FIRST WORKSHOP PRESENTATION · JUNE 9, 2026

AB 825 Jobs Assessment

PREPARED FOR

The California Independent System Operator

PREPARED BY

David Roland-Holst
Sam Heft-Neal
Drew Behnke
Jonathan Chang

BEAR
BERKELEY ECONOMIC ADVISING AND RESEARCH

Today's Agenda

1
INTRODUCTION

Project Background & Scope

Motivation, CGE model design, and project schedule

2
BASELINE JOBS

Employment by Generation Technology

Fleet inventory, O&M workforce, wages, and construction intensity

3
ECONOMIC MODEL

Gravity Model Methodology

Bilateral pairwise specification, general performance statistics

4
2040 FORECAST

Two-Stage Forecasting Pipeline

ARDL capacity + gravity-model share allocation

5
UNCERTAINTY

Monte Carlo Risk Framework

6 stochastic layers, 5,000 runs, Wilson 95% confidence intervals

SECTION ONE · PROJECT INTRODUCTION

1. Introduction to the Jobs Assessment

Motivation, modeling approach, and project schedule through December 2026

BEAR
BERKELEY ECONOMIC
ADVISING AND RESEARCH

Why This Study? — Statutory Mandate & Policy Context

INTRODUCTION

- AB 825 authorizes CAISO to transfer regional market governance to an independent Regional Organization for Western Energy (ROWE).
- Section 4.(f) of the statute mandates an independent assessment of employment impacts — specifically jobs constructing and maintaining powerplants in California.
- The study must be completed by December 31, 2026, delivered to the Legislature, and incorporated into the ISO's findings and resolution.

> ***"up to $10 billion in ratepayer savings over the next decade"***
>
> — Estimate cited by California policymakers for ROWE regional market benefits

Apr 2026

BEAR LLC commissioned for the studay.

Dec 2026

Statutory deadline for final report

23 yrs

BEAR’s economic assessment experience in California

Study Approach — The BEAR Economic Model

195 Activity sectors in the 2023 California SAM

23 Occupation categories — tracks powerplant jobs explicitly

10 Household income deciles (distributional detail)

25 Factors of production, with full government fiscal accounts

2023 California SAM
195 sectors · 23 occupations · 10 household deciles

▼

Model Baseline Calibration
Projected forward via DoF forecasts

▼

AB 825 Scenario Codification
Economic changes coded relative to Baseline

▼

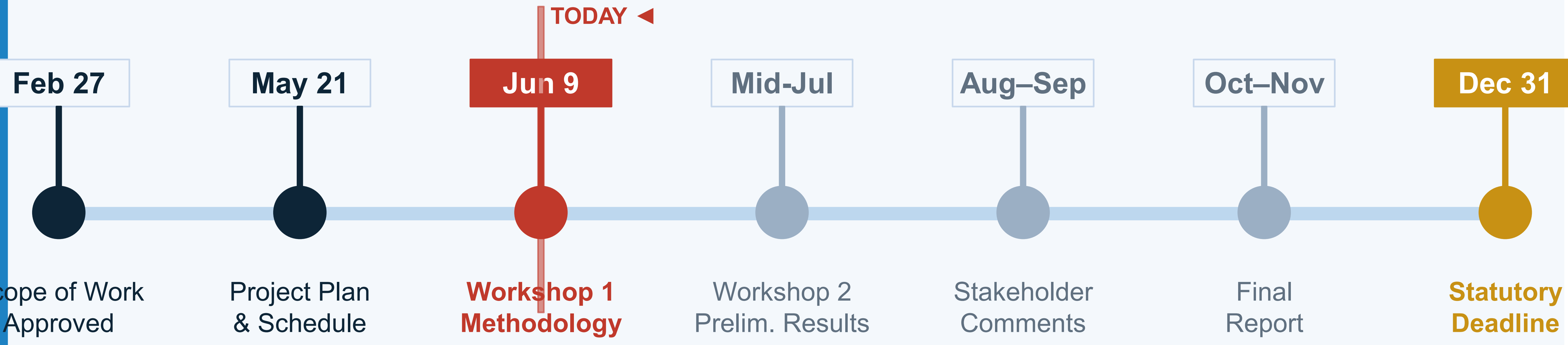
Employment by Occupation
23-occupation decomposition tracks power-sector jobs

