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Hourly Electricity Demand

California Energy Demand Forecast Update, 2024-2040

Nick Fugate, Energy Assessments

Use cases

- Input to system and reliability modeling
- Monthly system peak days serve as a system-level benchmark for Resource Adequacy
- Detailed planning use cases outlined in Single Forecast Set agreement published in each IEPR

For IOU TAC areas, peak loads are derived from hourly load modeling

Hourly Forecast Framework

1. Apply base load profile to annual “consumption” forecast
2. Adjust hourly consumption using profiles for:
   - Climate change impacts
   - Electric vehicle charging
   - Behind-the-meter PV generation and storage
   - “Additional Achievable” efficiency and electrification
3. Calibrate to weather-normal base-year peak load

Objectives for CED 2024

1. Address areas of concern identified in previous cycles
    - High PG&E calibration adjustment
    - Low SDG&E coincidence factor
    - Large delta between consumption and system peaks
    - System ramps vs actuals
2. Facilitate future work
    - Expand use of downscaled, localized climate projections
    - Develop stochastic data sets

Estimating Consumption Profiles

1. Hourly models estimated with recent load/weather data, used to simulate consumption under different weather patterns
   - Simulations can use historic weather or synthetic climate data
2. Simulated consumption profiles serve multiple purposes
   - Direct input to reliability studies (CEC/CPUC)
   - 1-in-2 load duration curve (IEPR forecast)
   - 8760 base consumption profile (IEPR forecast)

More details covered at a **July 30 IEPR workshop**

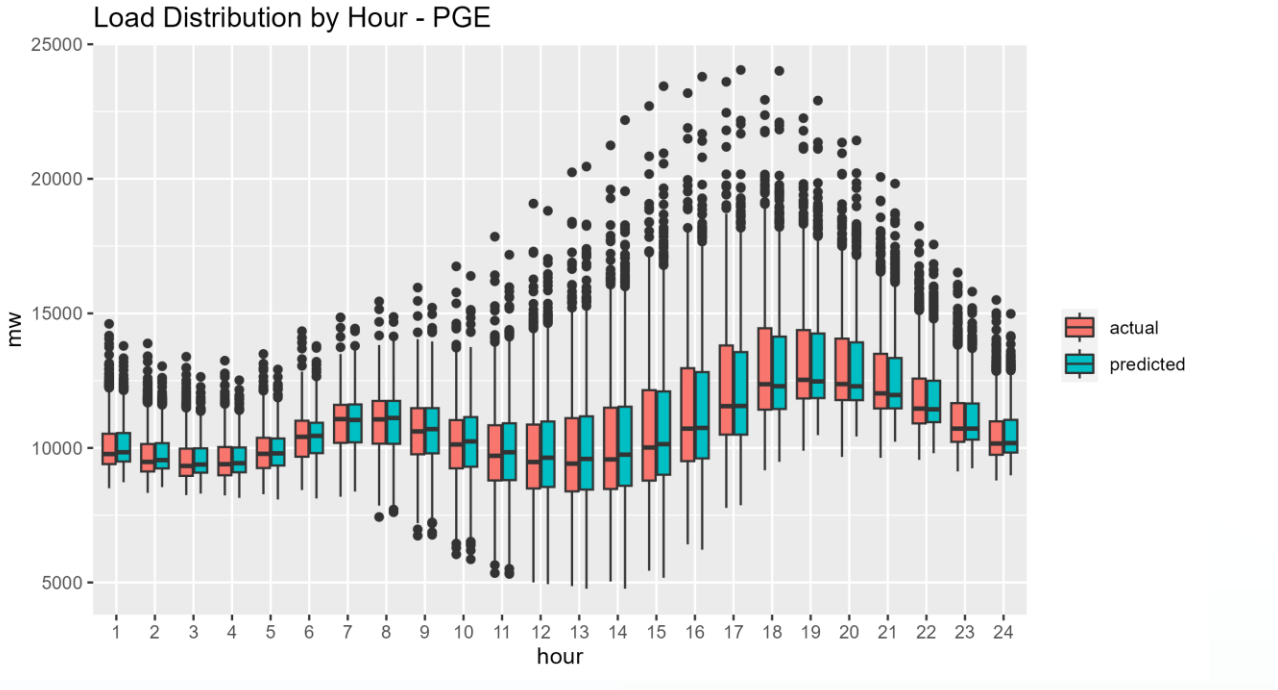
Updated Inputs

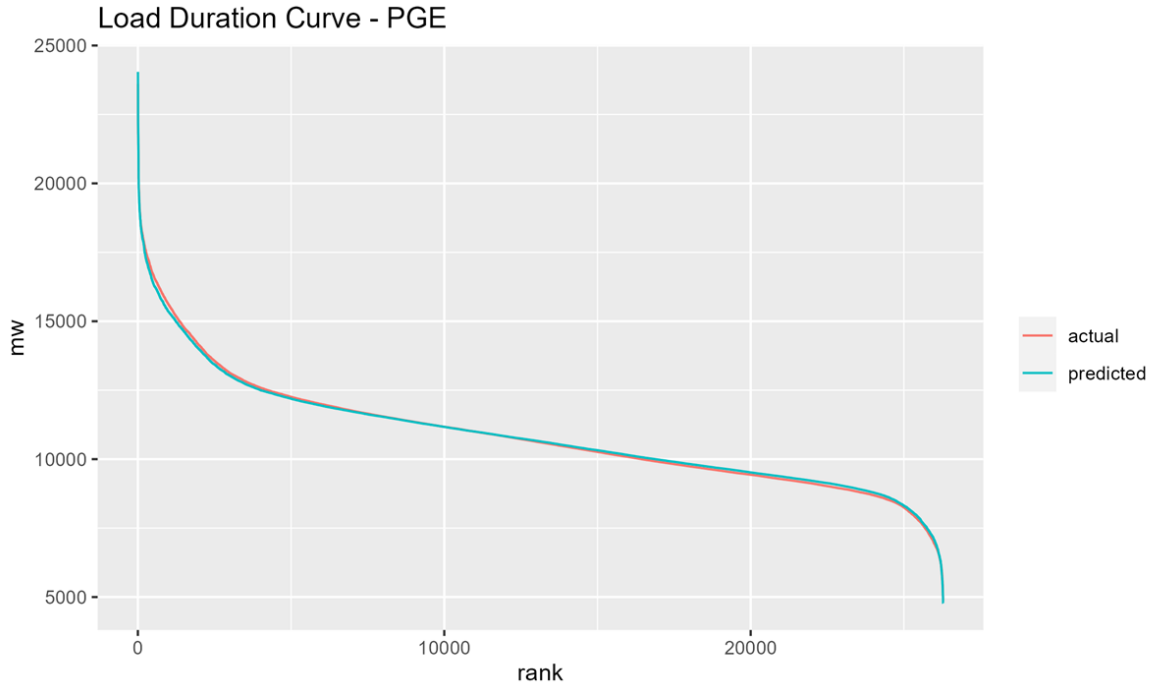
- Additional historical years used to estimate models
  - Draft forecast used 2016-2023, excluding 2020
  - Previous forecast used 2020-2022
- Revised PV generation profiles used to construct historical consumption
  - Less consumption assumed during PV generation hours
- New load management program events
  - Demand Side Grid Support Program (DSGS)
  - Emergency Load Reduction Program (ELRP)
- Out-of-market grid-connected storage systems (SCE only)

Hourly Model Changes

- Revised hourly model specification to reflect:
  - Changes in system load profile over time
  - Increasing temperature response
- Forecast calibrated to 2024 weather-normal annual peak estimate
  - Annual sales forecast adjusted by the ratio of EMS system loads and reported QFER sales
- Modified calendar assignment process to improve stability of consumption profile (timing of monthly peaks)

