California Energy Commission

Title: Data Center Load Forecasts, 2024 - 2040

Presenter: Jenny Chen, Taylor Harms, Energy Assessment Division

Date: 10/21/2024

Agenda

1. Data received and methodology
2. Forecasts for two scenarios

Definitions

- **Annual Load Factor**
  - Total consumption (kWh) throughout the year ÷ (peak load * 8760 hours)
- **Average Demand / Load**
  - Load averaged over 8760 hours of the year
- **Installed Capacity/Nameplate Capacity**
  - Full load of the facility
- **Method of Service (MOS) Study**
  - Type of service that utilities provide to new and existing customers requesting to connect load at 66 kV or higher. It addresses all technical requirements of the customer facility.
- **Peak Demand / Load**
  - Highest level of power consumption experienced by the system during a specific timeframe (“max demand”)
- **Power Usage Effectiveness (PUE)**
  - Ratio of total facility source energy (including IT source energy such as servers) to IT source energy. The closer the PUE is to 1.0, the more efficient the server facility.
  - (e.g.,) PUE of 1.25 means that the facility must draw 5 MW of electricity for each 4 MW of power consumed by servers.
- **Utilization Factor (UF)**
  - Percentage of installed or nameplate capacity at which data center operates, based on historical AMI data

Assumptions

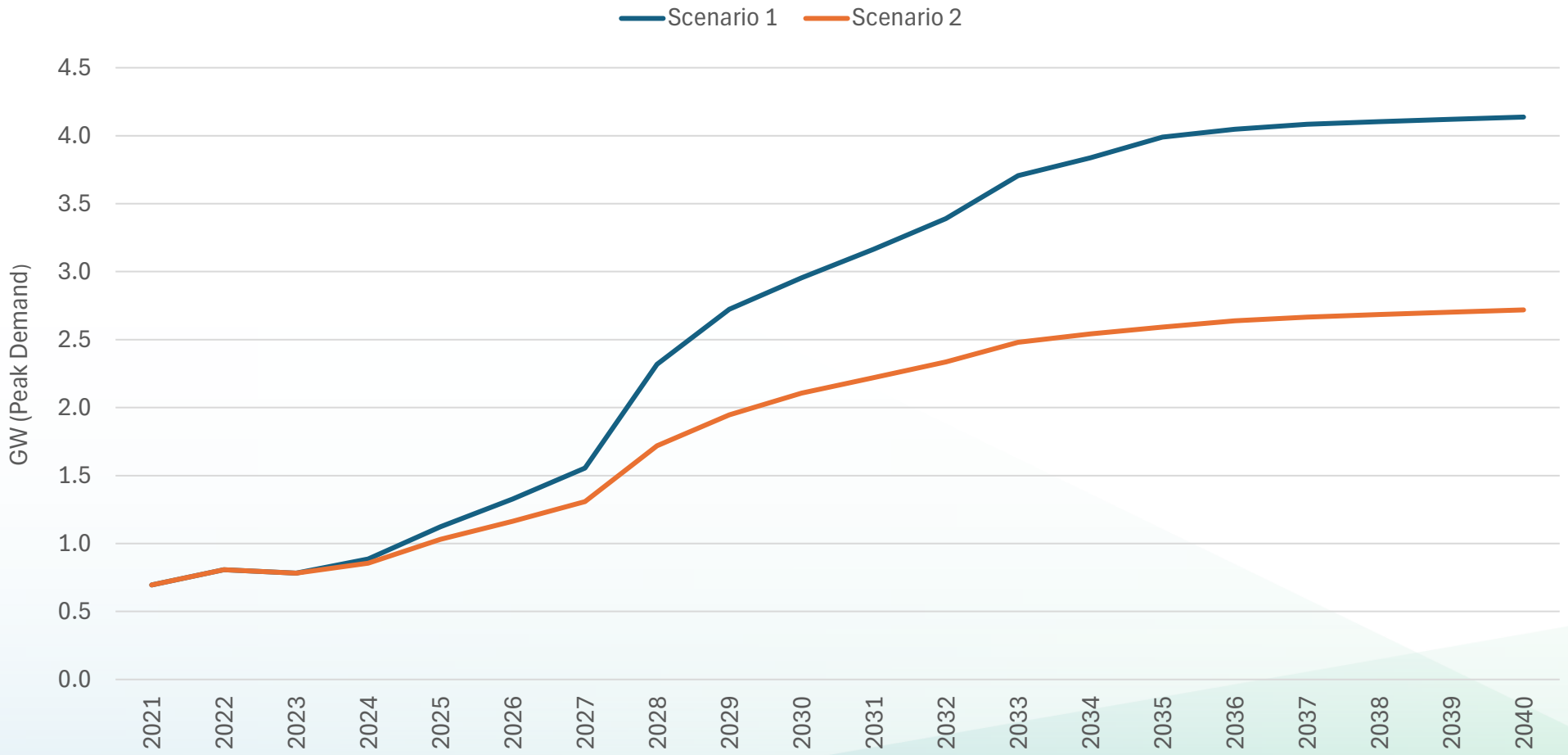
Scenario 1:

