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# **Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans**

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**Energy Analysis Department**



# Overview of Report

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**Objective:** Summarize western utility resource plan treatment of renewable energy (RE), based on compilation and analysis of resource plan assumptions and methods

- 1) Planned Renewable Energy Additions in Western Resource Plans
- 2) Portfolio Construction
- 3) Wind Power Cost and Performance Assumptions
  - a) Busbar costs, transmission costs, integration costs, capacity value
- 4) Risk Analysis
  - a) Natural gas price risk
  - b) Environmental compliance risk
- 5) Balancing Cost and Risk
- 6) Conclusions

# Western Utility Resource Plans Included in Our Sample

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Resource plans from utilities subject to a Renewables Portfolio Standard (RPS)

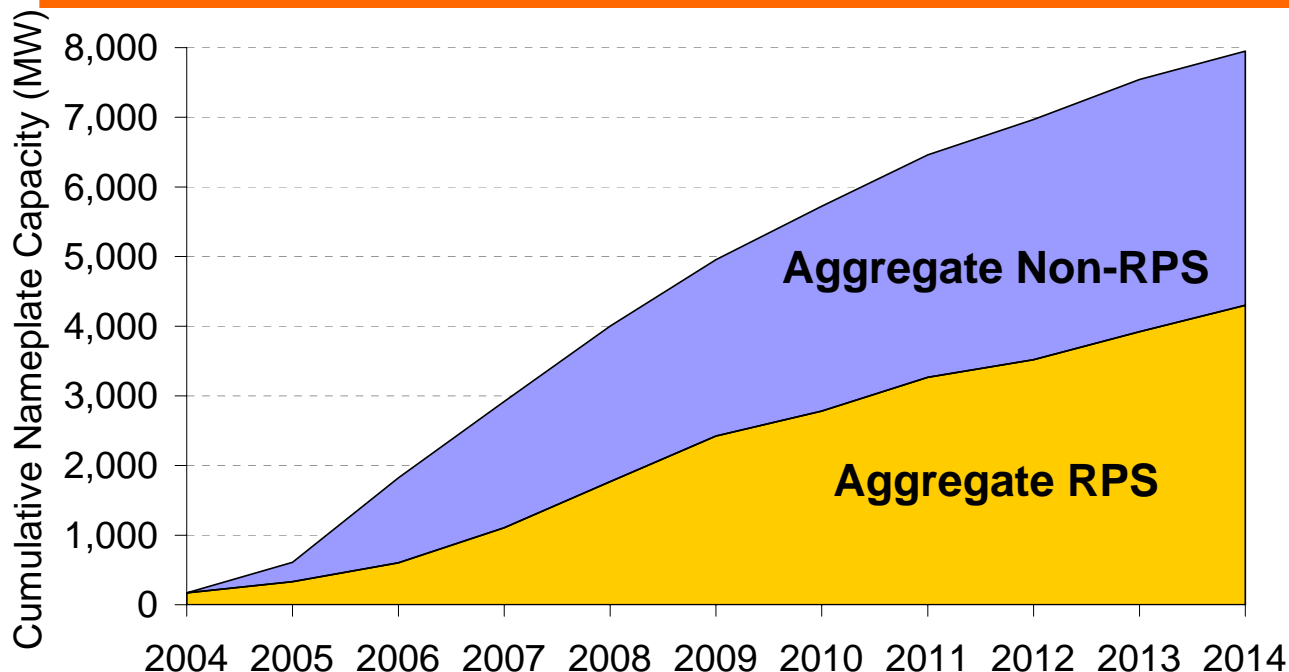
PG&E, SCE, SDG&E, Nevada Power, Sierra Pacific

Resource plans in which no regulatory requirements compel RE additions

Avista, Idaho Power, NorthWestern\*, Portland General (PGE), PacifiCorp, Puget Sound (PSE), PSCo\*

