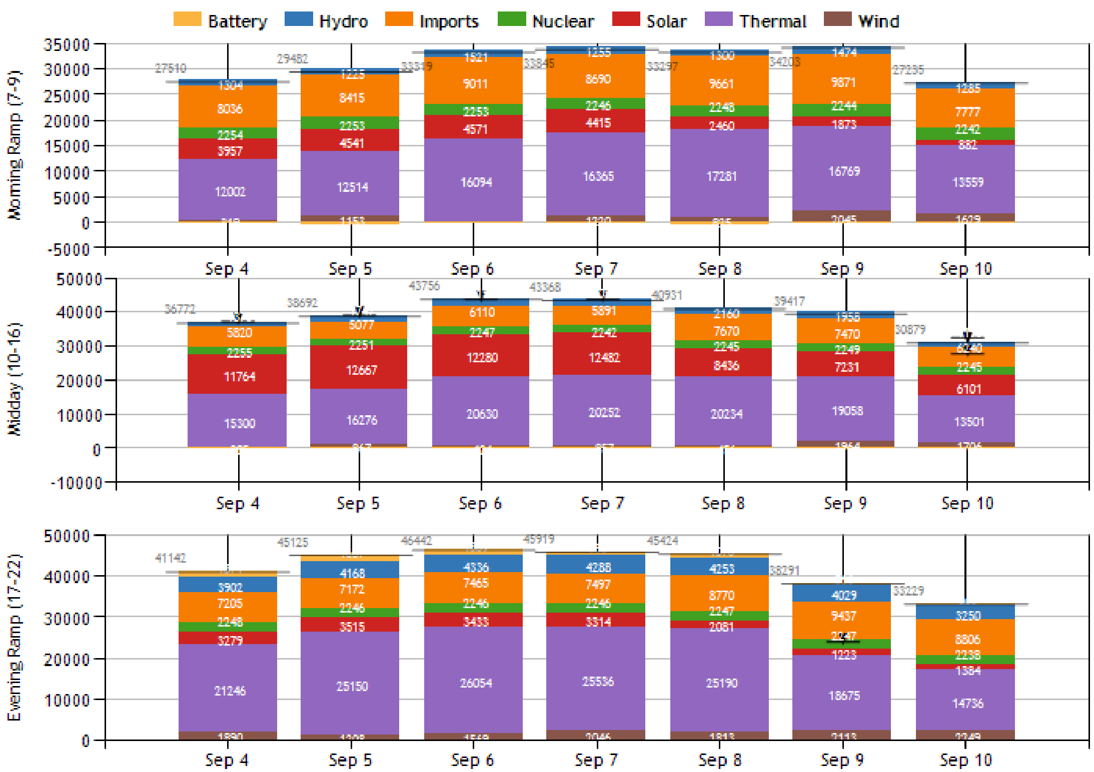
CAISO Thermal Fleet - Generation

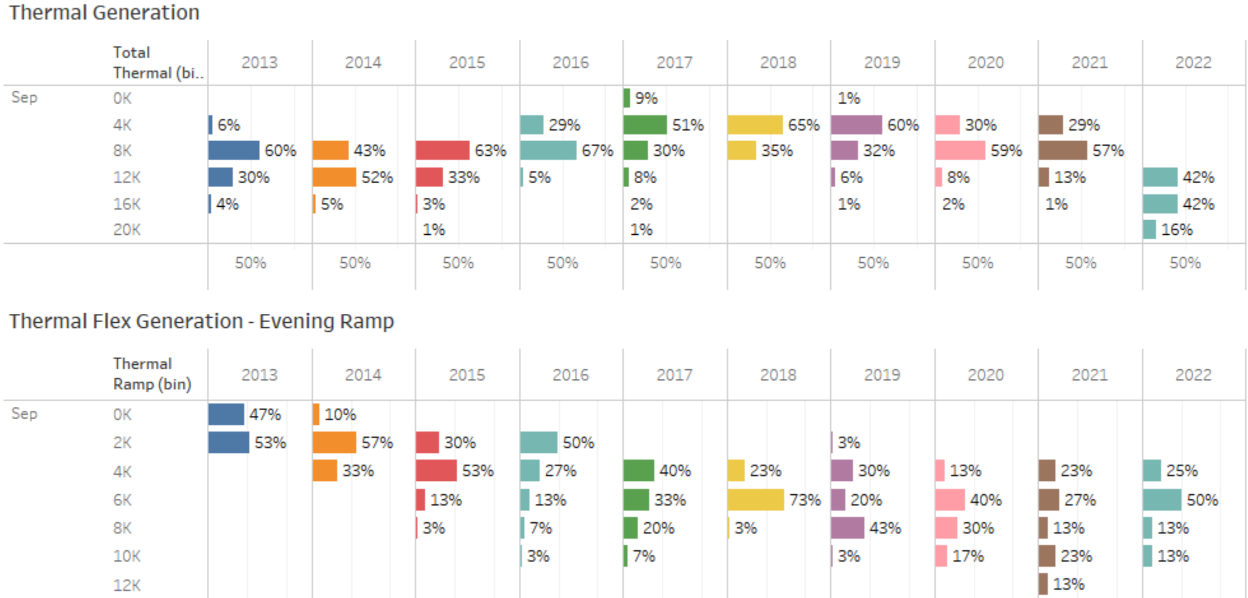


CA Breakdown

- **Morning Ramp**– moved up from 12.5 GWa to 17.2 GWa
- **Midday**– delta change from 9/4 to 9/7 was 4.9 GW
- **Evening Ramp**– peak output averaged 26.0 GW on 9/6 and 25.5 GW on 9/7