- Includes all projected data-center projects and known loads.
- For both scenarios 1 and 2, apply ramp rate of 149% annually, until estimated peak load of projected facility is reached.

Scenario 2:

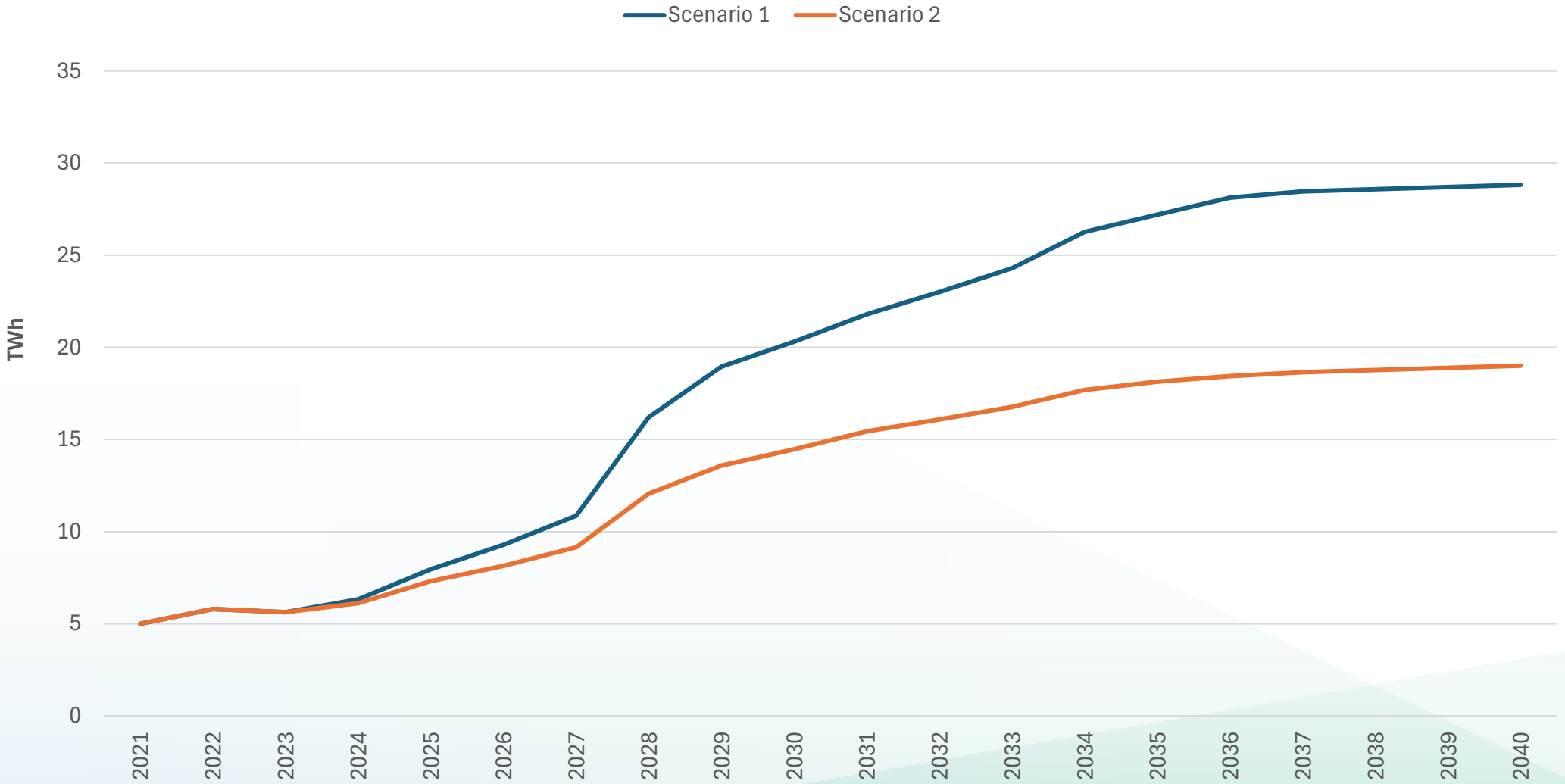
- All reported projects and known loads are accounted for, **except**:
  1. 50% of PG&E projected incremental capacity over 2025 – 2037,
  2. Pre-MOS projects in SCE territory,
  3. One project application in City of San Jose.

