# Power Supply Loading Analysis and Low-Load Testing Proposal

## Presented to ENERGY STAR®

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PG&E

SOUTHERN CALIFORNIA EDISON
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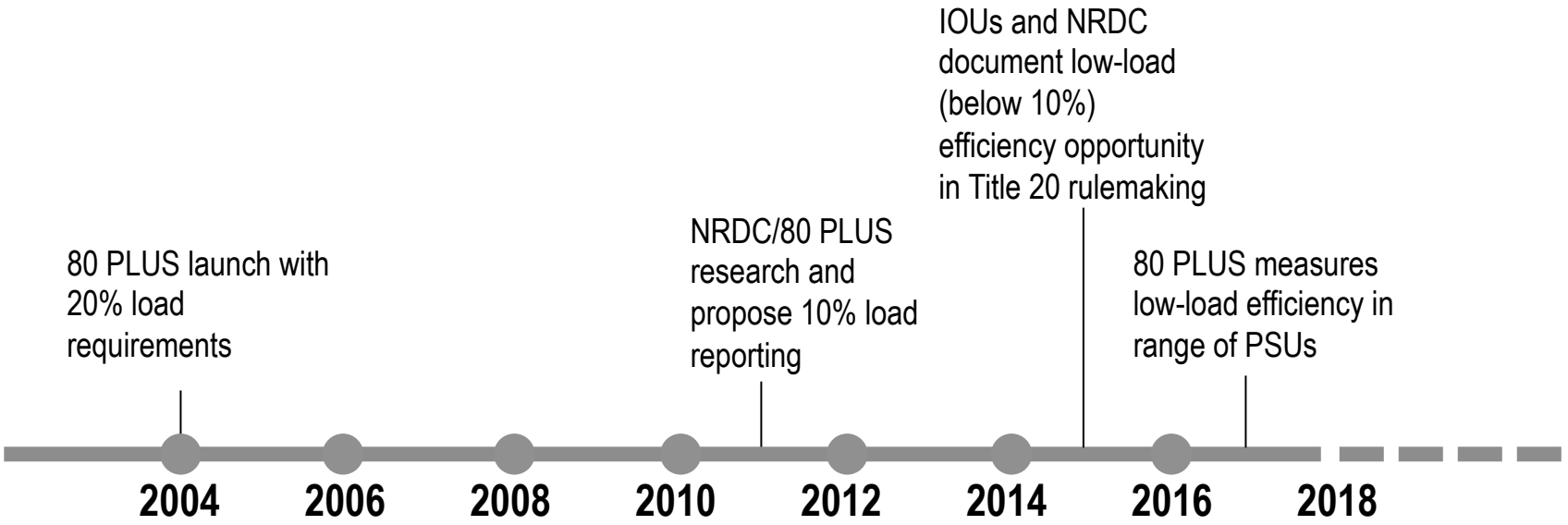
# Objectives

1. Recap power supply loading concerns
2. Present IOU power supply loading analysis
3. Discuss IOU proposal for new PSU testing and reporting requirements