\*PSCo's and NorthWestern's most-recent resource plans preceded each state's RPS

# Western Resource Plans Are a Major Source of Demand for New Renewable Energy



## Non-RPS:

Wind accounts for 93% of new capacity in 2014

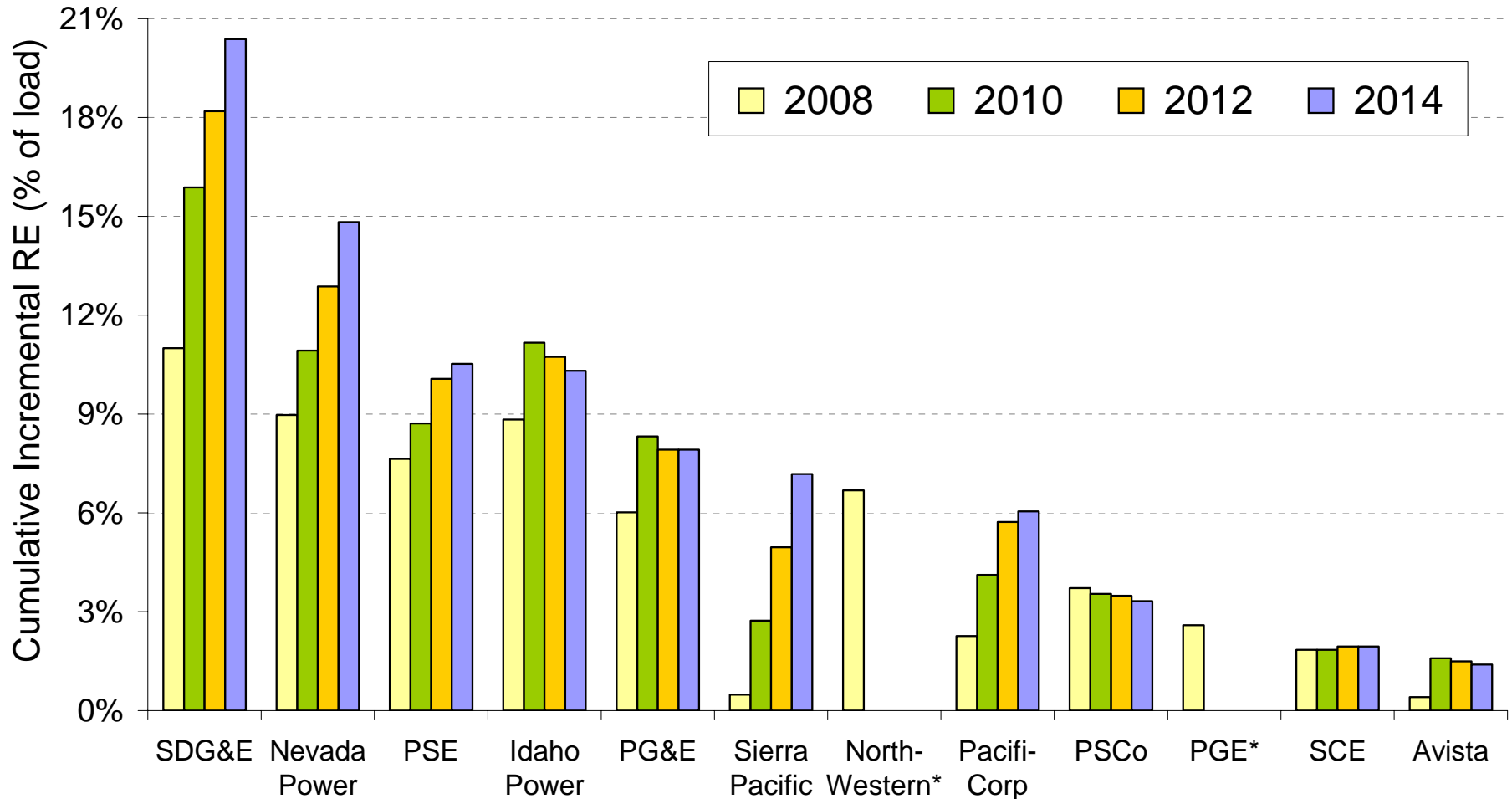
## RPS:

Resources often unspecified

## New Renewables Capacity in 2014 (MW)

	PG&E	Pacifi-Corp	SCE	PSE	SDG&E	PSCo	Idaho Power	Nevada Power	PGE	North-Western	Sierra Pacific	Avista
<b>Non-RPS</b>	0	1,420	0	745	115	500	450	0	195	150	0	75
<b>RPS</b>	2,150	NA	1,021	NA	630	NA	NA	361	NA	NA	137	NA
<b>Total</b>	2,150	1,420	1,021	745	745	500	450	361	195	150	137	75

# Planned Incremental Demand for RE Is Significant in Both RPS and non-RPS States



\*PGE's and NorthWestern's procurement horizons end in 2007, so only their 2008 values are shown.

# Planned Renewable Energy Additions Are Affected By...

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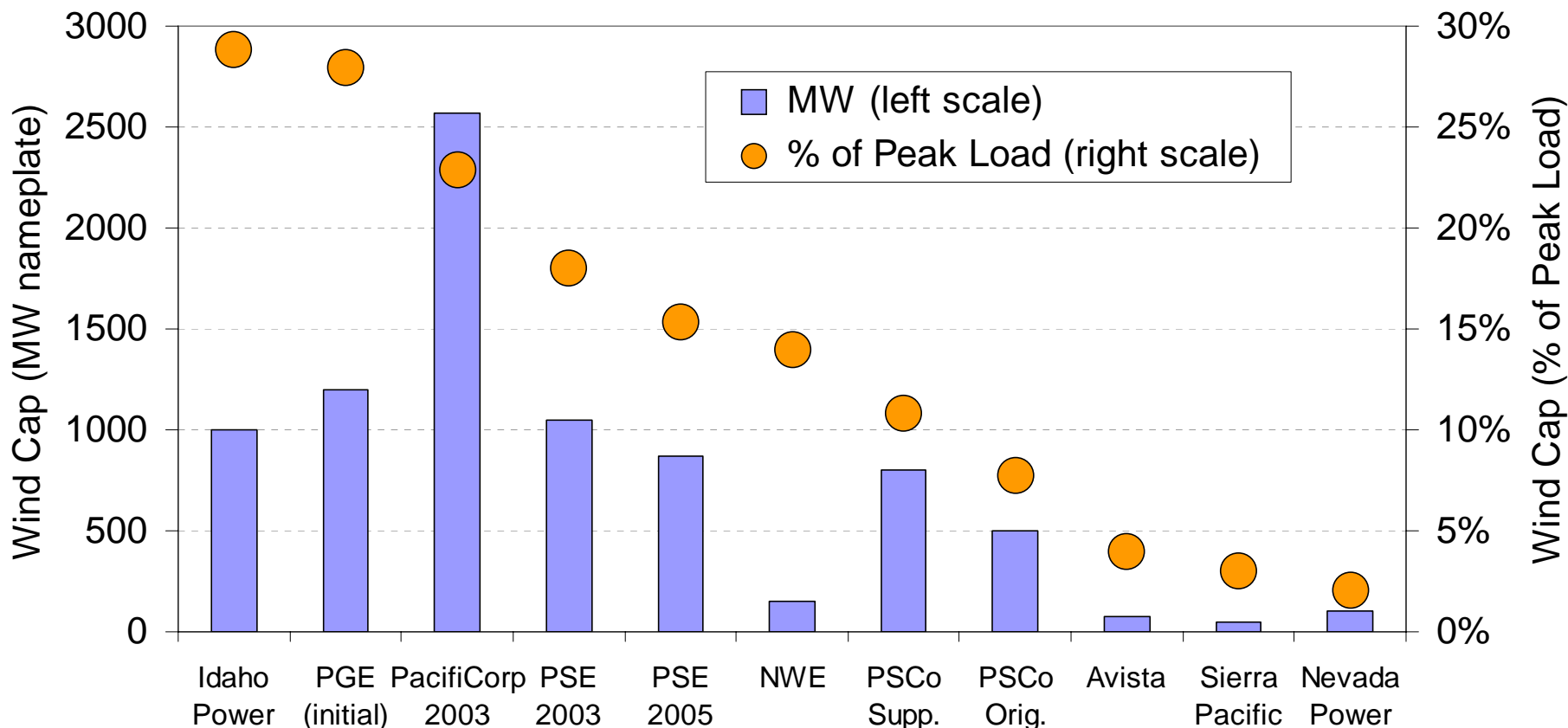
- How candidate portfolios are assembled and defined
- What assumptions are made for the cost and performance of renewable energy
- The degree to which (and how) electricity sector portfolio risks are considered
  - Natural gas price risk
  - Environmental compliance risk
- How tradeoffs between the expected cost and risk of different portfolios are made