Peak Demand – Scenarios 1 and 2



Source: CEC Staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

Consumption – Scenarios 1 and 2



Source: CEC Staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

Data Received & Methodology

Data Received and Methods

Estimated Peak Load, using Assumptions from Existing Data Centers

SCE	• Peak demand of planned data centers to be served at the distribution-level from 2024 - 2028, • Installed capacity of planned data centers at the sub-transmission level
PG&E	• Projections of incremental installed capacity from 2025 – 2037, based on customer-provided ramping schedule
City of San Jose	• Received start dates and total capacity for potential data center projects.

Utility-provided Data

SVP	• Annual peak demand for SVP system under 1-in-2 weather scenario. • Broke out peak demand for data centers.
City of Palo Alto	• Annual peak demand for City of Palo Alto system under 1-in-2 weather scenario. • Broke out peak demand for data centers.

Estimating Peak Load of Data Centers

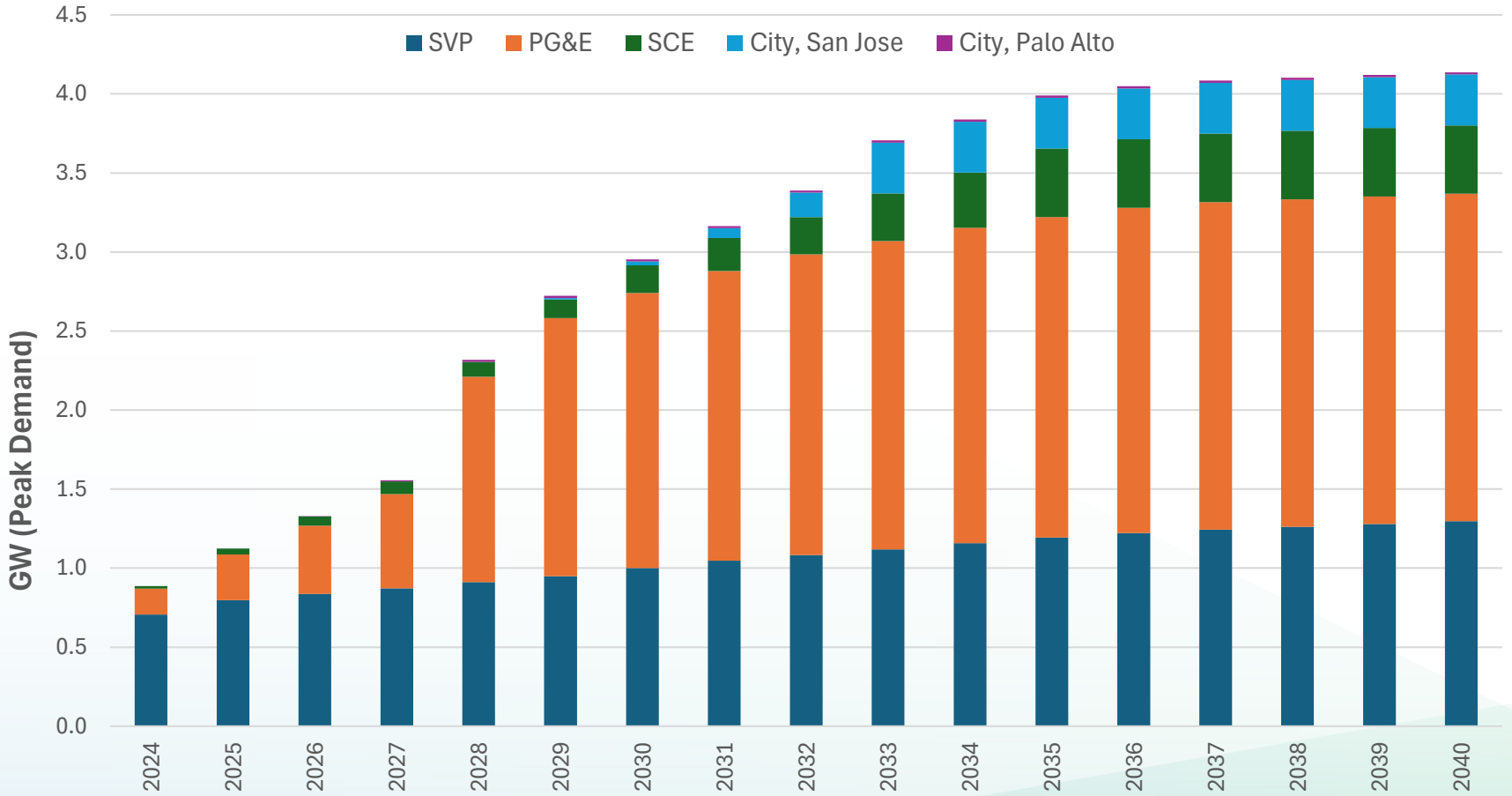
Based on historical load of 60+ data centers in SVP territory:

1. **Demand of either new or existing project requests assumed to be 5.0 MW in Year 0,**
2. **Year-0 demand ramped up year over year (YoY) 149% from Year 0 – 5; 113% from Year 6 – 10.**
3. **Peak load of data center: ~67% of nameplate capacity**
4. **Efficient data centers have relatively similar total facility source energy to IT source energy**
    - Power Usage Effectiveness (PUE) ~1.2

Example:
Data Center Peak Load Estimate (MW) = IT load or installed capacity (MW) * UF of 67% * PUE

Source: Silicon Valley Power (SVP). Data Center Load Estimation Data & Methods. SVP Engineering Division. Sep 11, 2024.