▼

Report to ISO and Legislature
Final report by December 31, 2026

Project Schedule — Key Milestones to December 2026

INTRODUCTION



Statutory deadline: December 31, 2026 · Study delivered to the California Legislature

SECTION TWO · BASELINE ASSESSMENT

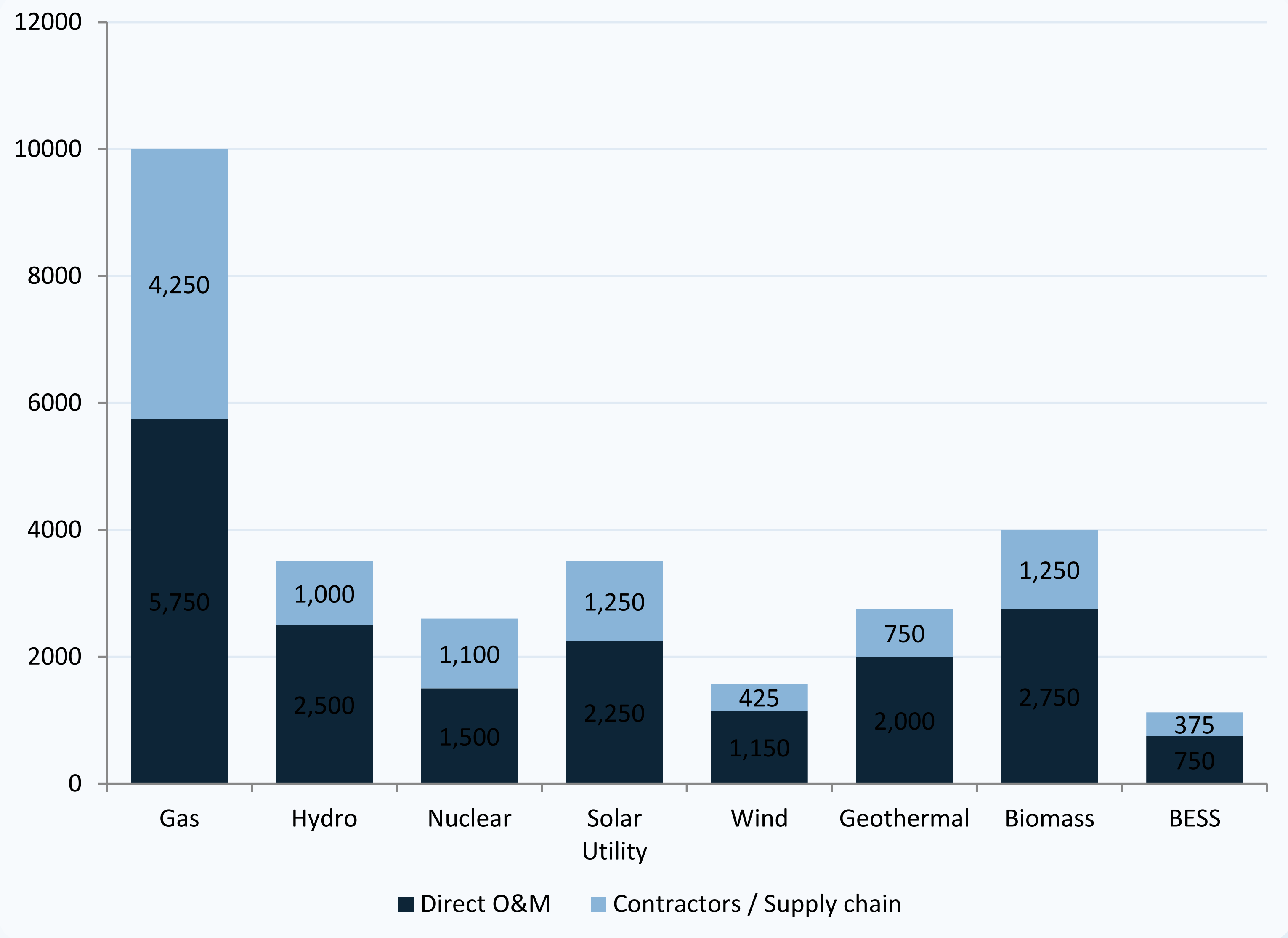
2. Jobs in California Electric Power Generation