# Construction of Candidate Portfolios

One of the goals of resource planning is to evaluate different “candidate” resource portfolios

- Most plans create the candidate portfolios by hand, making the composition of these portfolios all the more important
  - Avista and PSCo use an optimization process to construct portfolios
- Resource plans in states with RPS obligations frequently do little to analyze the potential value of exceeding the obligations; the RPS “caps” planned RE additions
  - SCE, Nevada Power, Sierra Pacific, PG&E (original plan)
- Many plans only include wind power in candidate portfolios, with other renewable resources screened out at an earlier phase
- Many of the plans exogenously cap the maximum amount of wind additions, in some cases at very low levels, effectively pre-defining the amount of wind ultimately selected

# Exogenous Build Limits “Cap” the Amount of Wind Selected by Some Resource Plans

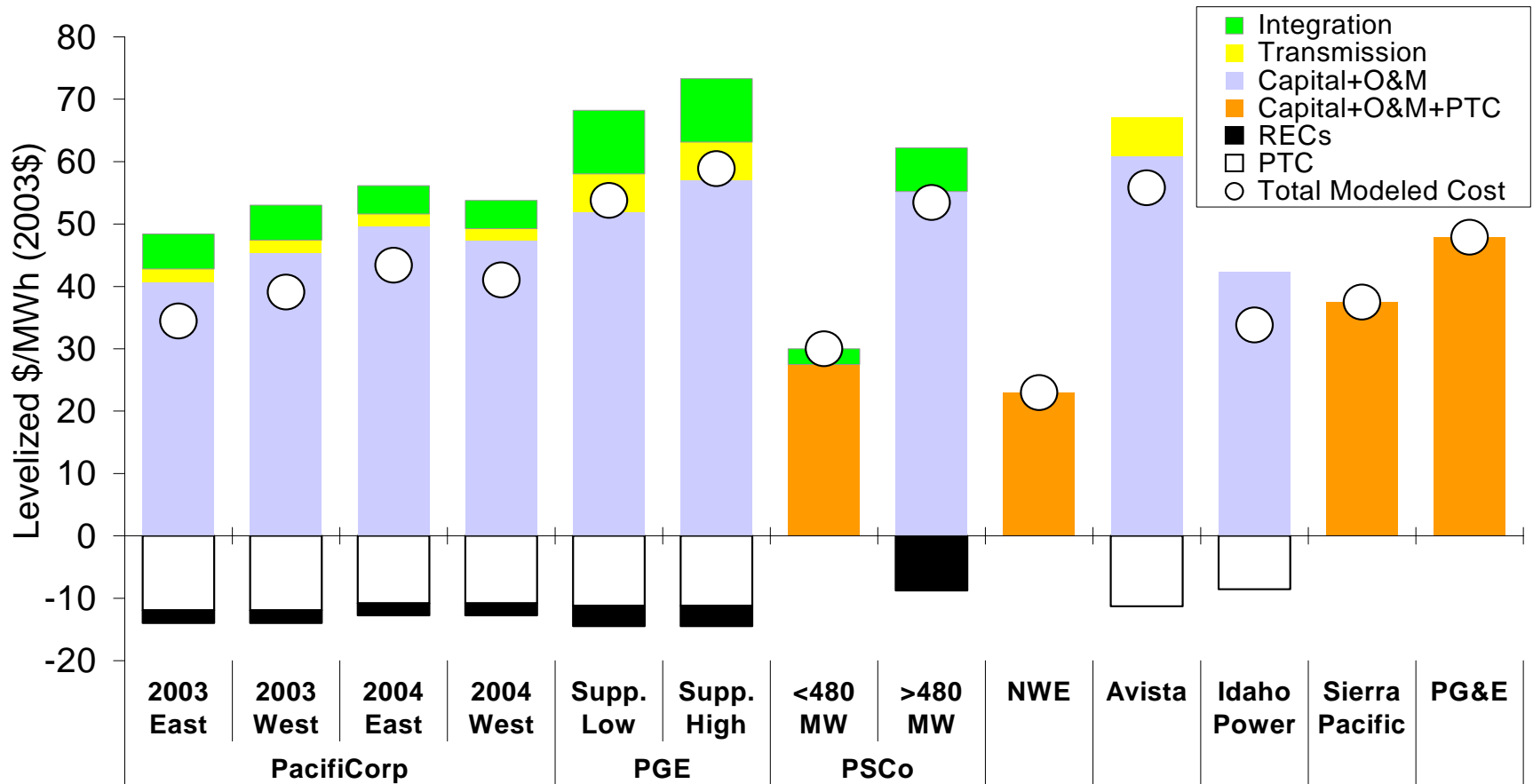


NWE, PSE 2003, PSCo, and Avista all chose portfolios with wind at the cap (Sierra Pacific and Nevada Power do not report RE additions by technology, but presumably would also hit their low caps)