Model Performance





Source: CEC staff

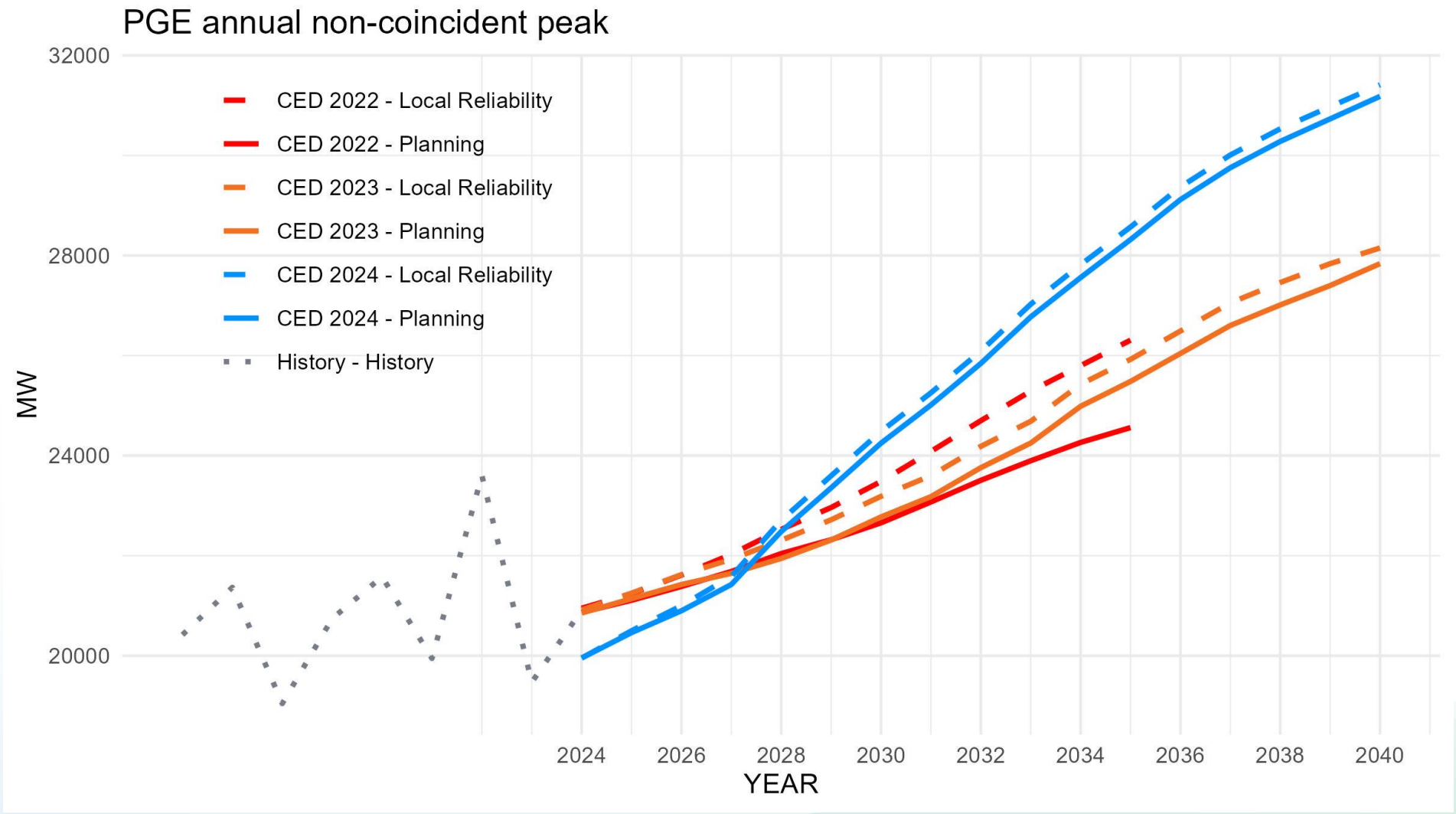
Shown above, model predictions with 2021-2023 weather data were used to construct system loads over that same time period. Simulated load distributions are well aligned with observations.

Load Modifier Updates

- Self-generation
  - Updated PV and storage forecasts
  - Forecast PV generation profiles reflect lower capacity factors
- Additional Achievable modifiers
  - Fuel Substitution
  - Transportation Electrification
- New load modifiers
  - New data center load
  - New carriers to be stationed at Naval Base Coronado (SDG&E)

Results

PG&E Non-Coincident Peak

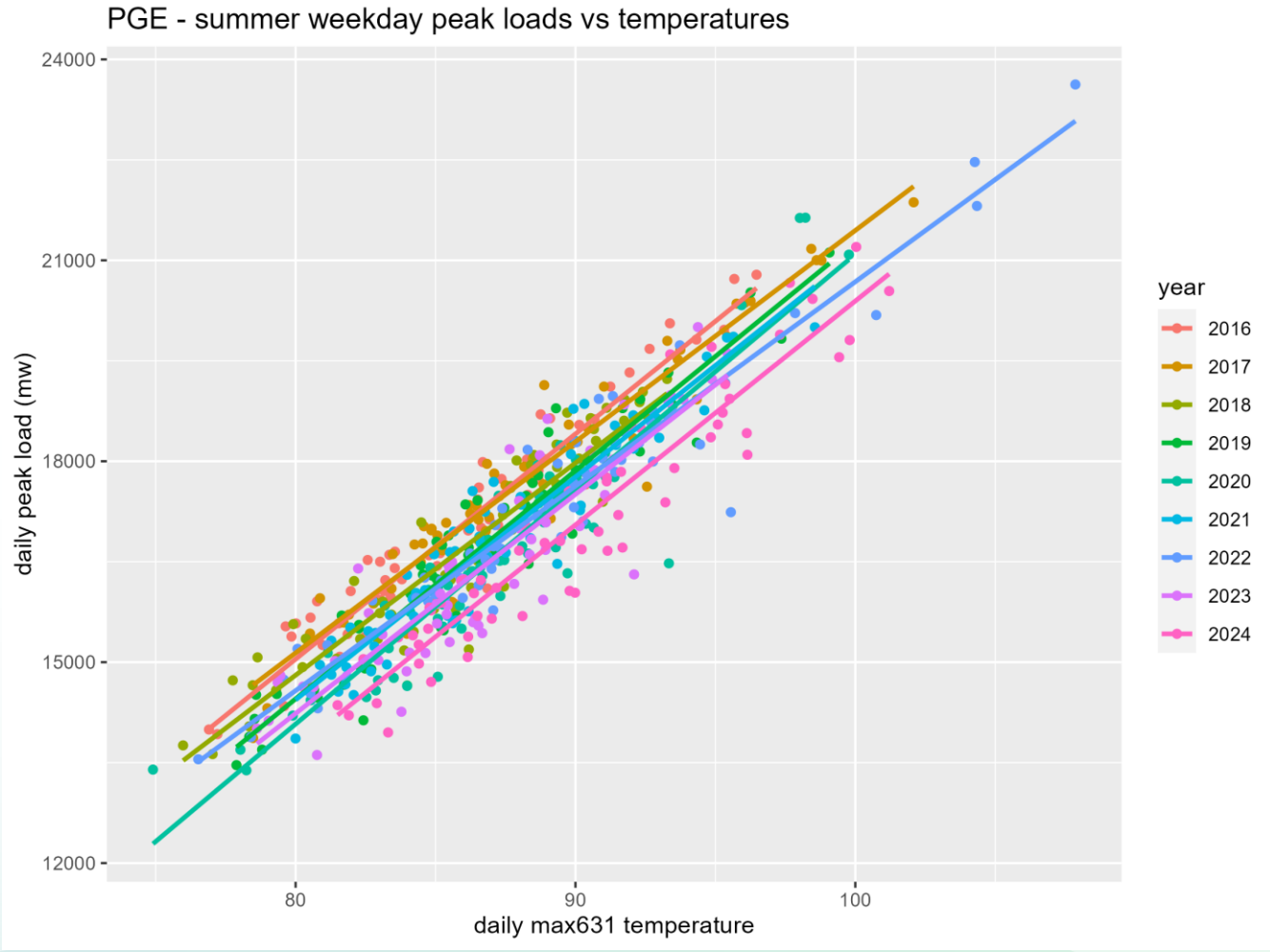


Year	Month	Hour	Peak
2016	7	18	20,418
2017	9	17	21,367
2018	7	18	19,044
2019	8	18	20,742
2020	8	18	21,578
2021	6	18	19,946
2022	9	17	23,606
2023	8	18	19,469
2024	7	18	20,908
2024	8	18	19,954
2025	8	18	20,420
2026	8	18	20,911
2027	8	18	21,456
2028	8	18	22,535
2029	8	18	23,423
2030	8	18	24,337
2031	8	18	25,106
2032	8	18	25,958
2033	8	18	26,896
2034	8	18	27,701
2035	8	18	28,464
2036	8	18	29,278
2037	8	18	29,925
2038	8	18	30,462
2039	8	18	30,927
2040	8	18	31,387