# A Brief History of Power Supply Loading




**ENERGY STAR milestones**

20% efficiency requirements

Efficiency incentives, including 10% load

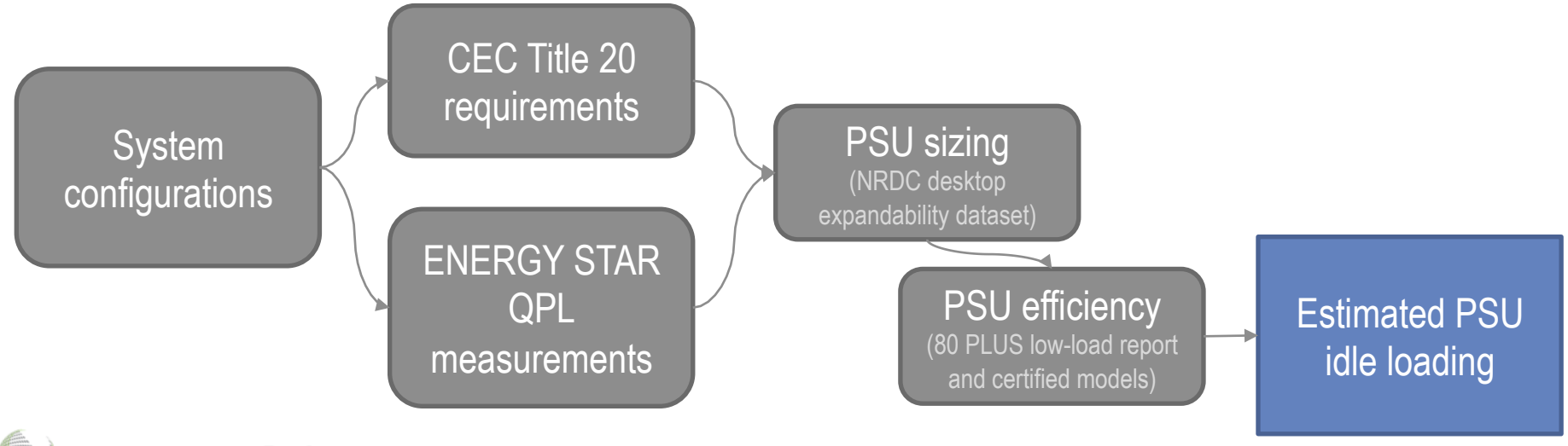
# What We Know Now

- PSU efficiency is key criteria to meet future efficiency specifications and regulations
- Desktop computers can idle at very low load fractions (below 10%) due to PSU sizing
- Efficiency varies widely in this load range and does not correlate to badge/rating

BUT we lack consensus on which load point(s) should be used to characterize efficiency at low load levels.

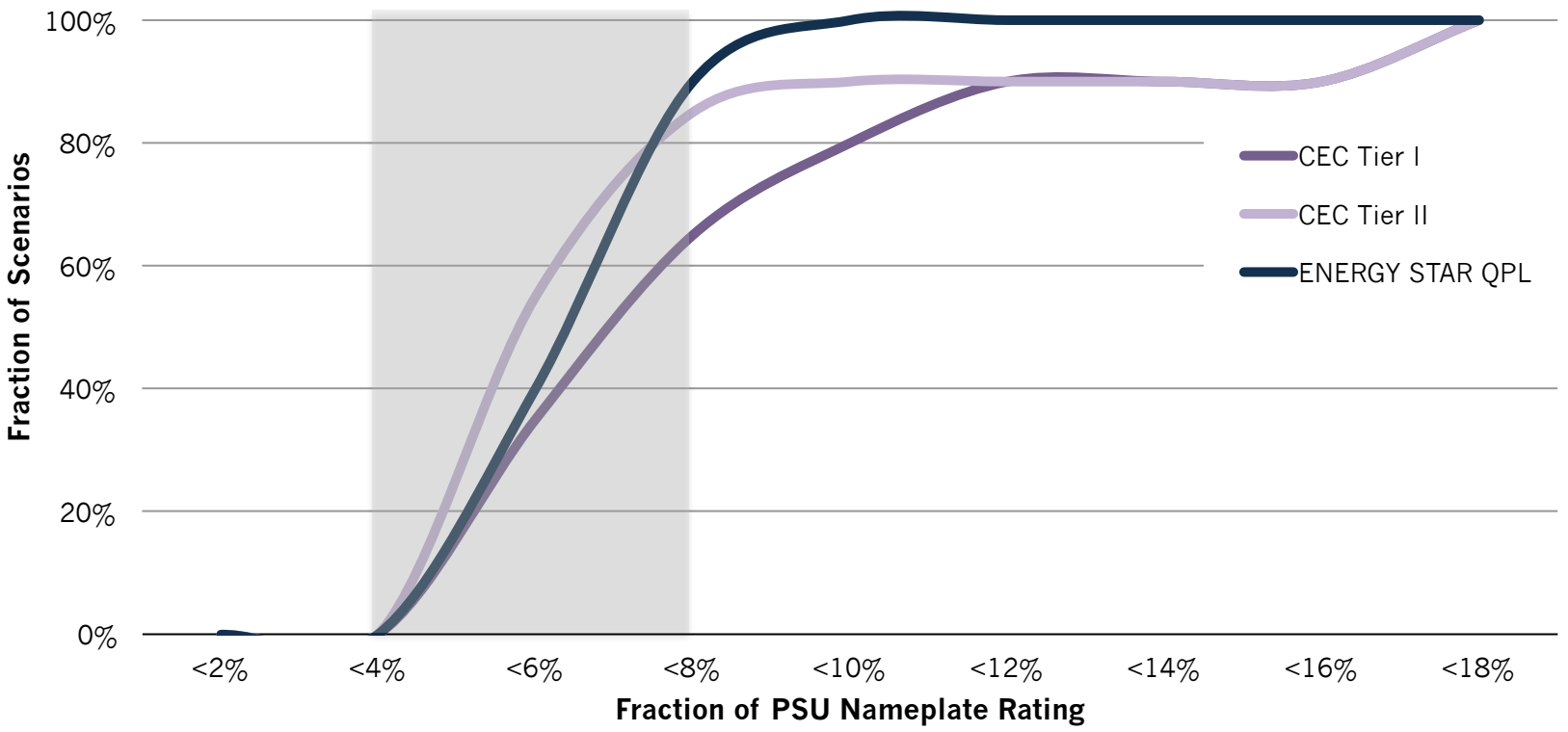
# Estimating Desktop PSU Idle Load Fraction