Employment by generation technology — fleet size, O&M workforce, wages, and construction intensity

BEAR
BERKELEY ECONOMIC ADVISING AND RESEARCH

Direct O&M Employment by Generation Technology, 2024

BASELINE JOBS



NaturalGas

CAISO RMR contracts sustain 1,000–3,000 jobs at plants that would otherwise retire.

Nuclear

Diablo Canyon pays the highest wages of any technology — $110K–$130K mean direct.

Solar

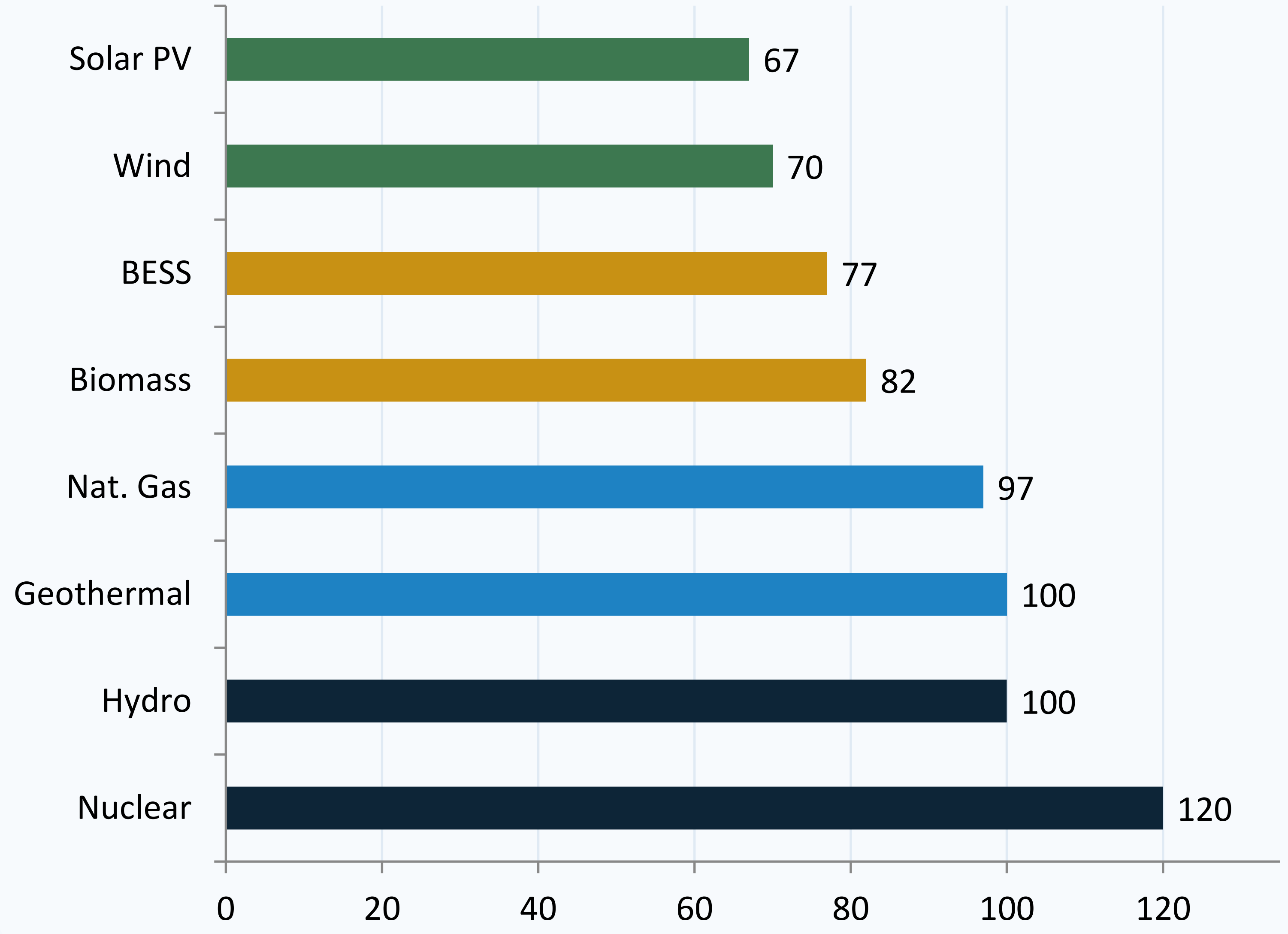
Distributed solar adds 30K–45K workers; construction runs 5–7 job-years/MW.