Source: CEC staff

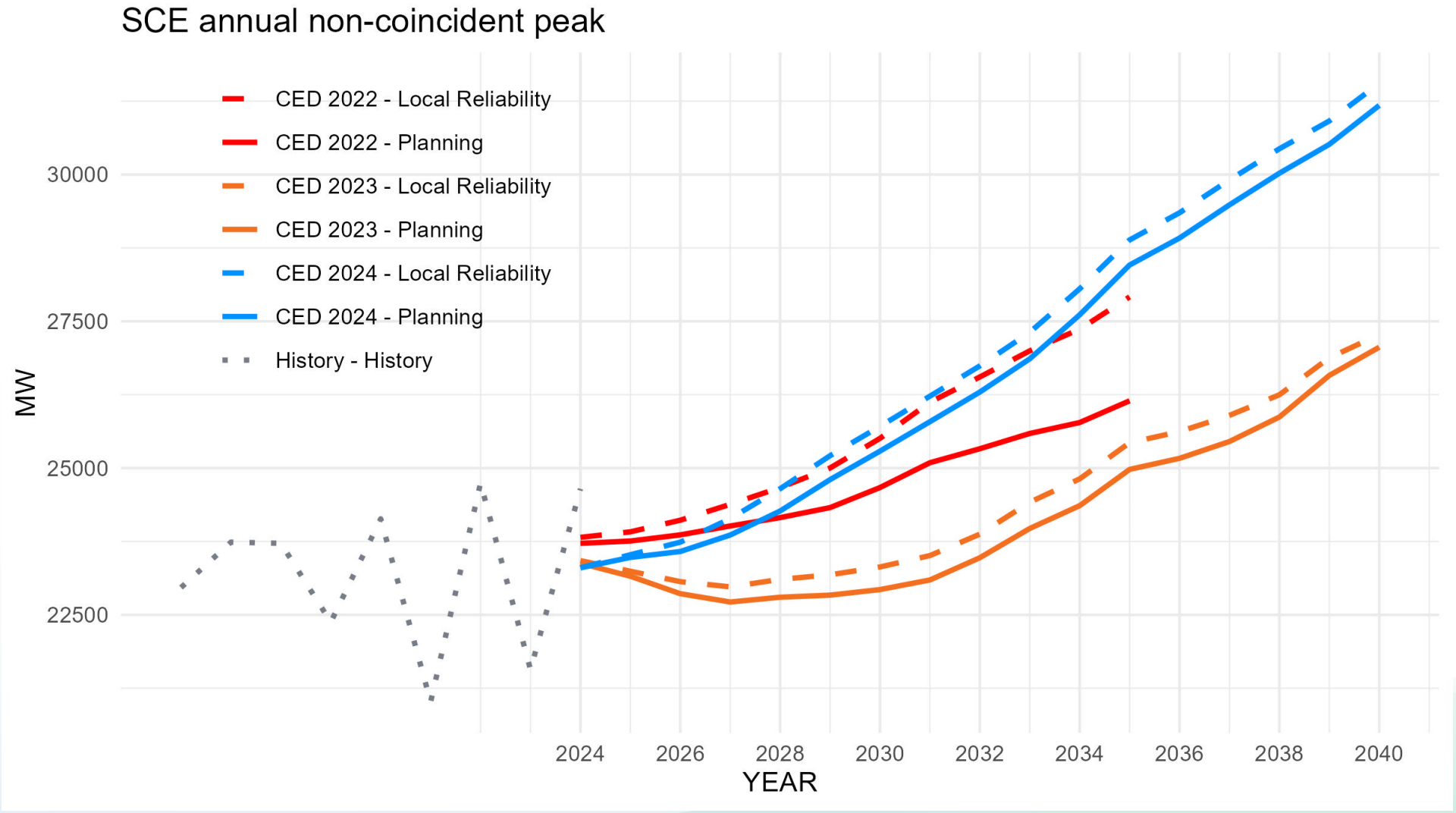
PG&E Weather-normal Peak

- PG&E summer daily peak load relative to temperature has been consistently declining since 2016
- This translates to a weather-normal peak estimate for 2024 which will appear low relative to recent historical peaks



Source: CEC staff

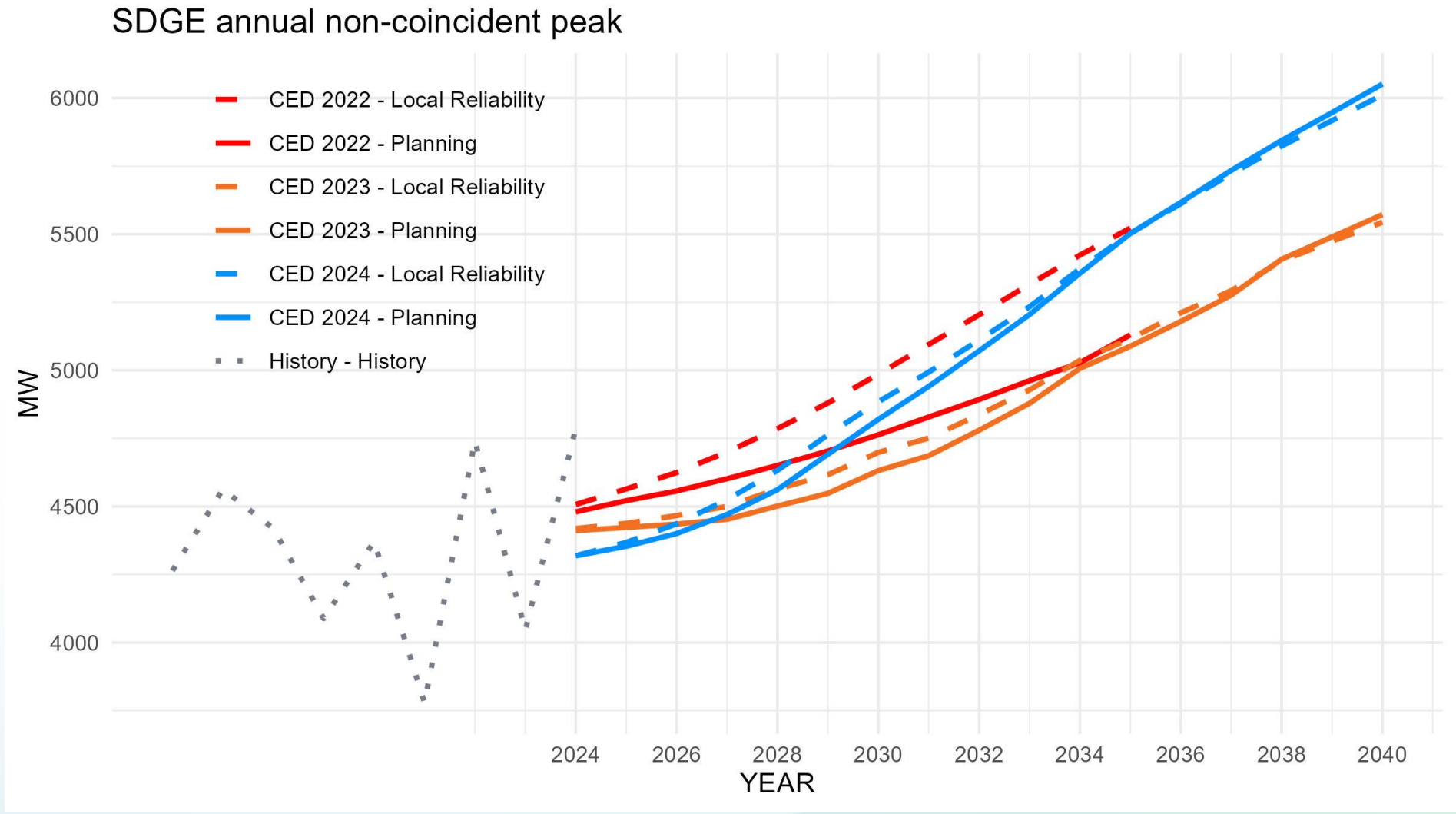
SCE Non-Coincident Peak



Year	Month	Hour	Peak
2016	6	17	22,965
2017	9	16	23,739
2018	7	16	23,718
2019	9	15	22,375
2020	8	16	24,135
2021	9	15	21,018
2022	9	16	24,747
2023	8	17	21,567
2024	9	17	24,647
2024	8	16	23,301
2025	8	16	23,478
2026	8	16	23,579
2027	8	16	23,859
2028	9	15	24,269
2029	9	15	24,803
2030	9	15	25,288
2031	9	15	25,790
2032	9	15	26,295
2033	9	15	26,861
2034	9	15	27,611
2035	9	15	28,459
2036	9	15	28,918
2037	9	15	29,483
2038	9	15	30,022
2039	9	15	30,514
2040	9	15	31,177