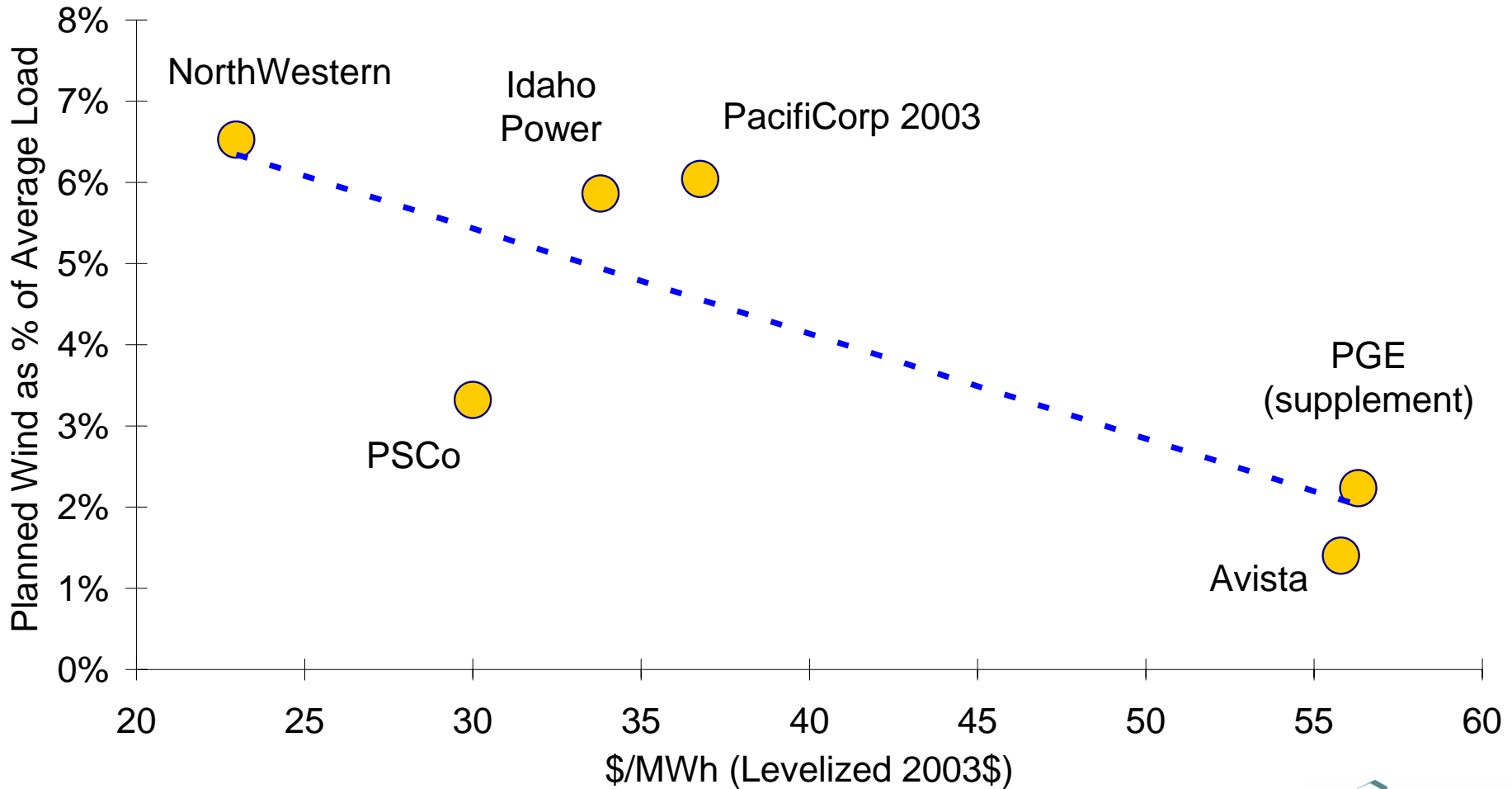


# Wind Power Cost and Performance Assumptions Vary Considerably Among the Plans

Total modeled cost for wind, including capital and O&M, PTC, integration, transmission, and RECs, ranges from \$23/MWh to \$59/MWh