BESS

Only 2–6 FTE per 100 MW — lowest O&M intensity in the fleet.

Mean Annual Wages by Generation Technology ($000s)

BASELINE JOBS

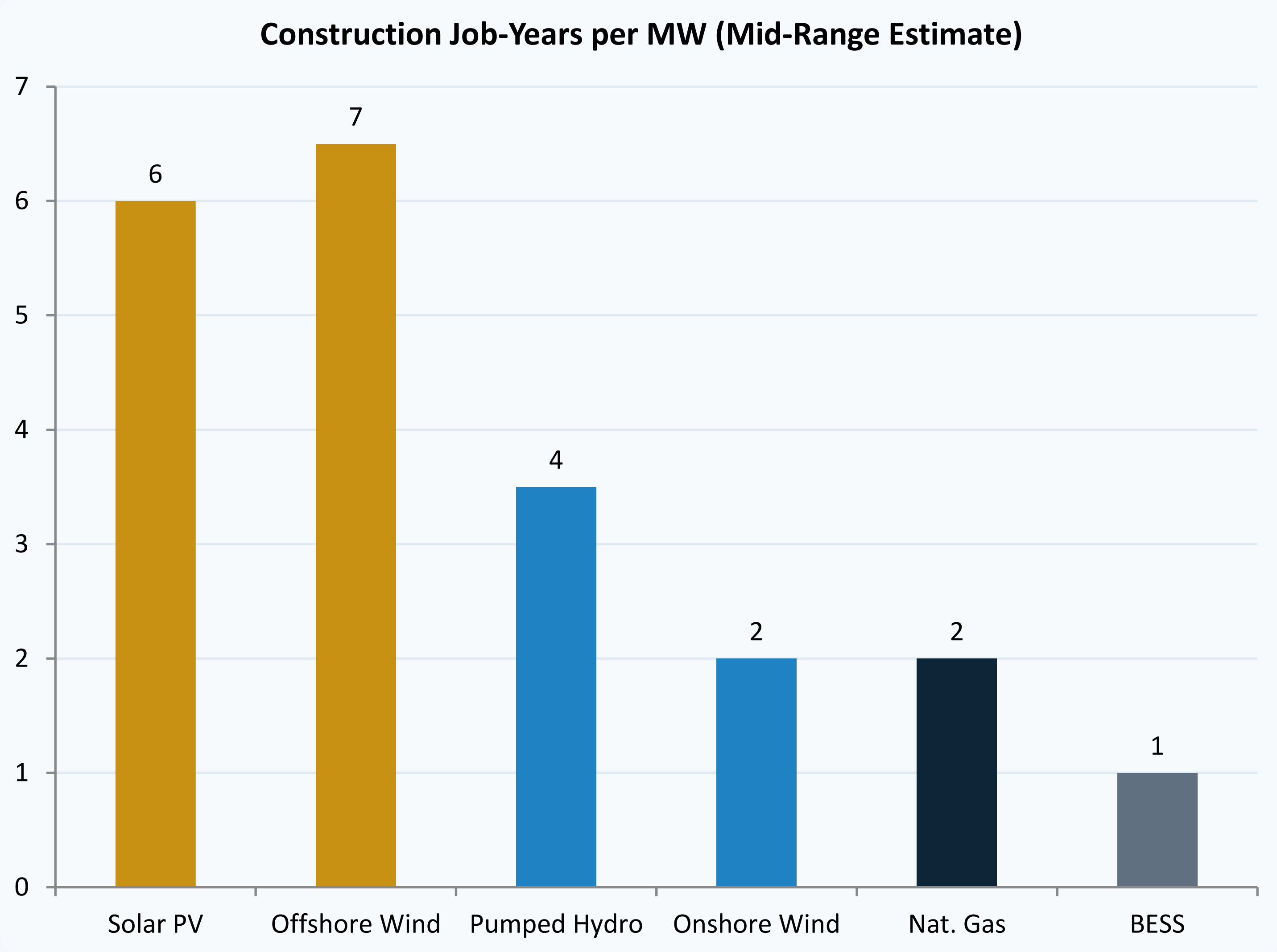


Key Findings

- Nuclear commands the highest wages — licensed reactor operators earn $120K–$155K
- Hydro and geothermal significantly outpay wind and solar O&M
- Solar and BESS — California's fastest-growing technologies — carry lower wage profiles
- Total compensation including benefits is typically 25–40% above mean direct wages