Note | the natural gas fleet was running near max capacity during the evening ramp on the days mentioned its respective bin above

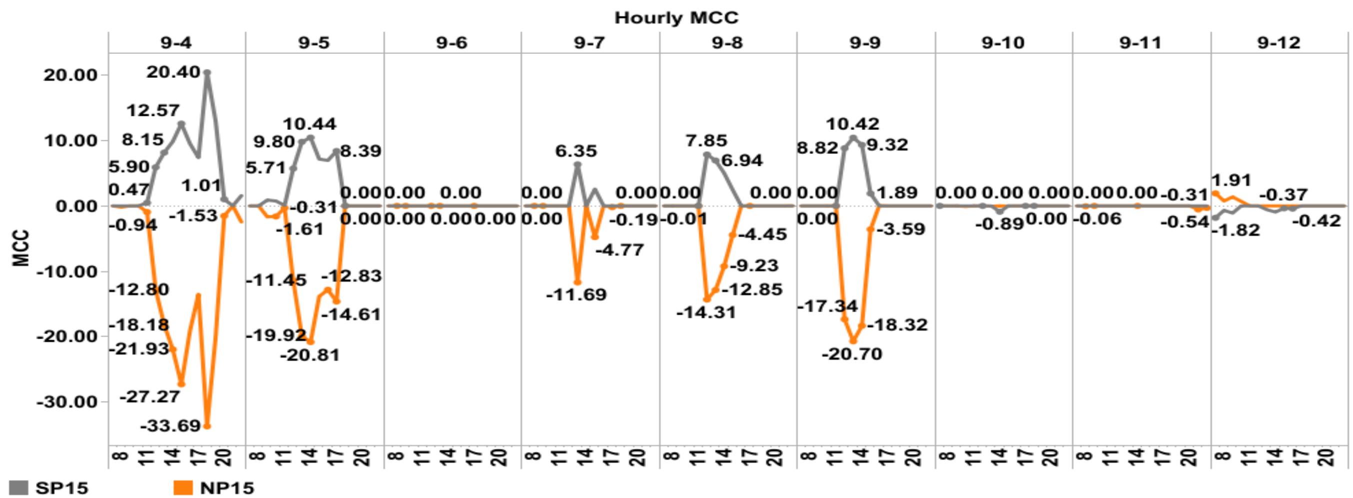
CAISO Thermal Fleet – Generation/Flex



CAISO Thermal Generation/Flex

- **Generation** – September 2022 Heat Wave relied on the in-state thermal fleet to balance the system, only solution was to turn on units throughout the day, so CAISO had enough flex generation available for the evening ramp
- **Flex Volume** – the volume bins have been lower compared to 2021 as the thermal fleet was acting more like baseload given the lack of wind generation and battery charging volume

CAISO Thermal Fleet – Little/No Congestion



<u>CAISO Congestion N to S between Gen Hubs</u>

- **Pre-Heat Wave (Pre-Labor Day)**
  - Big Congestion N to S through the evening ramp
- **Heat Wave**
  - Midday N to S congestion
  - Nothing during the evening ramp block of hours

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Future Factors – Market Fundamentals

- **Weather Events –** discussion around 1 in 30-year event but with weather conditions changing, the lens is more like 1 in every ??? Years
- **Timing/Heat Location –** multiple regions being warm/hot, July and August are peak load months, September continues to have strong weather events
- **Pacific Northwest Hydro** – below normal/normal hydro conditions do not carry into August/September typically
- **Mid-C/PV Pricing over CA Hubs** – this combines timing/heat location with regional seasonal outlook
- **Battery capacity outpaces structural load growth** – does new capacity outpace the power demand increases across the country?

Future Factors – Structural/Policy

- **Pacific Northwest Power Demand –** continued structural load growth via AC installations for residential/commercial, Electric Vehicle (EVs), commercial development (cannabis industry/distribution centers/bitcoin mining)
- **Washington Carbon**
- **Western Resource Adequacy Program (WRAP) –** capacity across the entire West in high demand (both transmission and generation)
- **Supply Chain Shortages around the Globe** – planned renewable technology installations
- **Western Hydro Outlook**
  - Pacific Northwest Spill Requirements restricting generation
  - California Drought-like conditions worsening
  - Desert Southwest point of no return?
- **Nuclear and Once-Thru Cooling (OTC) Units with California** – next steps
- **Aging Thermal Fleet??**

Contact Information

- **Product/Consulting Contact Information**
  - Email | support@energygps.com
  - Phone | 503-764-9120
- **EGPS Staff - Jeff Richter**
  - Jeff Richter
    - Email | jrichter@energygps.com
    - Cell/Whats App | 503-989-9540
    - ICE | jrichter3
  - Nadine Knight (Client Representative)
    - Email | nknight@energygps.com
- **Newsletter Blog** – www.energygps.com