# Total Cost Matters: Wind Additions Generally Higher When Modeled Costs Are Lower

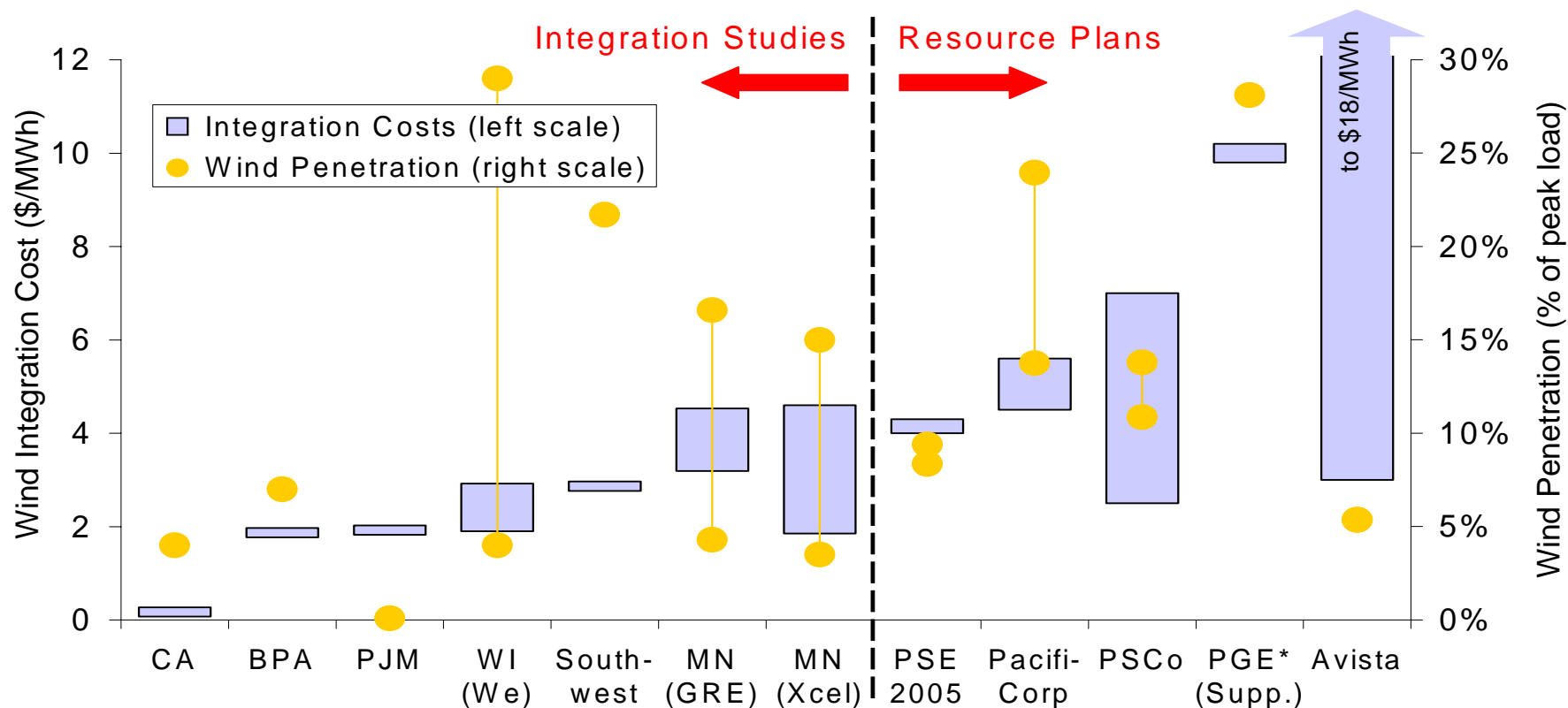


# Are the Assumptions Underlying Total Modeled Wind Power Costs Reasonable?

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- **Busbar Costs: Capital, O&M, PTC**
  - Capital and O&M assumptions are reasonable at: \$41-61/MWh
  - PTC is undervalued by some resource plans (by ~\$7/MWh), but many plans overstate the likelihood of PTC renewal over a lengthy time horizon, and do not evaluate the risk of expiration
- **Transmission Costs**
  - Plans often include expected transmission wheeling costs, but do not try to carefully evaluate transmission expansion needs
- **Integration Costs**
  - The science of quantifying integration costs has improved considerably, and these costs are being evaluated in an increasingly sophisticated way within utility resource plans, but...
  - Some utilities still appear to be over-estimating this cost, and others have established very low limits to wind penetration due to arguably exaggerated concerns about integration difficulties