Source: CEC staff

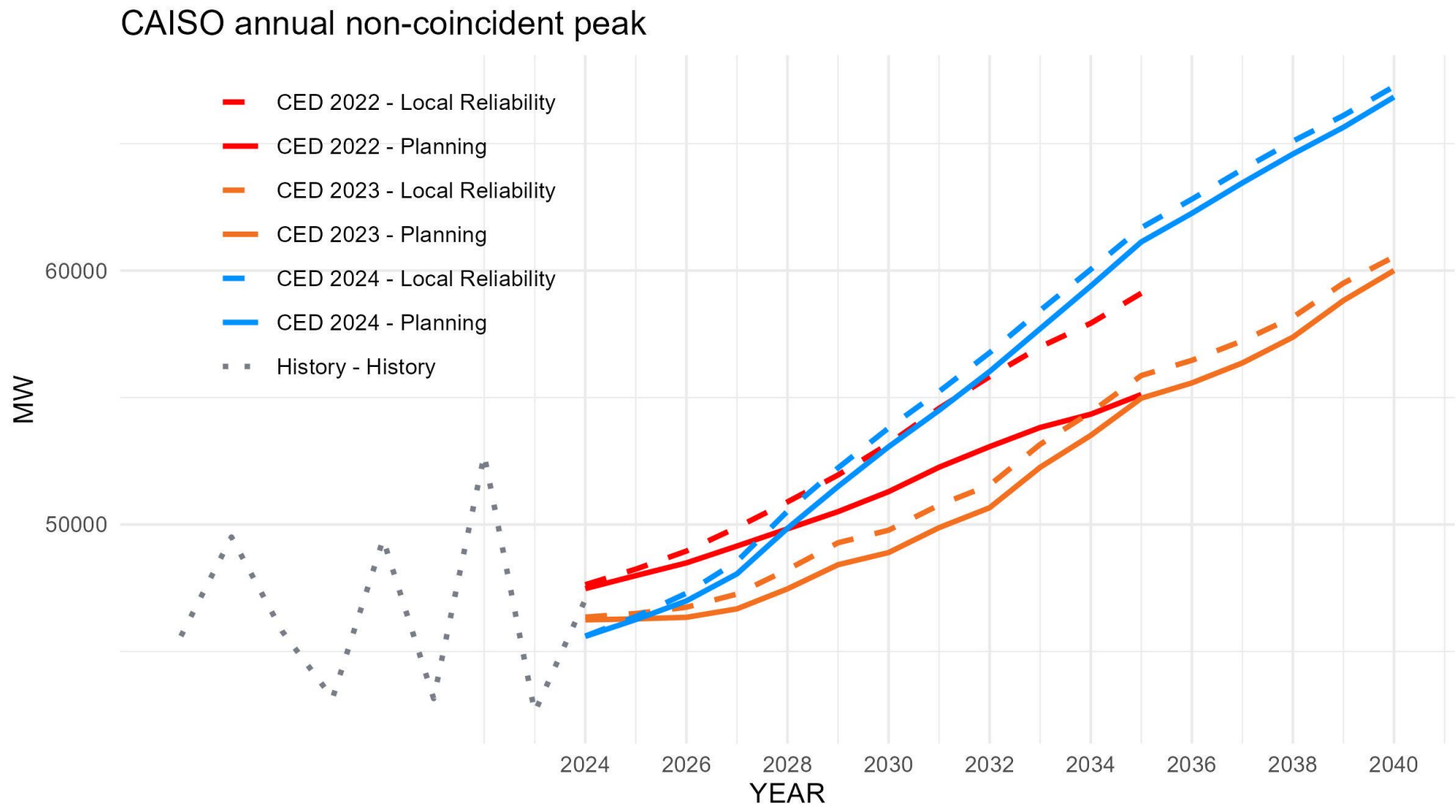
SDG&E Non-Coincident Peak



Year	Month	Hour	Peak
2016	7	17	4,264
2017	9	16	4,563
2018	8	17	4,420
2019	9	17	4,088
2020	9	16	4,372
2021	9	17	3,779
2022	9	17	4,741
2023	8	18	4,045
2024	9	17	4,786
2024	9	18	4,319
2025	9	18	4,353
2026	9	18	4,399
2027	9	18	4,473
2028	9	18	4,574
2029	9	18	4,707
2030	9	18	4,836
2031	9	18	4,957
2032	9	18	5,087
2033	9	18	5,219
2034	9	18	5,371
2035	9	18	5,520
2036	9	18	5,635
2037	9	18	5,754
2038	9	18	5,866
2039	9	18	5,971
2040	9	18	6,077

