DOCKETED	
Docket Number:	24-IEPR-03
Project Title:	Electricity Demand Forecast
TN #:	258122
Document Title:	Presentation - Weather and Climate Data in Annual Electricity Consumption Models
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Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	7/29/2024 12:17:46 PM
Docketed Date:	7/29/2024

Weather and Climate Data in Annual Electricity Consumption Models

California Energy Demand Forecast

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Climate Change in Demand Forecast

- Understanding and incorporating future impacts of climate change on California's electricity and gas demand is critical
- Climate change uncertainty complicates the practice of using historical weather data to establish normal weather conditions
  - Transition to using climate projection data
- Treatment of climate change will continue to evolve alongside new climate modeling tools and datasets

Detrended Data Insights

- Increasing frequency of hot days, prolonged heat waves, and elevated number of warm months in the future (IEPR 2023)
- Increasing trend of number of days with maximum temperature exceeding 100^0F
- Increase in winter minimum temperature leading to less heating degree days

Climate Projection Data in Demand Forecast

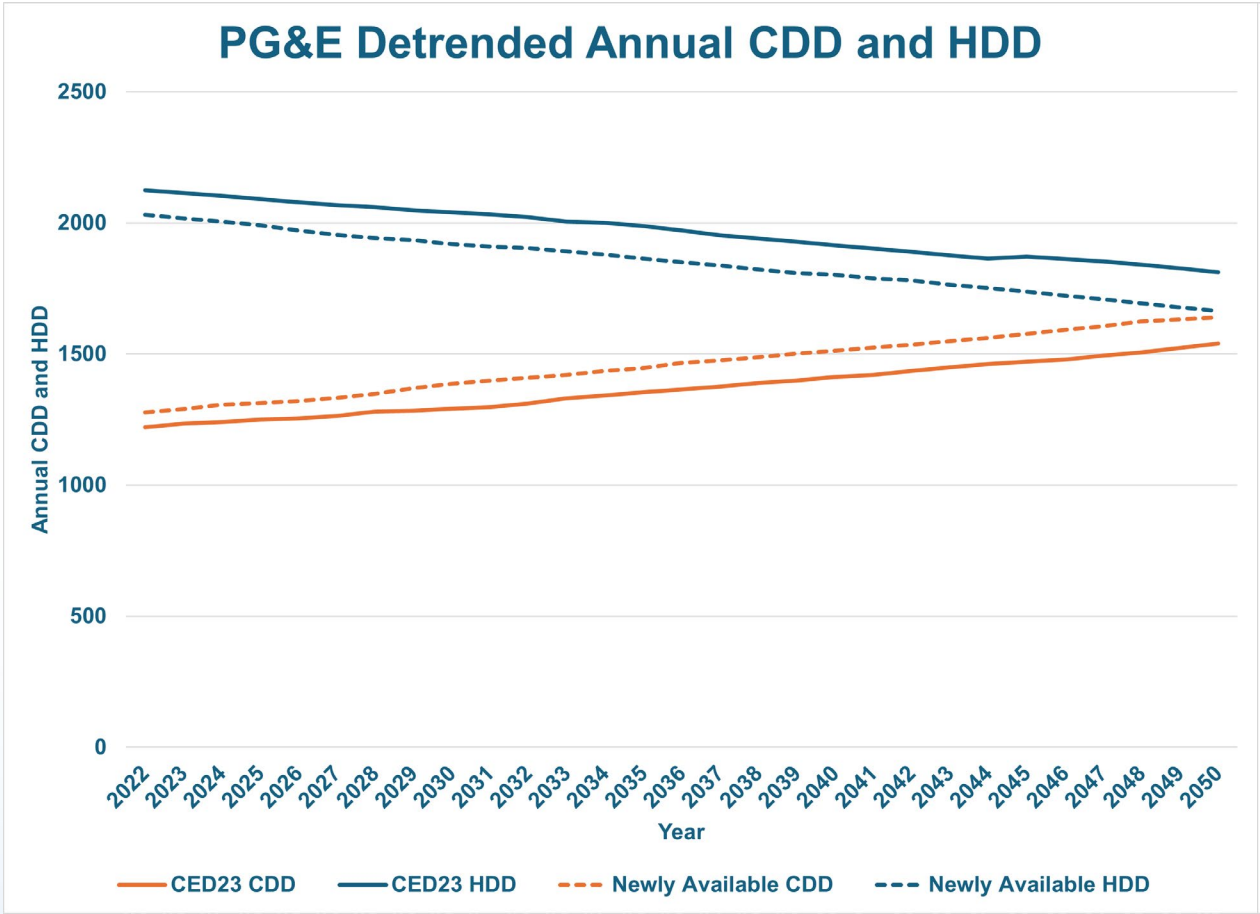
- The 2023 IEPR forecast used updated climate projections
- The updated climate projections included detrended temperature libraries for weather stations used in the forecast
- Data is aggregated to forecast zones (FZ) and planning area (PA) levels
- Detrended CDD and HDD were used to establish “normal” levels as well as long-run annual trends