Fleet Overview & Construction Employment Intensity

BASELINE JOBS

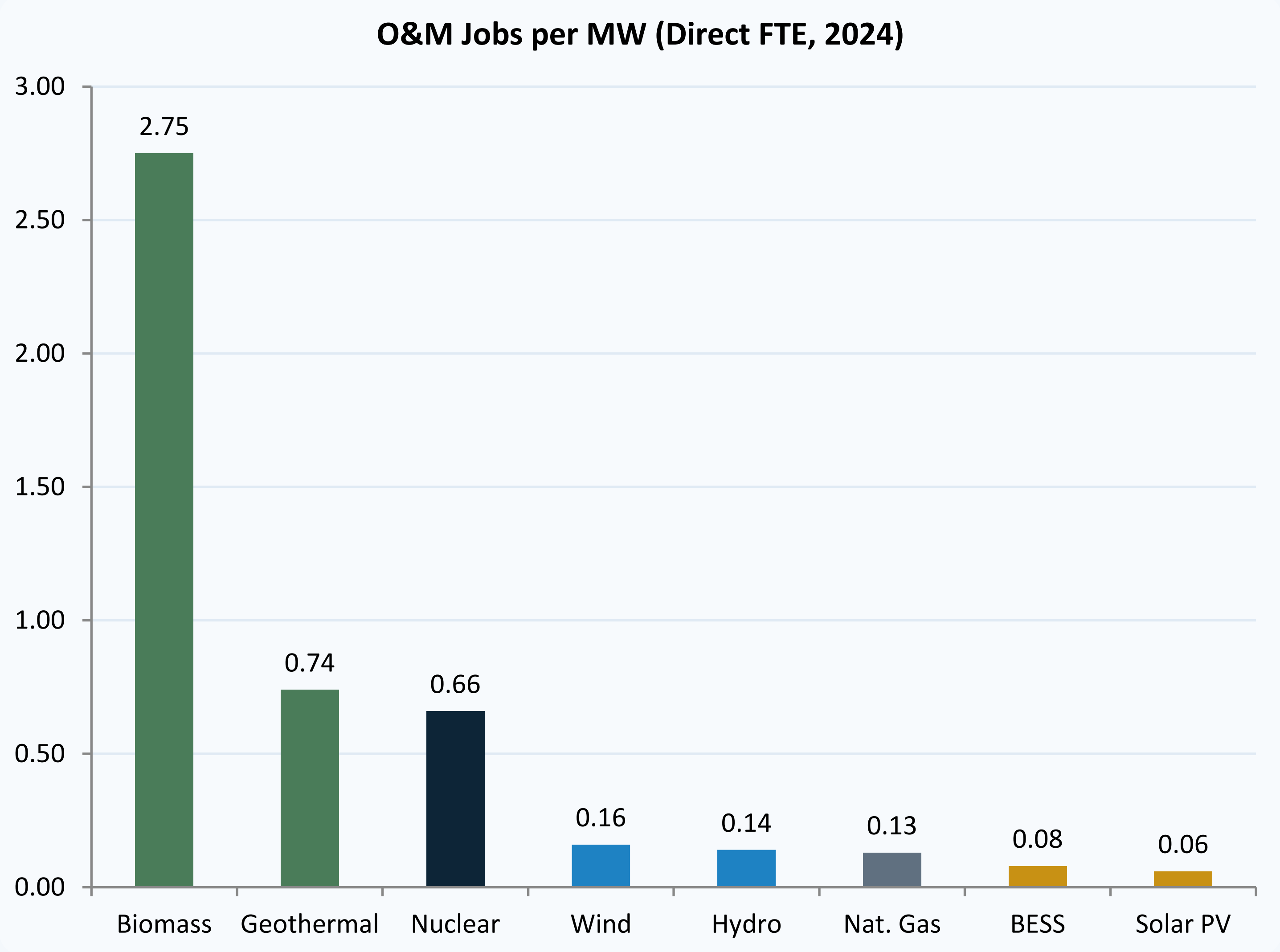


Technology	Fleet (MW)	Gen. Share
Natural Gas	~45,000	35–50%
Solar (utility+DG)	~40,000	25–30%
Hydro + Pumped	~17,500	10–15%
Battery Storage	8,000–10,000	—
Wind (onshore)	~7,000	8–12%
Nuclear	2,256	8–9%
Geothermal	~2,700	~2%
Biomass	~1,000	~1%
Total (2025Q1)	~136,000 MW	—

Solar is California's most construction-employment-intensive pathway at 5–7 direct job-years per MW.

O&M Employment Intensity per MW

BASELINE JOBS



Technology	Fleet (MW)	Gen. Share
Natural Gas	~45,000	35–50%
Solar (utility+DG)	~40,000	25–30%
Hydro + Pumped	~17,500	10–15%
Battery Storage	8,000–10,000	—
Wind (onshore)	~7,000	8–12%
Nuclear	2,256	8–9%
Geothermal	~2,700	~2%
Biomass	~1,000	~1%
Total (2025Q1)	~136,000 MW	—

Biomass leads in O&M intensity (2.75 FTE/MW); geothermal and nuclear follow. Solar PV and BESS — California's fastest-growing technologies — are lowest at 0.06–0.08 FTE/MW.

SECTION THREE · ECONOMIC MODELING

3. Gravity Model of Power Sector Competition

Bilateral pairwise specification · $R^2 = 0.92$ · 3,948 quarterly observations

Bilateral Gravity Model — Specification & Intuition

GRAVITY MODEL

$$ln\left(\frac{G_i}{G_j}\right)_t = \alpha + \beta_1 ln(Cap_i)_t + \beta_2 ln(Cap_j)_t + \beta_3 ln\left(\frac{Cost_i}{Cost_j}\right)_t + \gamma_1 Q1_t + \gamma_2 Q2_t + \gamma_3 Q3_t + \varepsilon_{ijt}$$

$\ln(G_i/G_j)$

Log-ratio of quarterly generation — technology i vs rival j

$\beta_1 \cdot \ln(Cap_i)$

Own-capacity: more installed MW → greater generation share

$\beta_2 \cdot \ln(Cap_j)$

Rival displacement — merit-order effect (consistent with solar curtailment)

$\beta_3 \cdot \ln(\text{Cost ratio})$

Relative cost: lower-cost technology gains dispatch share

$\gamma_1, \gamma_2, \gamma_3$

Seasonal effects — Q2 summer premium largest ($\gamma_2 = 0.099$)