Source: CEC staff

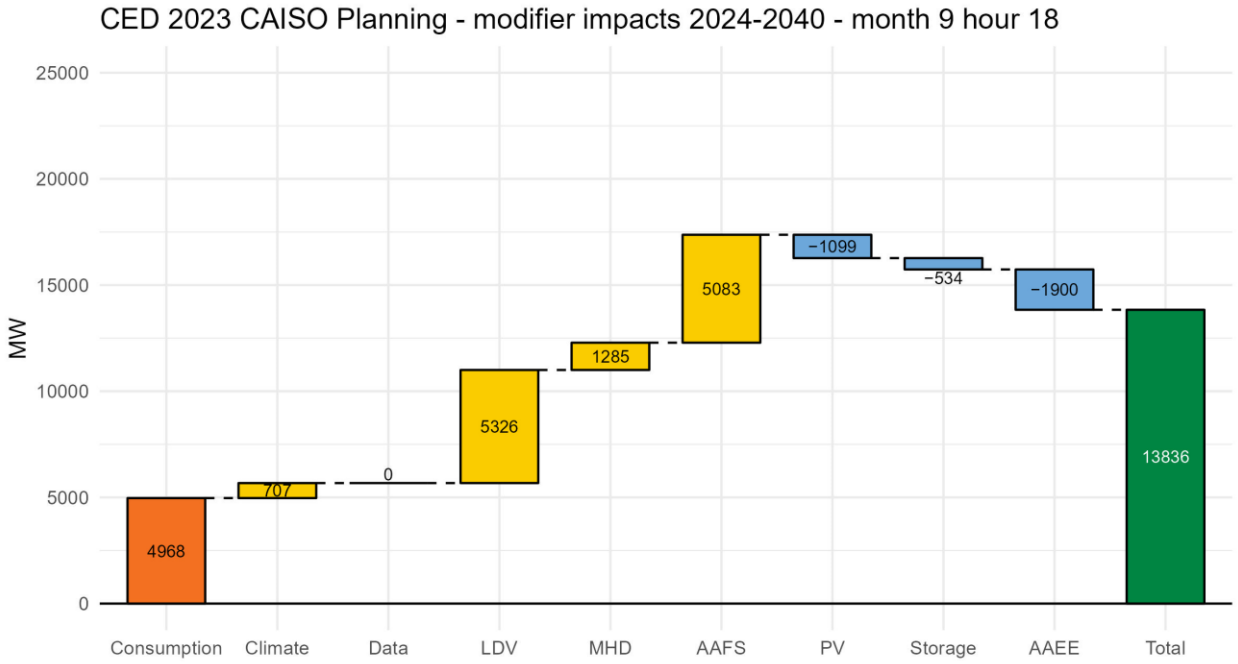
CAISO Annual Peak

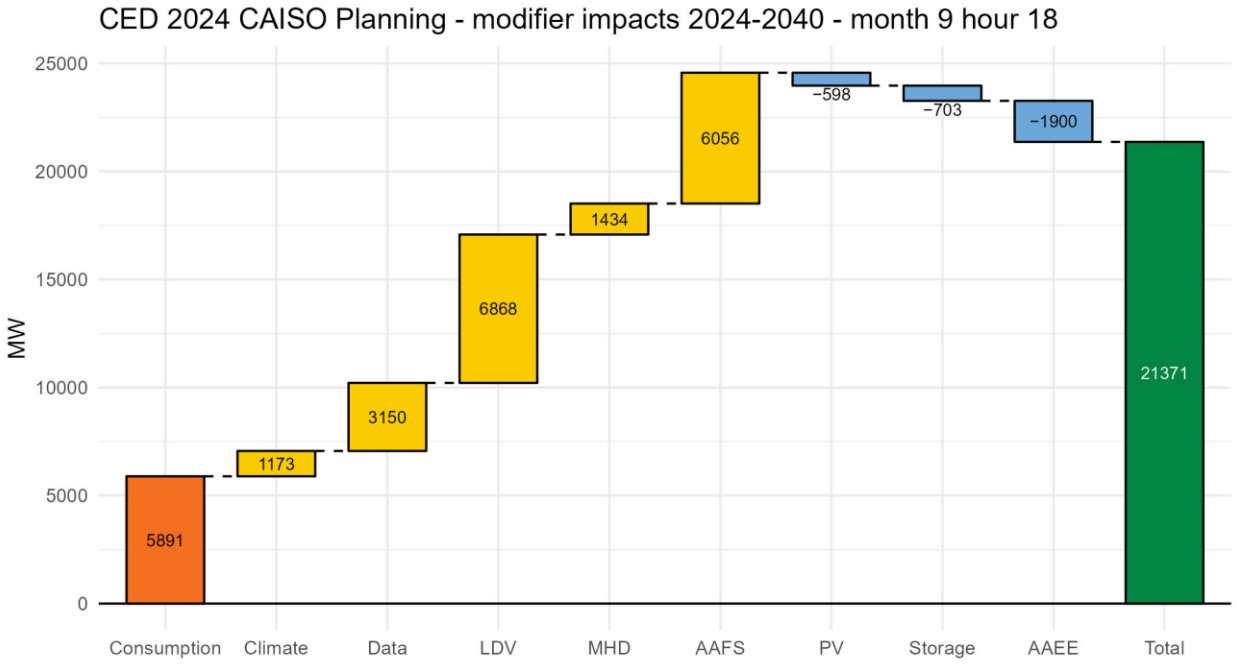


Year	Month	Hour	Peak	Coinc
2016	7	17	47,787	95.4%
2017	9	16	49,809	99.4%
2018	7	17	47,322	96.8%
2019	8	17	47,346	91.2%
2020	8	17	50,225	98.4%
2021	9	17	44,883	96.1%
2022	9	17	53,234	99.1%
2023	8	17	45,221	94.2%
2024	9	17	50,481	93.2%
2024	9	17	45,593	95.5%
2025	9	17	46,257	95.6%
2026	9	18	46,990	95.8%
2027	9	18	48,056	96.3%
2028	9	18	49,850	96.7%
2029	9	18	51,496	97.0%
2030	9	18	53,060	97.1%
2031	9	18	54,497	97.3%
2032	9	18	56,027	97.4%
2033	9	18	57,710	97.6%
2034	9	18	59,390	97.6%
2035	9	18	61,128	97.6%
2036	9	18	62,255	97.3%
2037	9	18	63,452	97.1%
2038	9	18	64,589	97.1%
2039	9	18	65,642	97.1%
2040	9	18	66,833	97.1%

Source: CEC staff

Load Modifier Impacts on Peak

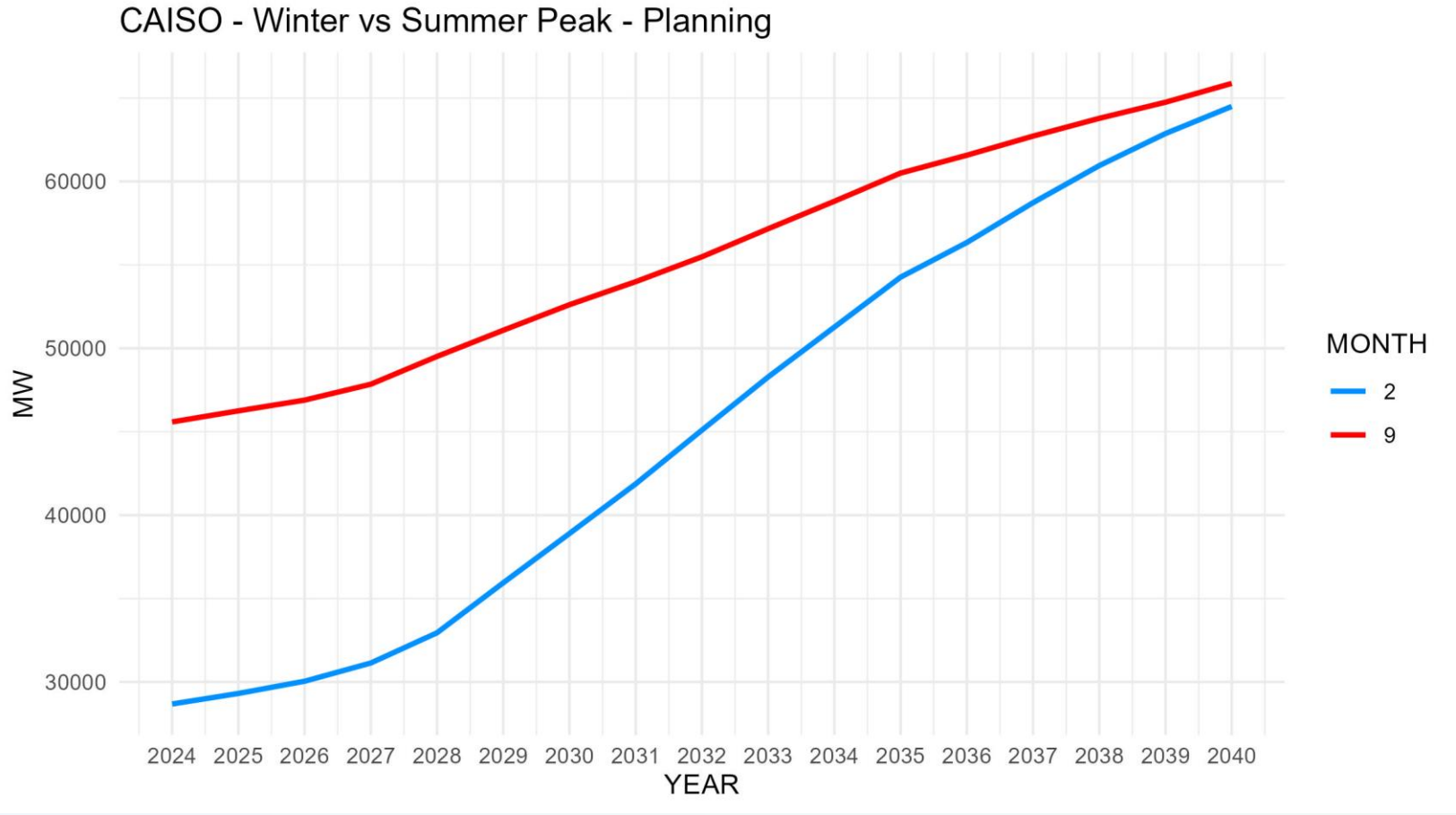




Source: CEC staff

All load growth categories have increased relative to last cycle. The largest increase in a single category comes from newly added data center load.

CAISO Winter Peak

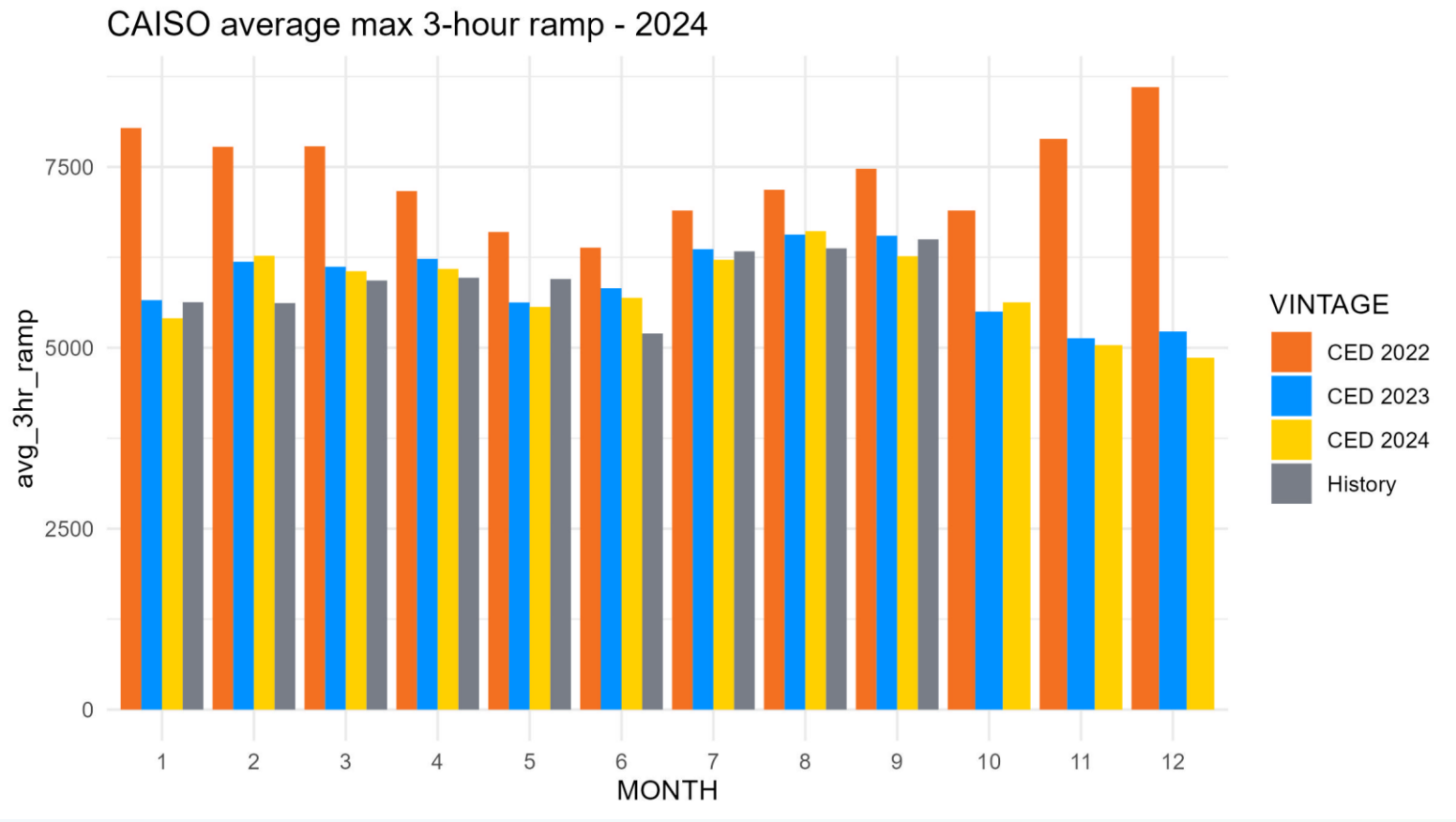


Source: CEC staff

Additional achievable fuel substitution adds substantial heating load to winter morning hours.