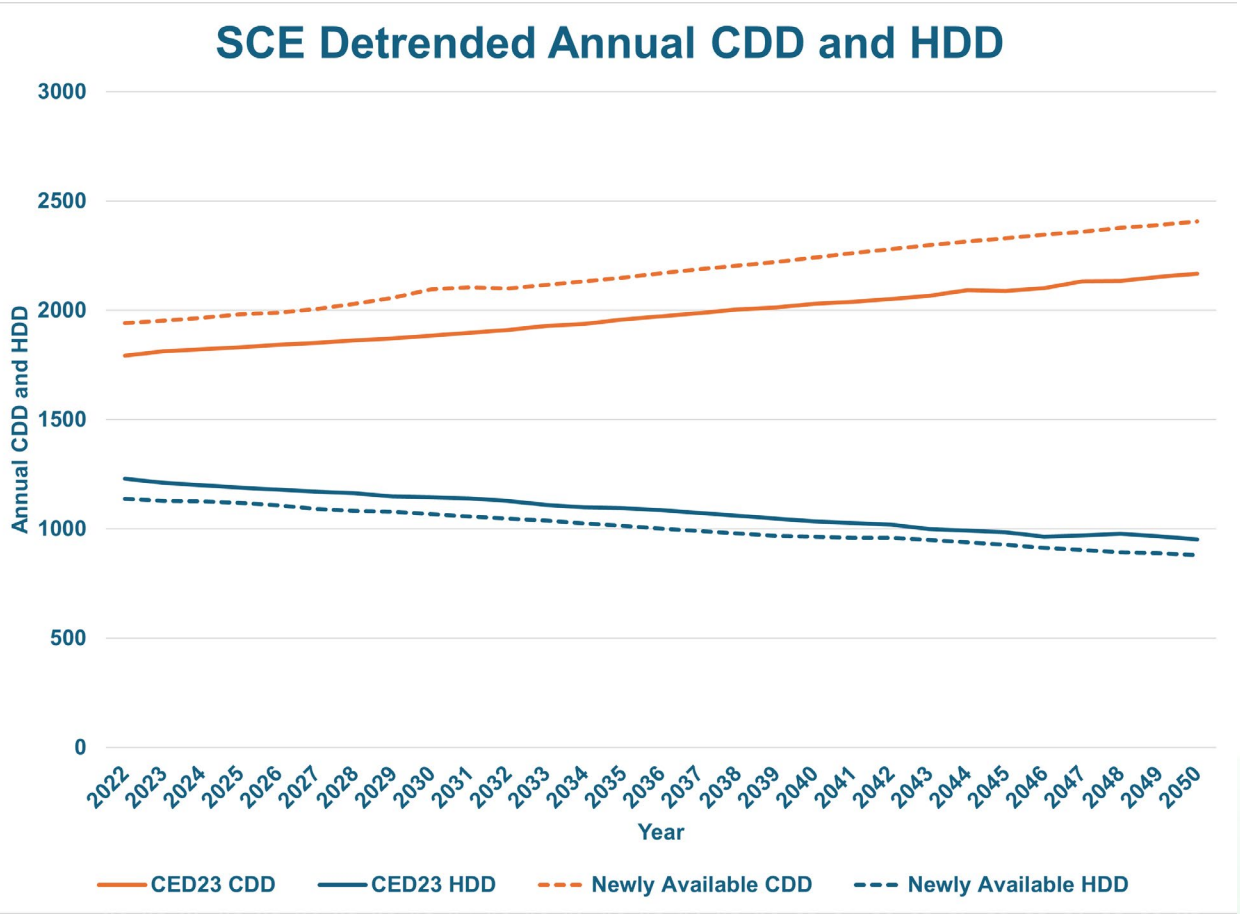
Climate Projection Data Source

The EPIC-funded **Cal-Adapt Analytics Engine** provided the large ensembles of climate model data using **statistical and dynamical downscaling** methods

WRF Models Available During CED 2023	Newly Available WRF Models
CESM2 r11i1p1f1	EC-Earth3 r1i1p1f1
CNRM-ESM2 r1i1p1f2	MIROC6 r1i1p1f1
EC-Earth3-Veg r1i1p1f1	MPI-ESM1-1-HR r3i1p1f1
FGOALS-g3 r1i1p1f1	TaiESM1 r11i1p1f1

PG&E & SCE Annual CDD & HDD





Source: CEC Staff

Econometric Sector Models

- CEC uses econometric models for residential and commercial sectors to estimate climate impacts on annual energy demand
- Econometric sector models incorporate weather and climate data seasonally for electricity (summer, winter) and gas (winter) forecasts
  - Residential model uses CDD and HDD
  - Commercial model uses only CDD

Overview of Method

- In CED 2023, CEC used the base-year value of the detrended CDD/HDD data sets
  - Departure from typical method of using 30 years weather history to establish "normal" levels
- Econometric sector models are run with "normal" levels and with the "climate impacted" scenario
- The delta between the runs establishes annual energy impacts of climate change for res space cooling, res space heating, and com cooling
- The models also run HDD/CDD levels observed in the base year, and the ratio of predicted consumption at observed vs normal levels is used to "weather-normalize" base year energy-consumption for those two weather-sensitive sectors

End-use Sector Models (Future Work)

- Residential end-use model was recently rebuilt
- Temperature-sensitive UECs assume normal weather
  - Functionality included for UECs to change over time in response to forecasted CDD/HDD scenarios
  - Currently turned off and res sector is modified with exogenous climate analysis
- Next steps: explore modeling climate directly with the res model and compare results to existing approach, but not for adoption this cycle

Thank You!