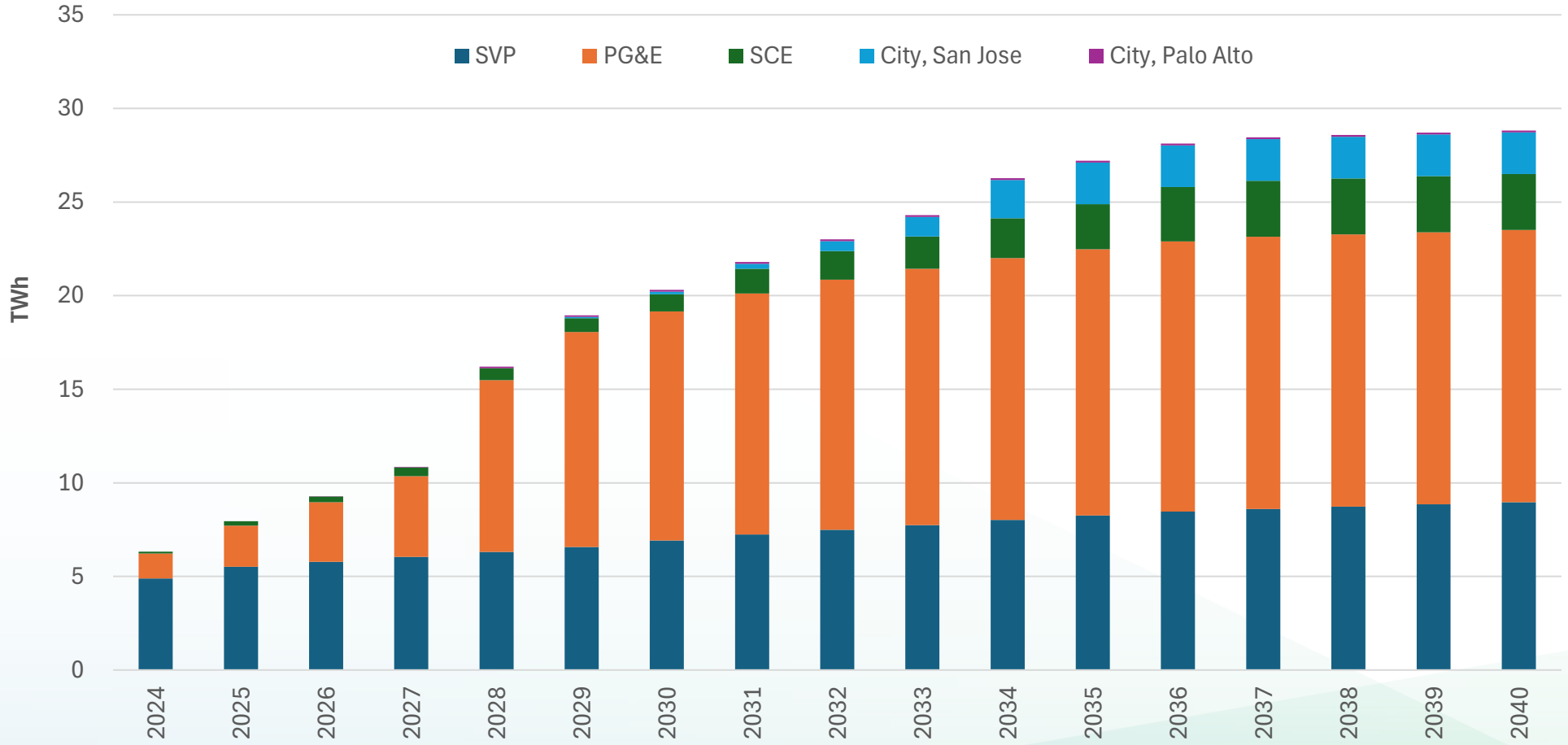
Peak Data Center Demand (Scenario 1):