Fuel substitution impacts on the winter peak hour (February, hour 8) surpass 23,000 MW by 2040, causing winter peak loads to approach summer peak levels.

Maximum Three-hour Ramp



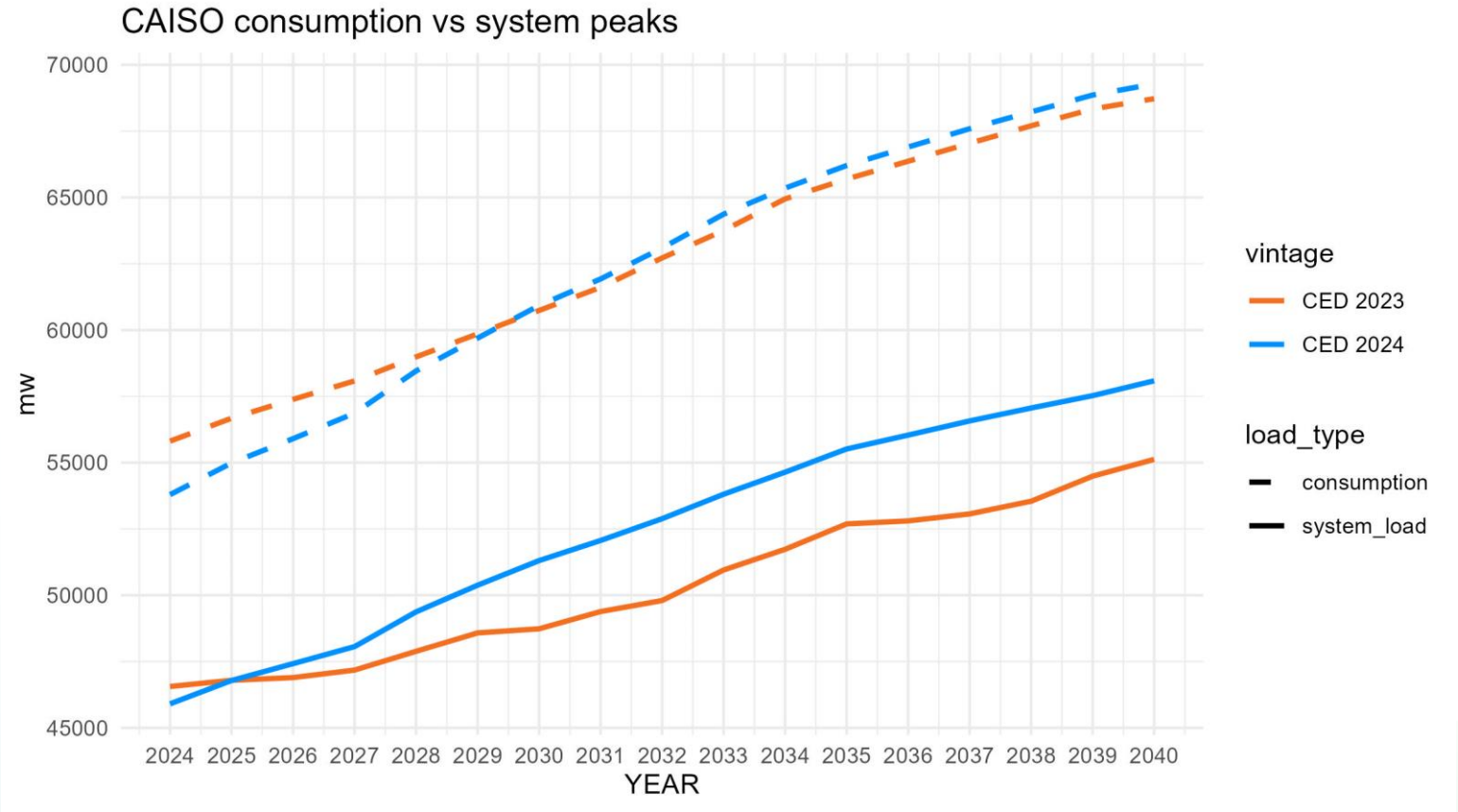
Source: CEC staff

- Max system ramps are an input to CAISO's Flexible RA study
- Chart compares max three-hour ramp from two CED vintages (forecast year 2024) against actuals-to-date for 2024
- Forecast ramps are reasonably aligned with observed levels

Consumption vs System Peak

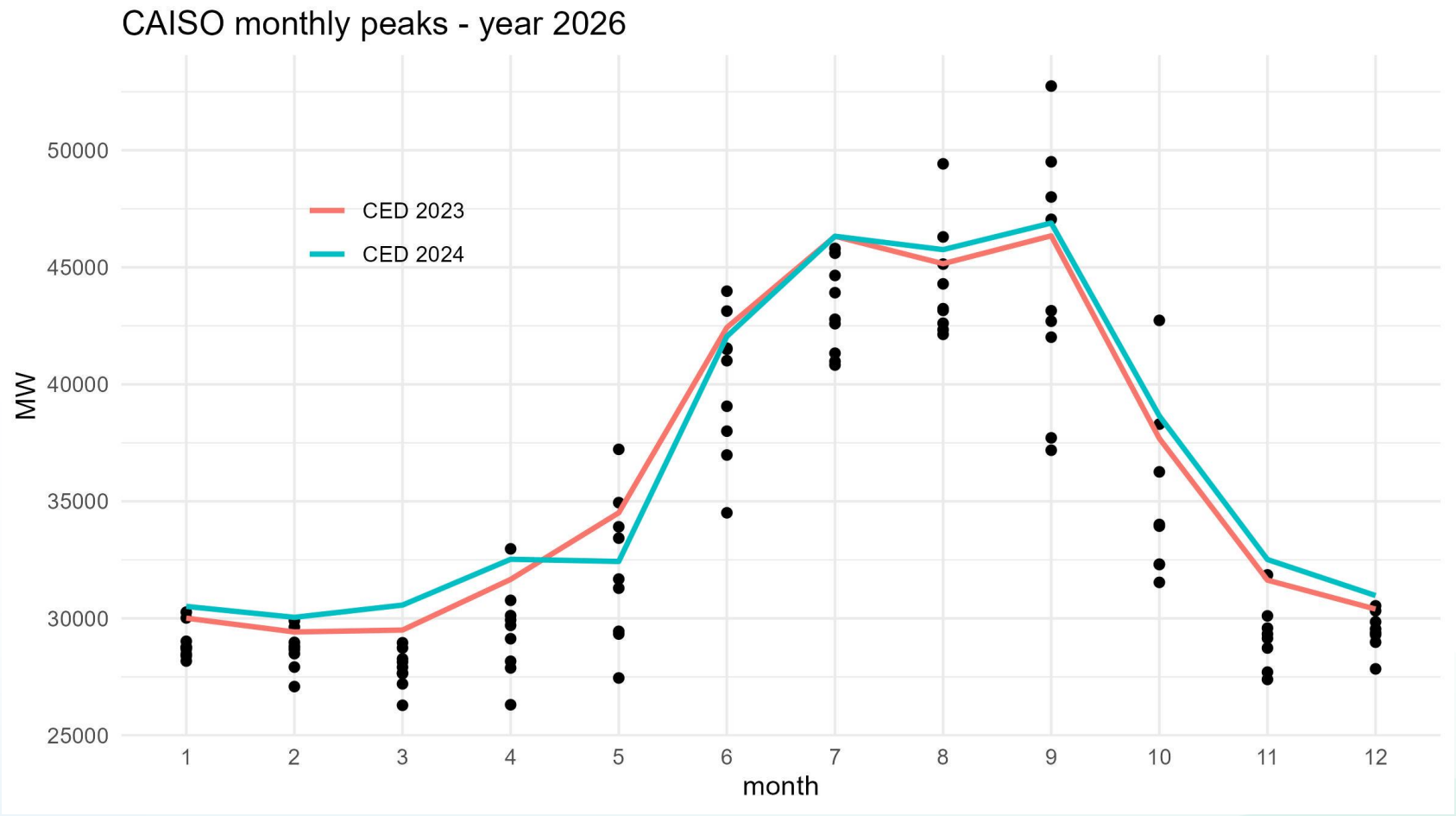
CPUC's modeling team expressed concern with the large delta between CED 2023 consumption and system peak forecasts