3,948	28	141	8	4
Observations	Technology pairs	Quarters (1990Q1–2025Q1)	Technologies	Model variants

Model Accuracy — Coefficient Estimates & Stability

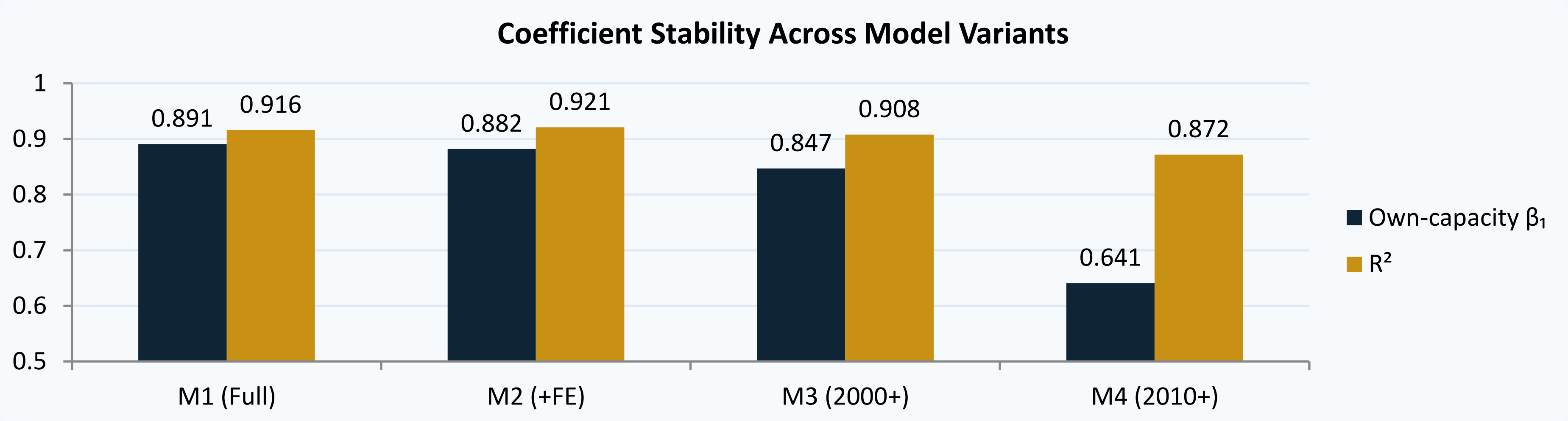
GRAVITY MODEL

R^2

0.92

Full sample · M1
HC3 robust SEs

Parameter	Estimate	Interpretation
α (intercept)	2.7034***	Baseline generation advantage
β_1 own-capacity	0.8911 ***	Sub-unitary: diminishing returns in constrained dispatch
β_2 rival-capacity	−1.2582 ***	Displacement > own-capacity — consistent with solar curtailment
β_3 cost-ratio	−0.3252***	Lower-cost technologies gain share; capacity dominates short-run
γ_2 Q2 summer	0.0986 ***	Summer generation premium
γ_3 Q3 autumn	0.0764	Autumn premium



- **** |t| > 82 · ** t = 2.61 · HC3 heteroskedasticity-robust standard errors*

SECTION FOUR · EMPLOYMENT FORECASTING

5. Forecasting Jobs to 2040

Two-stage pipeline: ARDL capacity projection → gravity-model generation share allocation

The Two-Stage Forecasting Pipeline

FORECASTING

STAGE 1 — ARDL CAPACITY PROJECTION

- Auto-Regressive Distributed Lag model projects MW by technology from 2025Q1 base (136,066 MW total)
- Three growth scenarios (geometric structure): Low 1.0% · Reference 2.0% · High 4.0% p.a.
- Per-technology capacity bounds: floors at 80–85% of 2025Q1; ceilings cap runaway growth
- Nuclear floor in Low Scenario: Diablo Canyon held online through 2035
- AR sum rescaled for stationarity