Annual Average Growth Rate, 2024 – 2040: 11%

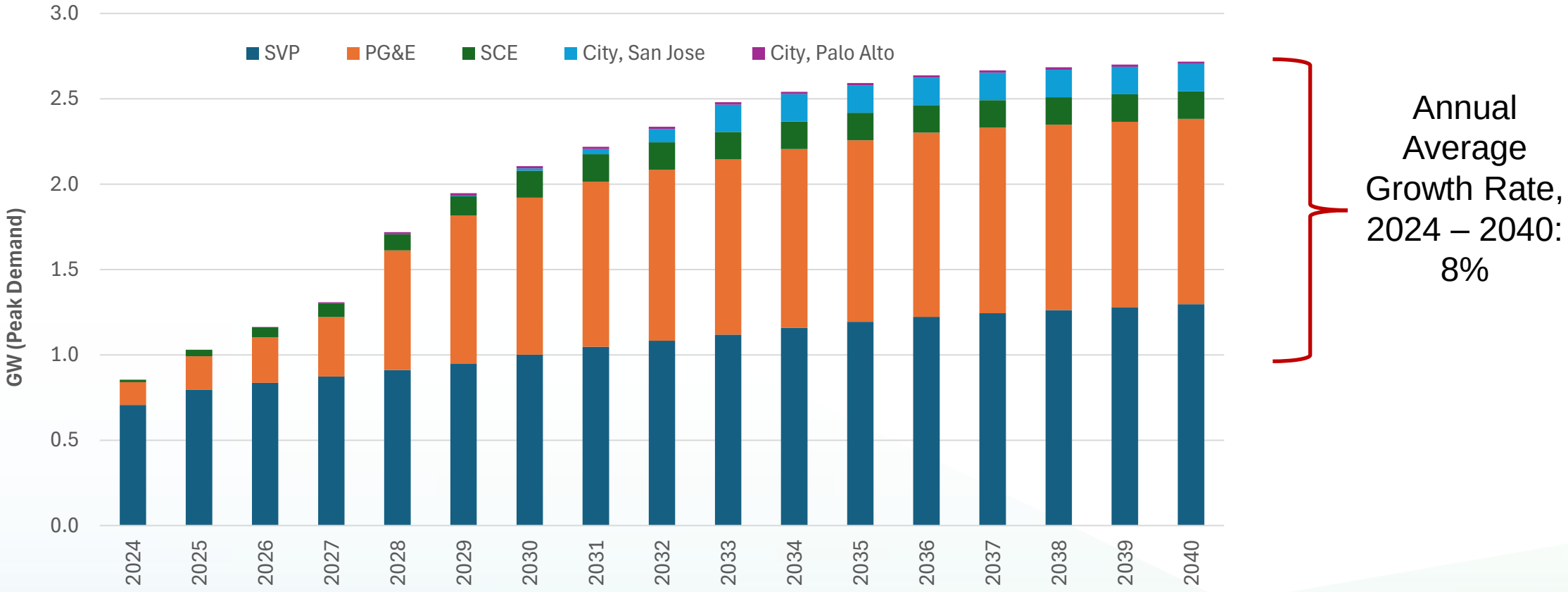
Source: CEC staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