CED 2024 shows a smaller delta, primarily the result of reduced PV capacity factors



Source: CEC staff

CAISO Monthly Peaks



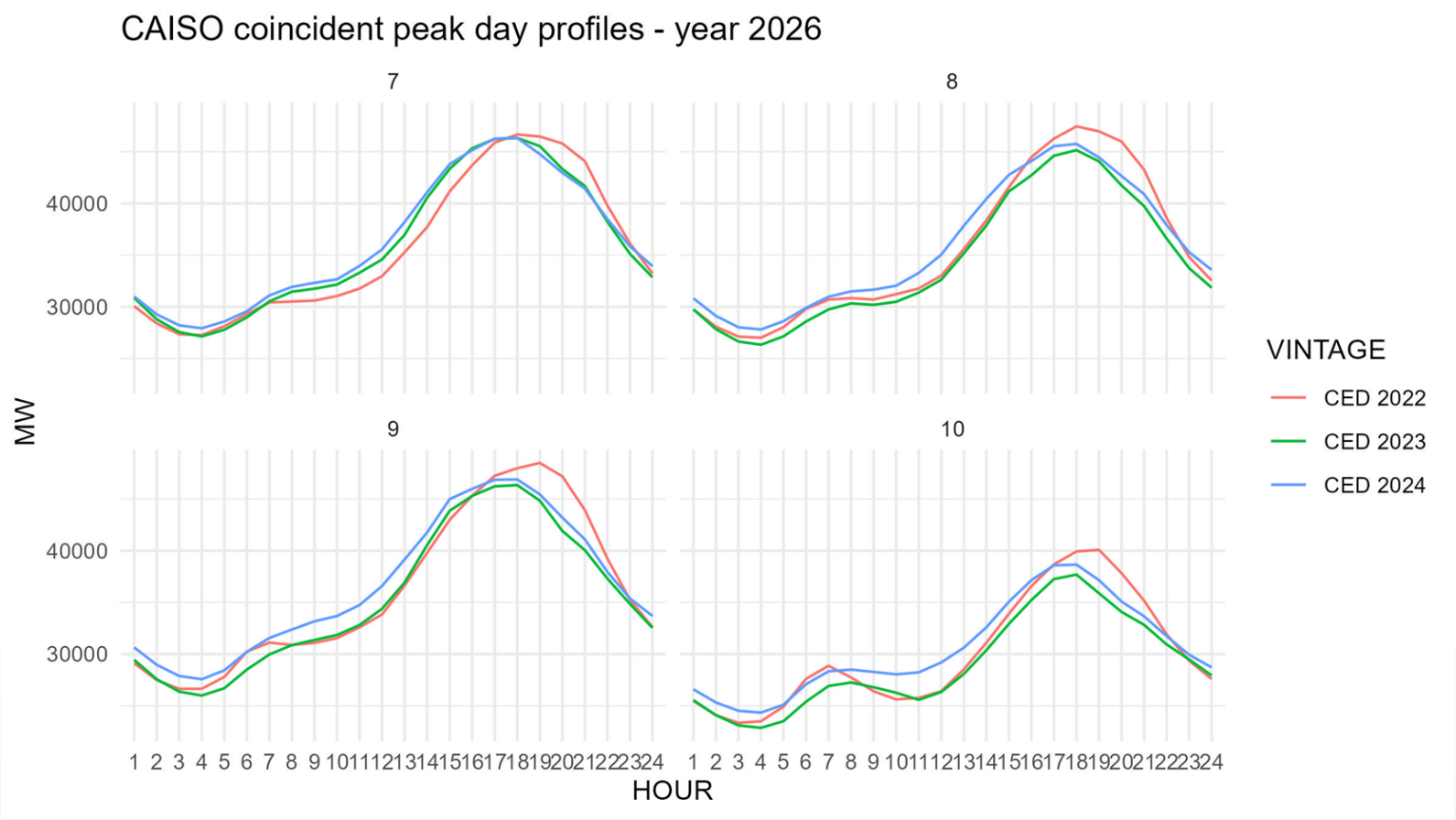
Source: CEC staff

Higher CED 2024 forecast leads to increases across most months

System peak falls in September rather than July

PG&E and SCE TACs peak in different parts of August

CAISO Peak Day Profiles - 2026



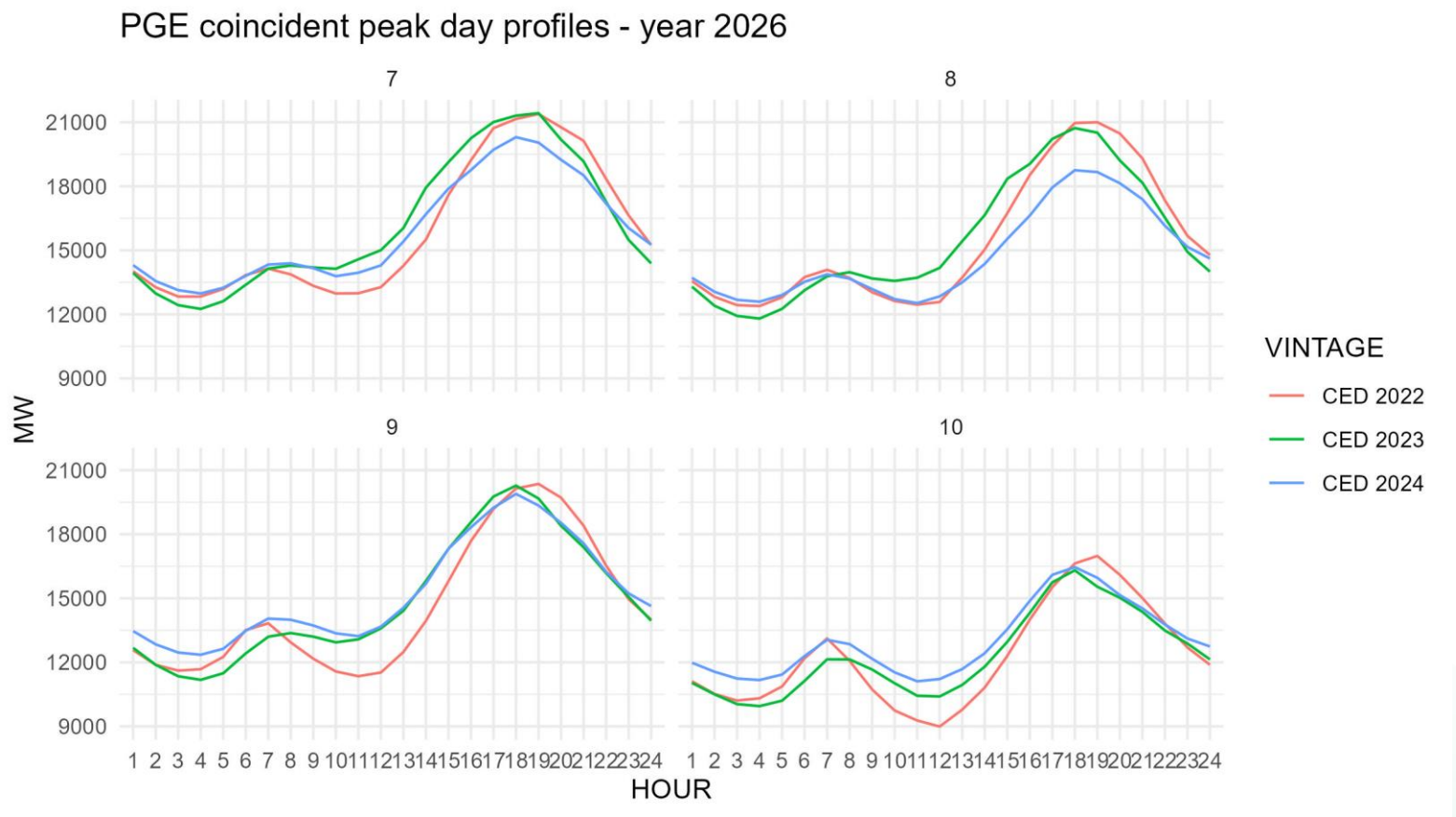
2026 monthly peaks generally higher relative to CED 2023