- Examined idle loading with 2 approaches:
  - Retrospective: based on ENERGY STAR measured data
  - Prospective: using CEC regulation targets
- Estimated idle load across range of desktop performance and categories
- Used power supply sizing and measured efficiency curves to iteratively arrive at load fraction estimate

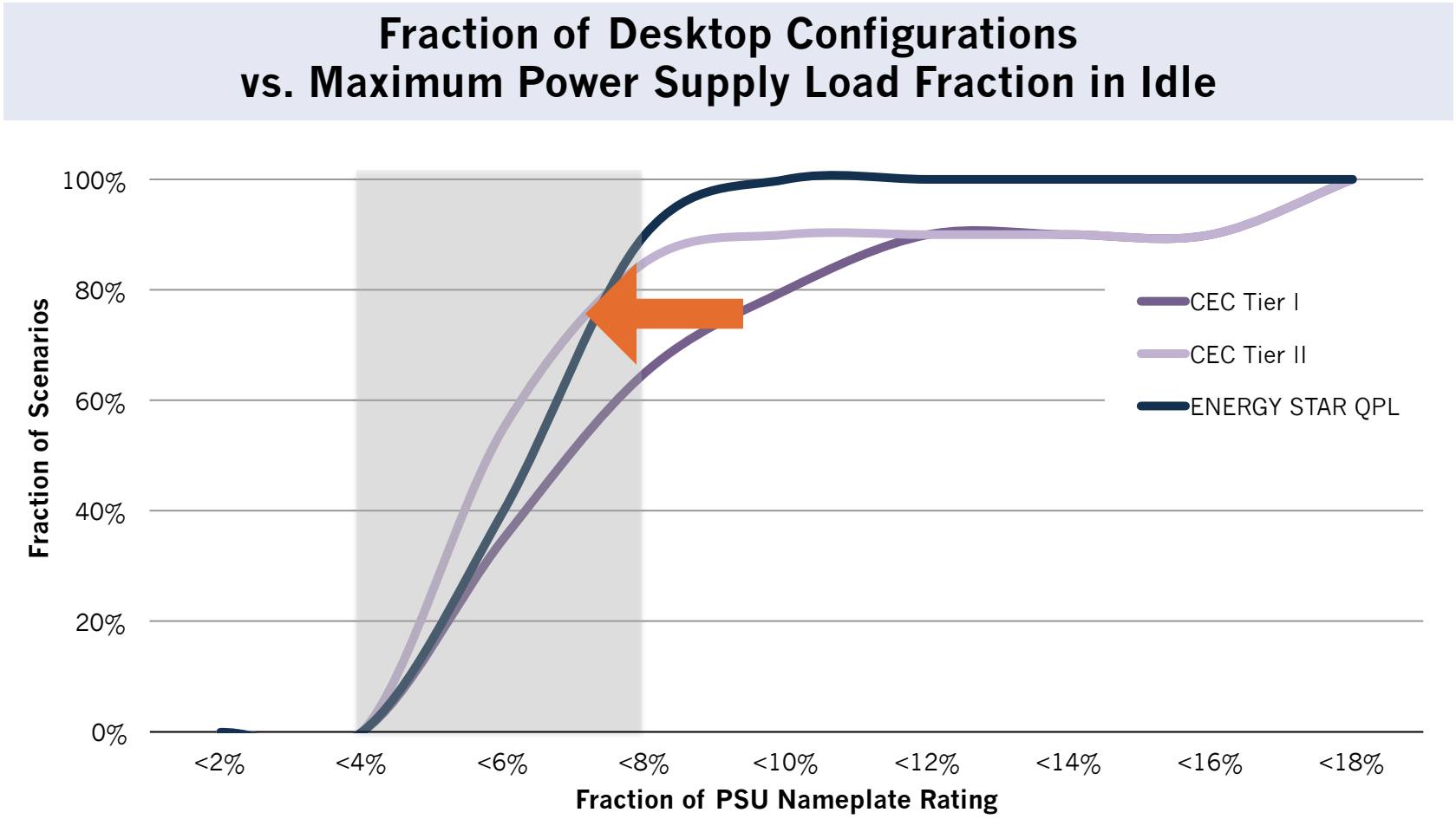


# Most Systems Expected to Idle in 4-8% Range

## Fraction of Desktop Configurations vs. Maximum Power Supply Load Fraction in Idle



# Future Regulations Will Push More Systems to Lower Load Points



# IOU Power Supply Low-Load Proposal

## ENERGY STAR v8 Revisions

- Measure and report following quantities at 5% and 10% load conditions:
  - $I_{dc}$, $V_{dc}$, $P_{dc}$
  - $I_{ac,rms}$, $V_{ac,rms}$, $P_{ac,true}$, PF, $I_{THD}$

## Long-Term Research Needs

- Document actual idle load fraction in representative systems
- Continue to evaluate energy savings opportunities through improved PSU low-load efficiency and architecture

# Industry Input

- Which efficiency load points are most informative for hardware designers moving forward?

- Are there trends in system design, duty cycle, or power supply topology that we should consider?

# ENERGY STAR Power Supply Loading Scenarios

| | | | Conventional Duty Cycle | Full Network Connectivity Duty Cycle |
|---|---|---|---|---|
| System Type | Assumed PSU Nameplate Size (W) | Assumed PSU Rating | Estimated Idle Load Fraction (%) | Estimated Idle Load Fraction (%) |
| I1 | 180 | Gold | 8% | 8% |
| I2 | 280 | Gold | 7% | 7% |
| I3 | 350 | Gold | 7% | 7% |
| D1 | 460 | Gold | 6% | 6% |