# Integration Costs Assumed in Resource Plans Compared to Recent Analytic Literature

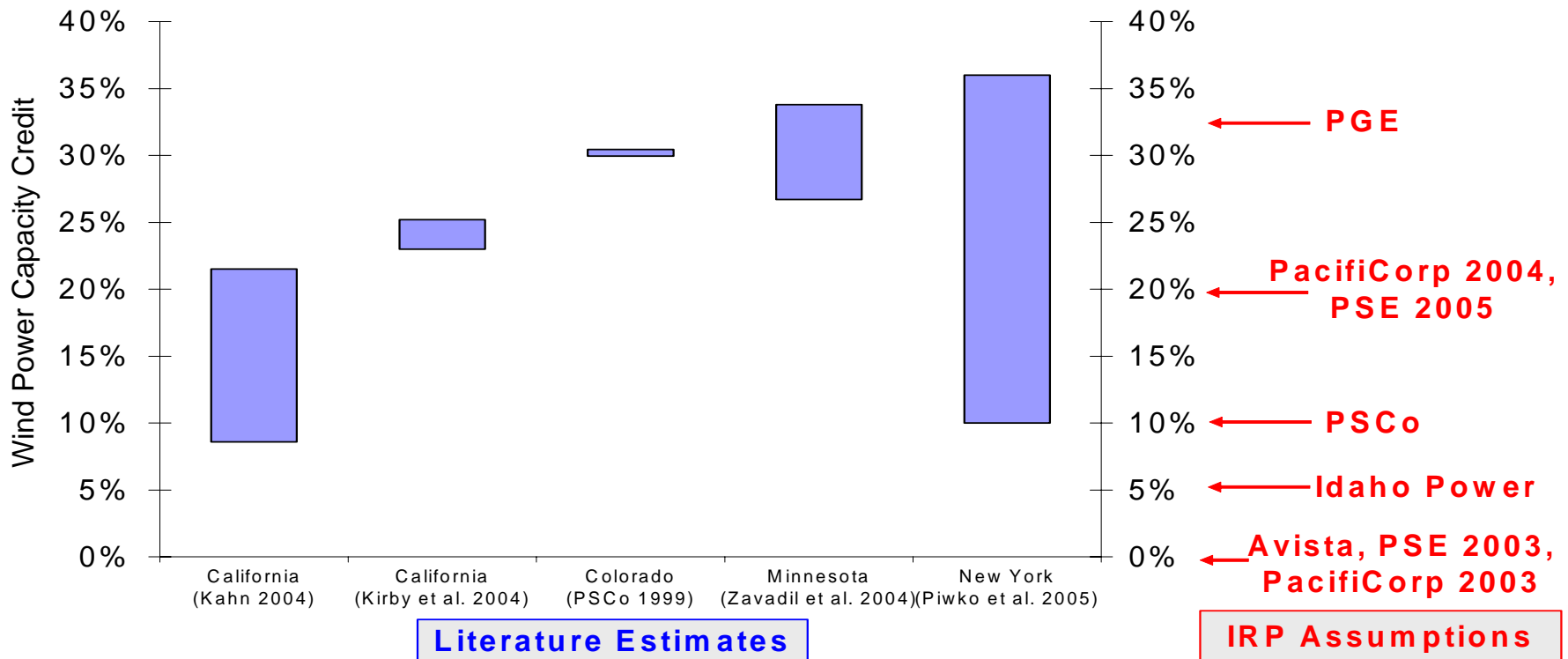


\*PGE's supplemental IRP estimates the cost of creating a flat, base-load block of power out of variable wind production, rather than simply the cost of integrating variable wind production. As such, its cost estimate is not directly comparable to the others.

Some resource plans set strict limits on wind penetration due to concerns about integration costs: Avista (75 MW, 4% of peak load), Nevada Power (100 MW, 2% of peak load), and Sierra Pacific (50 MW, 3% of peak load)

# Resource Plan Capacity Value Assumptions Are Low Compared to Recent Literature

- Though less dependable than other resources, wind provides *some* capacity value
- ELCC is the most widely recognized method for determining capacity value
- Most utility plans did not use ELCC to calculate capacity value
- Many plans assumed lower capacity value than suggested in the literature



# Renewable Energy as a Risk Mitigation Tool

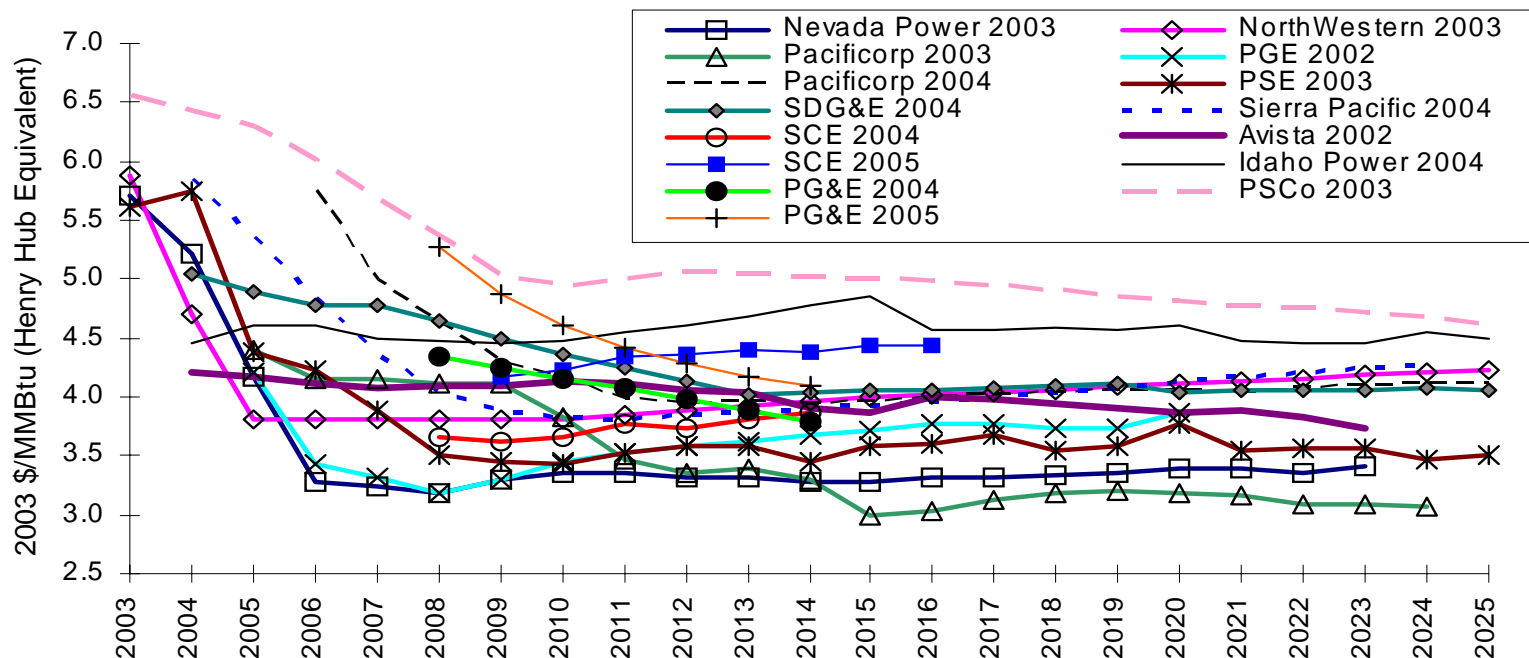
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**Renewable energy may reduce at least two important risks...**

- Risk of high and volatile natural gas prices
- Risk of more stringent environmental regulations

**Resource plans are becoming increasingly sophisticated in analyzing both risks, but further improvements are still needed**

# Base-Case Natural Gas Price Forecasts Vary Considerably Among Resource Plans



## Key Conclusions:

- **Use an Up-to-Date Forecast:** Long-term levelized natural-gas price expectations have risen by ~\$1/MMBtu over just the last 2 years
- **Benchmark Early-Year Prices to the NYMEX Forward Curve:** Forward prices are arguably the best predictor of future prices, and forecasts that are not consistent with NYMEX (SCE, Avista) merit an explanation