Other hours of the summer peak days see increased load in CED 2024

- Reduced PV
- Higher forecast
- Marginal PG&E calibration

Source: CEC staff

Monthly Coincident Peak Days PG&E - 2026

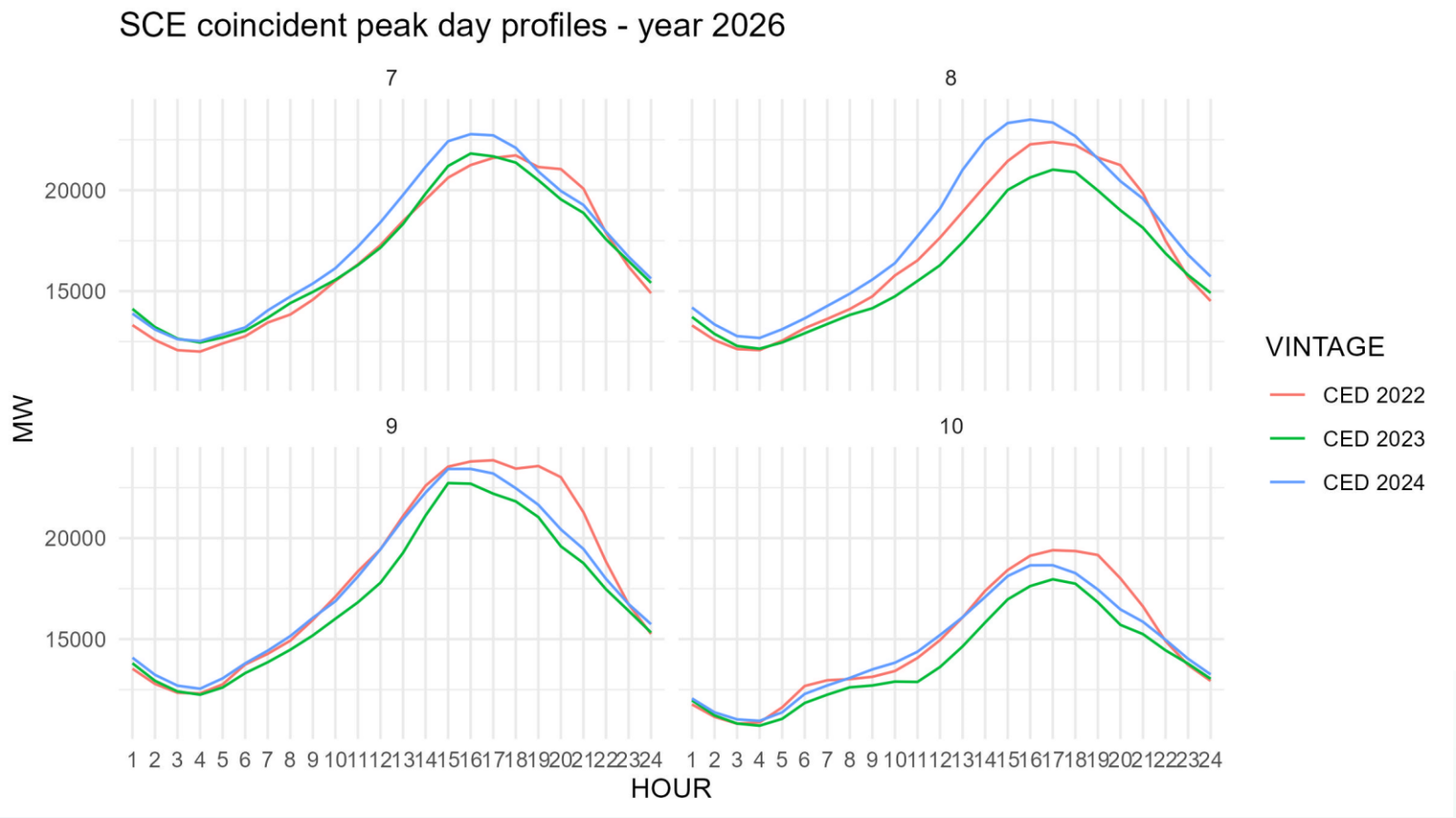


Source: CEC staff

Some changes to coincident peak day profiles are attributable to timing of revised consumption peak days

August peak driven by PG&E in CED 2023 but by SCE in CED 2024 profile

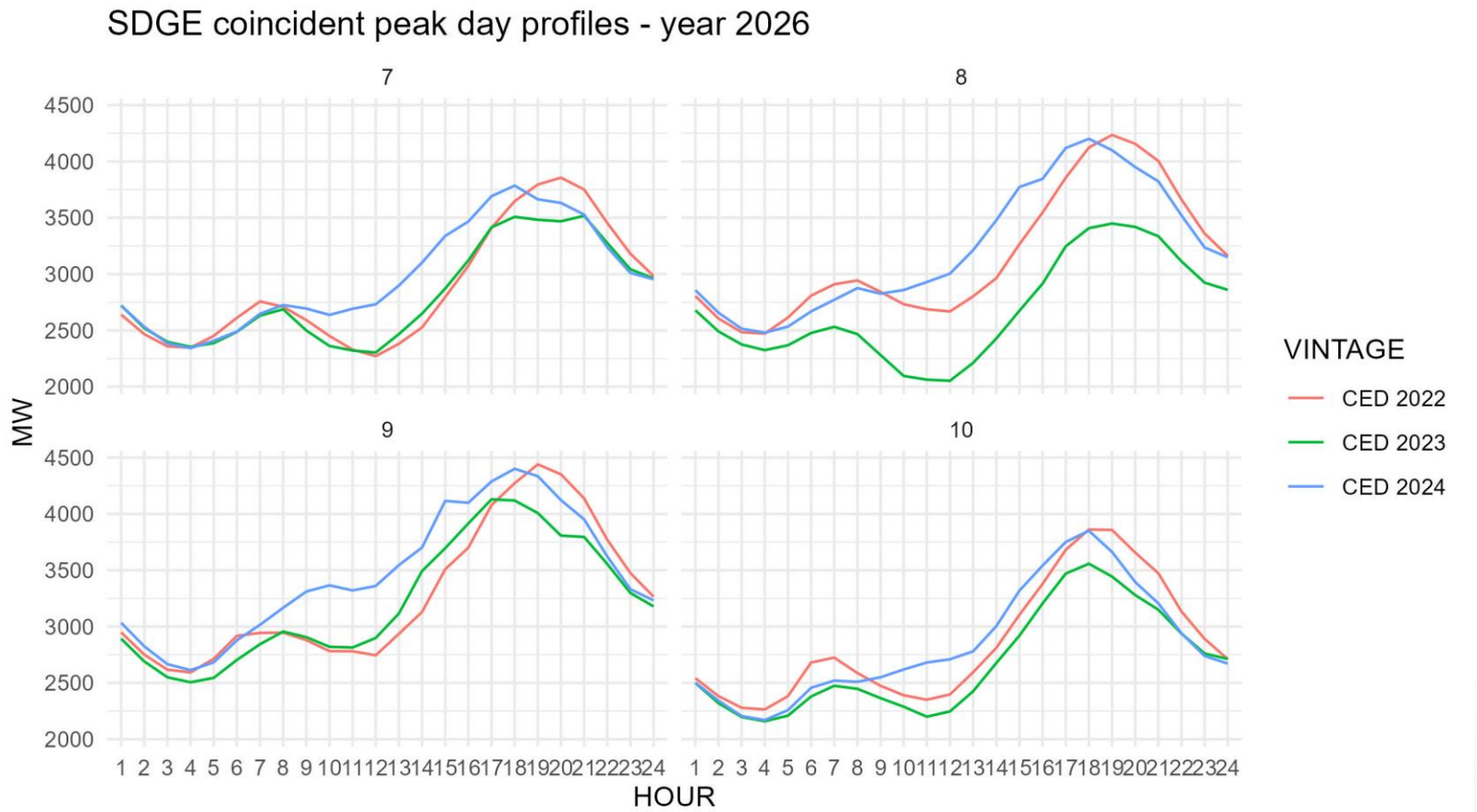
Monthly Coincident Peak Days SCE - 2026



Similarly, the change in timing of the CAISO August peak from early to late August leads to an increase in the coincident SCE TAC peak day profile

Source: CEC staff

Monthly Coincident Peak Days SDG&E - 2026



Source: CEC staff

CED 2023 showed remarkably low coincidence for the SDG&E August peak

Revised CED 2024 profiles show more reasonable coincidence with SCE/CAISO and consequently a higher peak-day profile

Questions