STAGE 2 — GRAVITY-MODEL SHARE ALLOCATION

- Gravity model converts ARDL capacity + cost-ratio inputs into bilateral log-generation scores for all 28 pairs
- Scores assembled into an antisymmetric 8×8 matrix
- Thurstone row-mean scoring + softmax normalization → portfolio generation shares
- Scale-invariance property: technology mix converges similarly across scenarios
- Employment intensities (jobs/MW, jobs/TWh) applied → quarterly trajectories to 2039Q4

Three Capacity Growth Scenarios — Geometric Structure

FORECASTING

LOW

1.0% p.a.

Constrained build environment

Diablo Canyon nuclear floor held online through 2035

REFERENCE

2.0% p.a.

Central case — current policy

Reference = √(Low × High)
Geometric mean by design

HIGH

4.0% p.a.

Accelerated clean energy deployment

Offshore wind, deep electrification, longer nuclear operation

Geometric structure: Reference = √(Low × High) → √(1.0% × 4.0%) = 2.0% · Reference is the geometric mean — no arithmetic upward bias

2025Q1 Base (136,066 MW) → **ARDL Capacity Forecast** → **Gravity Model Share Allocation** → **Employment Trajectories → 2040**

SECTION FIVE · RISK & UNCERTAINTY

5. Dealing with Uncertainty

Monte Carlo simulation framework — six stochastic layers propagated across 5,000 runs

BEAR
BERKELEY ECONOMIC
ADVISING AND RESEARCH

Monte Carlo Risk Framework — Six Stochastic Layers

UNCERTAINTY

5,000	≈8 sec	60	1/3
Simulation runs	Python runtime	Forecast quarters	Equal scenario probability

L1 — Scenario Draw

Low / Reference / High drawn with equal probability (1/3) at the start of each run

L2 — Capacity Growth

ARDL recursion with per-technology log-capacity bounds; floors at 80–85% of 2025Q1

L3 — Cost Trajectories

Technology costs via Exponential Smoothing (ES); feeds cost-ratio inputs to gravity model

L4 — Gravity Coefficients

β vector drawn from MVN([2.703, 0.891, −1.258, −0.325, …], Σ_HC3) each simulation

L5 — Capacity Factor Sigma

Low: 1.1× sigma multiplier; High: 1.3× to reflect faster deployment variability

L6 — Employment Intensity

Stochastic variation around technology-specific jobs/MW and jobs/TWh baseline ratios

Monte Carlo Integration — Pipeline & Simulation Outputs

UNCERTAINTY

How the Layers Connect

1. **Draw scenario, β cost paths, cap-factor sigma**
2. Run ARDL recursion → projected capacity by technology
3. Compute 28 bilateral log-generation scores
4. Assemble antisymmetric 8×8 matrix
5. Thurstone scoring + softmax → portfolio shares
6. Apply employment intensities → quarterly job trajectory

Repeat × 5,000 runs · seed = 42 · ~8 seconds · Wilson 95% CIs

Simulation Outputs

`mc_summary_stats.csv`
Percentile distributions by quarter and technology

`mc_scenario_means.csv`
Scenario-conditional mean trajectories (Low/Ref/High)

`mc_risk_metrics.csv`
VaR-style employment risk metrics

`mc_sensitivity.csv`
Sensitivity decomposition across stochastic layers

`mc_run_log.txt`
Full run log — seed=42 for reproducibility

Python 3.10+ · NumPy / SciPy / pandas · Wilson 95% confidence intervals

NEXT STEPS

What Comes After This Workshop

Mid-July 2026	Workshop 2 — Results by scenario and technology
Aug–Sep 2026	Stakeholder comment period on methodology and results
Oct–Nov 2026	Final report incorporating stakeholder feedback
Dec 31, 2026	Statutory deadline — report delivered to the Legislature

Questions & Discussion

BEAR
BERKELEY ECONOMIC
ADVISING AND RESEARCH