| D2 | 500 | Gold | 4% | 4% |

# CEC Power Supply Loading Scenarios

## Tier I (2019)

| System Type | Assumed PSU Nameplate Size (W) | Assumed PSU Rating | Conventional Duty Cycle Estimated Idle Load Fraction (%) | Full Network Connectivity Duty Cycle Estimated Idle Load Fraction (%) |
|---|---|---|---|---|
| **<250 Expandability** | | | | |
| w/o dGfx | 190 | Bronze | 4% | 6% |
| w/ dGfx | 250 | Bronze | 5% | 7% |
| **250-425 Expandability** | | | | |
| w/o dGfx | 220 | Bronze | 6% | 8% |
| w/ dGfx | 250 | Bronze | 8% | 12% |
| **425-690 Expandability** | | | | |
| w/o dGfx | 380 | Bronze | 6% | 9% |
| w/ dGfx | 500 | Bronze | 7% | 10% |
| **High Expandability Systems** | | | | |
| Low | 750 | Gold | 4% | 4% |
| High | 1300 | Gold | 4% | 4% |
| **Workstations** | | | | |
| Low | 210 | Gold | 7% | 7% |
| High | 557 | Gold | 17% | 17% |

## Tier II (2021)

| System Type | Assumed PSU Nameplate Size (W) | Assumed PSU Rating | Conventional Duty Cycle Estimated Idle Load Fraction (%) | Full Network Connectivity Duty Cycle Estimated Idle Load Fraction (%) |
|---|---|---|---|---|
| **<250 Expandability** | | | | |
| w/o dGfx | 190 | Bronze | 4% | 6% |
| w/ dGfx | 250 | Bronze | 4% | 6% |
| **250-425 Expandability** | | | | |
| w/o dGfx | 220 | Bronze | 5% | 6% |
| w/ dGfx | 250 | Bronze | 6% | 8% |
| **425-690 Expandability** | | | | |
| w/o dGfx | 380 | Bronze | 5% | 7% |
| w/ dGfx | 500 | Bronze | 5% | 7% |
| **High Expandability Systems** | | | | |
| Low | 750 | Gold | 4% | 4% |
| High | 1300 | Gold | 4% | 4% |
| **Workstations** | 0 | | | |
| Low | 210 | Gold | 7% | 7% |
| High | 557 | Gold | 17% | 17% |