# Little Weight Should Be Placed on Base-Case Forecasts

- The history of gas-price forecasting is dismal
- Utility resource plans are responding to this challenge with scenario and, more recently, stochastic analysis, but...
- Scenarios sometimes overly timid (PSE, PSCo, Nevada Power)
- Stochastic analysis difficult to critique due to inconsistent approaches and data release

Utility	Scenario Analysis	Stochastic Analysis
Avista	✓	✓
Idaho Power	✓	
Nevada Power	✓	✓*
North Western	✓	✓
PacifiCorp	✓**	✓
PG&E		✓
PGE	✓	✓
PSCO	✓	
PSE	✓	✓
SDG&E		✓
Sierra Pacific	✓	✓*
SCE		✓

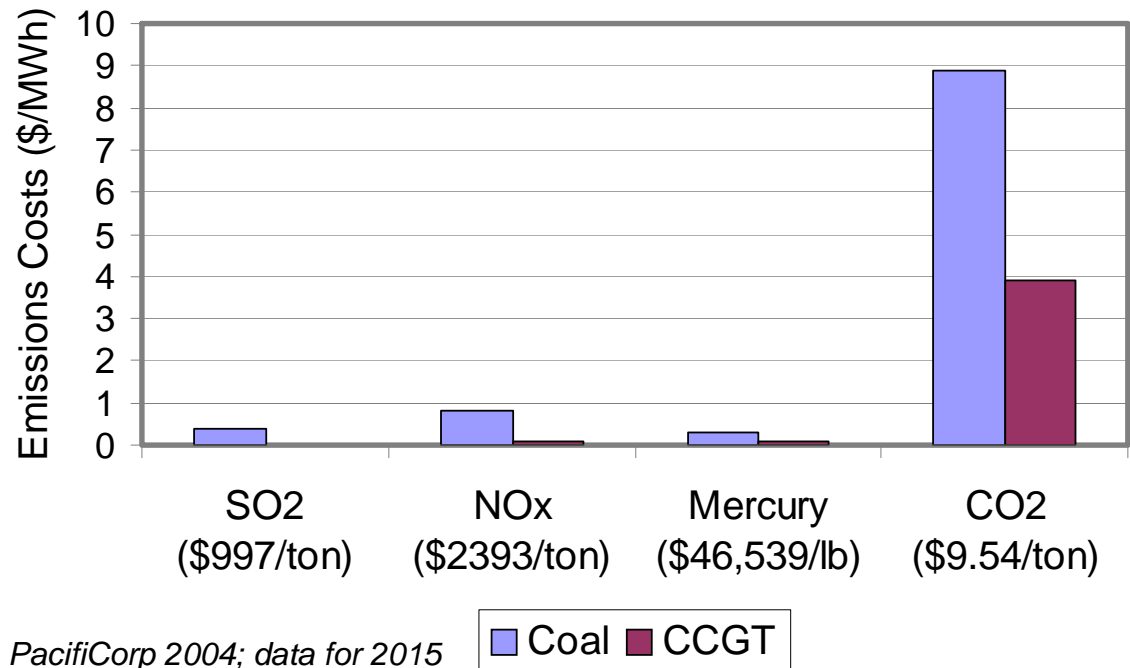
\* Stochastic analysis only conducted for short-term energy plan, not long-term resource portfolios.

\*\* Only for PacifiCorp's 2004 IRP



# Environmental Regulatory Risk

Environmental regulations are likely to change over the lifetime of electric supply investments, and utility planning should evaluate these risks, and mitigate them if cost-effective to do so



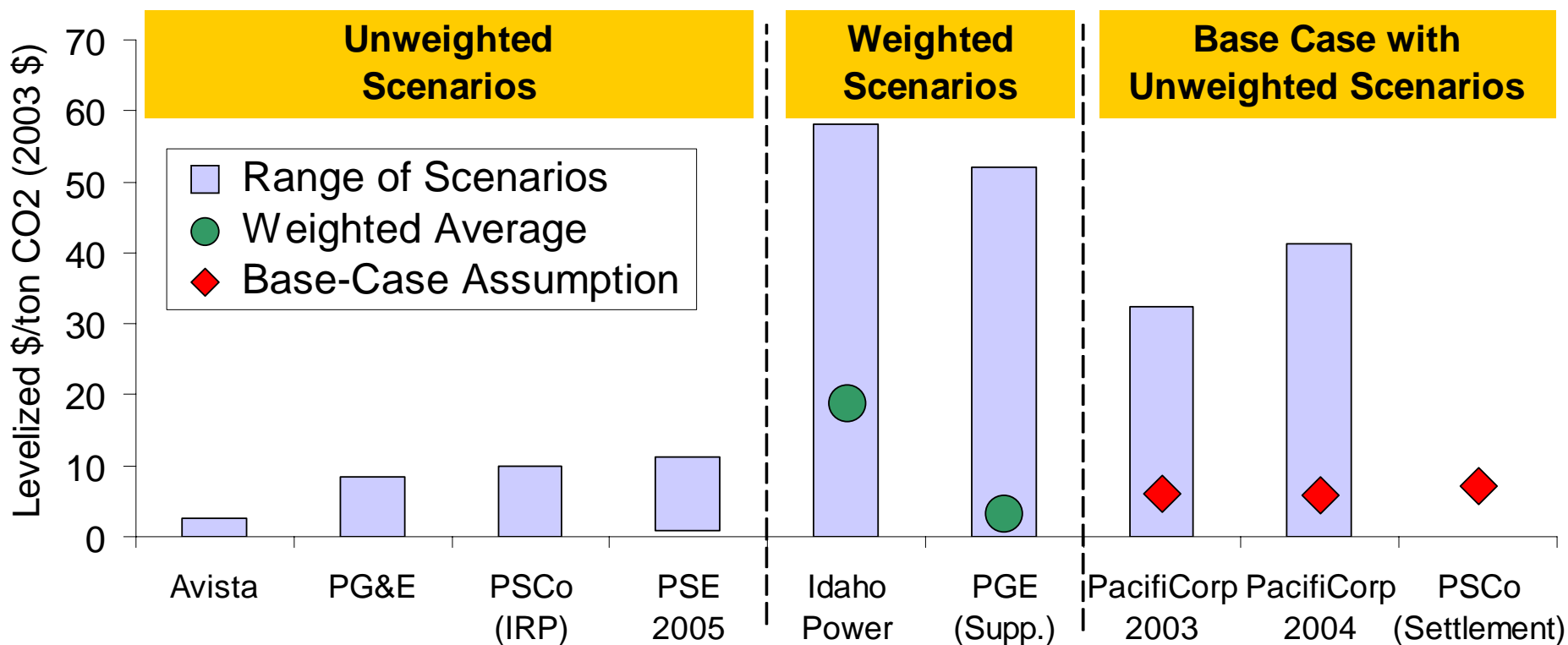
Risk of carbon regulation – at the state or federal level – is likely the most important to consider, but risk of strengthened regulations of SO<sub>2</sub>, NOx and mercury also deserve note