Annual Consumption (Scenario 1):



Source: CEC staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

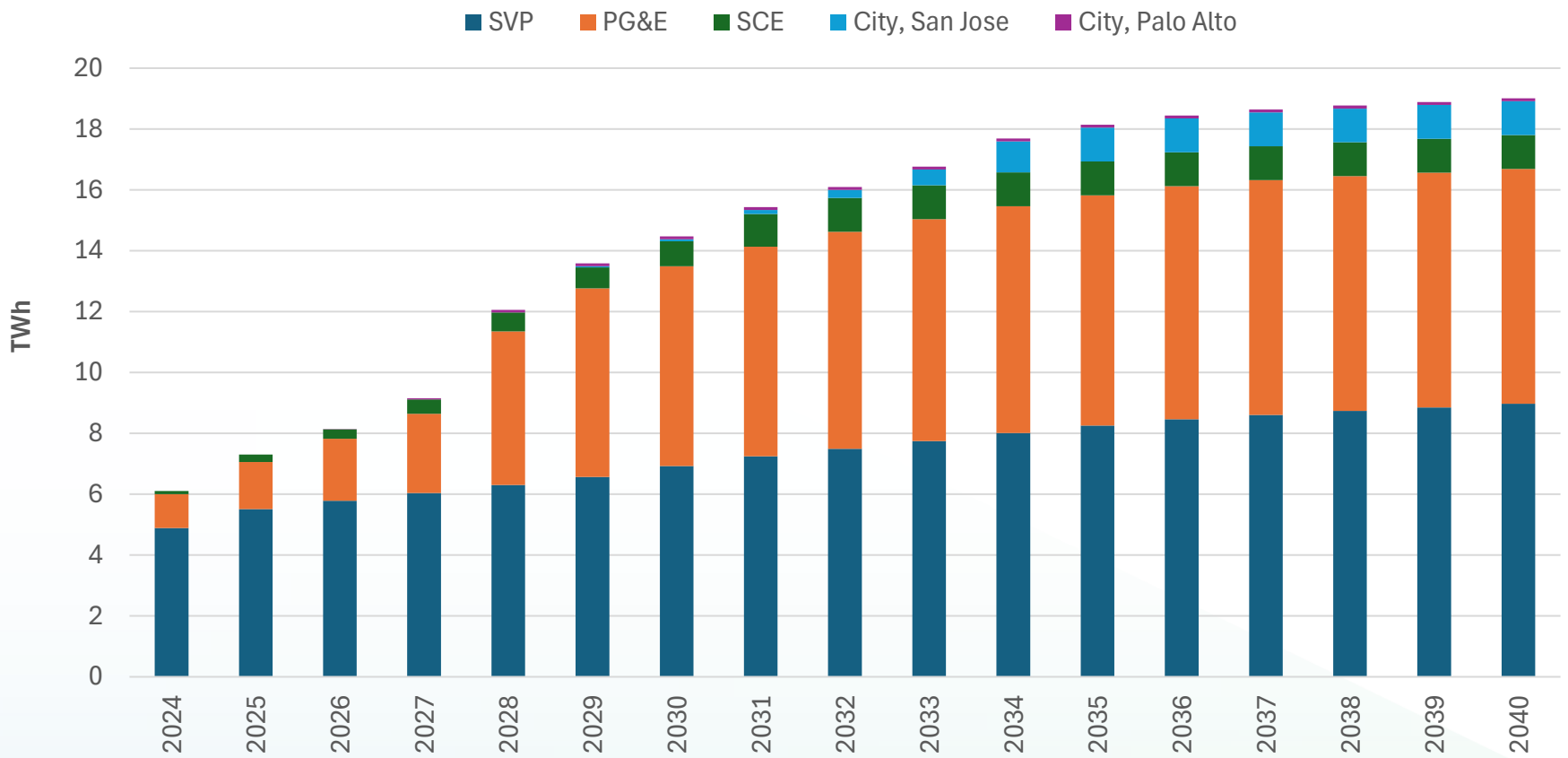
Peak Data Center Demand (Scenario 2):



All reported projects and known loads are accounted for, **except**: (1) 50% of PG&E projected incremental capacity over 2025 – 2037, (2) pre-MOS projects in SCE territory, (3) one reported project in City of San Jose.

Source: CEC staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

Annual Consumption (Scenario 2):



All reported projects and known loads are accounted for, **except**: (1) 50% of PG&E projected incremental capacity over 2025 – 2037, (2) pre-MOS projects in SCE territory, (3) one reported project in City of San Jose.

Source: CEC staff (with data inputs from PG&E, Palo Alto, SVP, San Jose, SCE)

Sources for Benchmarking

- "US data center demand is forecast to grow by some **10 percent** a year until 2030."
  - **Source:** McKinsey & Co. *Investing in the rising data center economy*. Exhibit 1. Jan 17, 2023.

- "PG&E currently has ~2,300 MW of applications for data center capacity (as of Oct 2024).
  - **Source:** Nelli, Daniel, et al. "Forecasting Electric System Impacts of New Large Loads: Challenges and Opportunities." Slide 2 (Key Messages). May 16, 2024.

- Range of projections for new US data center load growth: **approximately 9 – 16%**
  - **Source:** Energy + Environmental Economics (E3). Figure ES-2. "Load Growth is Here to Stay, but Are Data Centers?" Page 2. July 2024.

Estimating Average Load Data Centers

Based on historical load of 60+ data centers in SVP territory:

1. **Demand of either new or existing project requests assumed to be 5.0 MW in Year 0,**
2. **Year-0 demand ramped up year over year (YoY) 149% from Year 0 – 5; 113% from Year 6 – 10.**
3. **Peak load of DC: ~67% of nameplate capacity**
4. **Efficient data centers have relatively similar total facility source energy to IT source energy**
    - Power Usage Effectiveness (PUE) ~1.2
5. **Multiply estimated peak demand by load factor (LF) of 79% to derive average load.**

Example:
Data Center Average Load Estimate (MW) = IT Load (MW) * UF of 67% * PUE * Annual LF

Source: Silicon Valley Power (SVP). Data Center Load Estimation Data & Methods. SVP Engineering Division. Sep 11, 2024.

Questions for Stakeholder Feedback

- Power Usage Effectiveness (PUE): Currently using 1.2. Should it be higher for planned data centers in SCE territory? If so, how much higher?
- How likely are projections to be realized, given current and future rate environments?
- Are there other utilities with growing data-center load that should be considered?
- Which scenario is more reflective of future data center load? Please provide your justifications.

Q and A