# Western Resource Plans Are Increasingly Evaluating Carbon Regulatory Risk

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- 7 of 12 considered risk during portfolio selection in latest round of resource plans, representing 30% of western electricity supply
- Minimum of 10 of 12 plans will consider this risk in next round (due to recent CPUC and Montana PUC rulings): 42% of western electricity supply
- Two outliers: Nevada Power, Sierra Pacific
- For those utilities considering this risk already...
  - Approaches vary
    - ◆ Carbon scenarios but with no probabilities attached: Avista, PG&E, PSCo (original IRP), PSE 2005
    - ◆ Carbon scenarios with probabilities attached: Idaho Power, PGE
    - ◆ Included in base-case, sometimes with scenarios of varying regulatory stringency: PacifiCorp, PSCo (settlement)
  - Range of assumed carbon costs is wide, and some utilities are not evaluating a sufficiently broad range of scenarios (e.g., Avista)

# Methods and Approach to Carbon Risk Evaluation Vary



## We recommend that...

- all utilities evaluate carbon risk
- a greater level of consistency in evaluation approaches be sought
- a broad range of possible regulatory environments be considered

# Resource Plans Do Not Devote As Much Attention to Other Environmental Regulatory Risks

- Though not always stated, cost of complying with **existing** criteria air pollutant regulations is presumably included in all plans (though assumptions for the cost vary)
- Only **two** utilities in our sample appear to consider the very real possibility of strengthened **future** regulations:

## Assumed Cost of Complying with Future Environmental Regulations

	SO <sub>2</sub> (Levelized 2003 \$/ton)	NO <sub>x</sub> (Levelized 2003 \$/ton)	Mercury (Levelized 2003 \$/lb)
<b>PacifiCorp</b>	Base: \$675 Scenarios: \$335-\$708	Base: \$1,604 Scenario: \$264	Base: \$31,192
<b>PSCo (settlement)</b>	Base: \$796	Base: \$796	Base: \$9,954

- Recent EIA analysis suggests that plausible allowance prices are \$1,700/ton for NO<sub>x</sub>, \$1,200/ton for SO<sub>2</sub>, and \$35,000/lb for mercury
- A few other utilities (e.g., Nevada Power, Sierra Pacific) use mandated “externality values” to capture social costs beyond compliance costs

# Balancing Cost and Risk

**Ultimately, resource plans must balance portfolios that have different cost and risk characteristics; how this tradeoff occurs can effect how well renewable energy fares**

- Different definitions of risk are used, as are different approaches for balancing expected cost and expected risk
  - Stochastic analysis
    - ◆ Subjective weights to costs and risk (Avista, Northwestern)
    - ◆ Qualitative review (PacifiCorp, PSE)
    - ◆ California plans don't evaluate different portfolios at all!
  - Scenario analysis
    - ◆ Different degrees of quantitative and qualitative analysis (Idaho Power, PGE, PSCo, Nevada Power, Sierra Pacific)
- Each electricity customer may hold different risk preferences, and utilities have been given little guidance and have conducted little research on how to best make these tradeoffs
- Utilities virtually always use WACC to discount costs: we recommend scenario analysis be conducted on a wider range of discount rates

# Balancing Cost and Risk: Concerns for Renewable Energy

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- Plans often model RE primarily as wind power, assume a low capacity value, and/or apply low limits to wind penetration
  - As a result, many of the hand-crafted “renewables” portfolios are weighted heavily towards gas-fired generation, thereby exhibiting as much or more exposure to gas-price risk than other portfolios (e.g., PacifiCorp, Idaho Power, PSE)
  - Pushes resource selection towards coal more than renewable energy
- Fuel price risk is often analyzed quantitatively **early** in the modeling process, while carbon risk (where included) is typically analyzed through scenario analysis **later** in the process, and in a way that has less effect on portfolio choice
- Result is that RE portfolios are sometimes not considered low risk, and are sometimes “prematurely” weeded out at an early phase of the analysis

# Where Do We Go From Here...

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Western resource plans are becoming increasingly sophisticated, and have begun to consider RE as a serious resource option.

But improvements are still possible and needed:

- 1) Resource plans in RPS states should consider evaluating renewable resources as an option above and beyond the level required to satisfy RPS obligations.
- 2) Resource planners may wish to explore a broader array of renewable resource options.
- 3) The value of the federal production tax credit for renewable energy, and its risk of permanent expiration, could be more consistently addressed on an after-tax basis.
- 4) Methods for evaluating wind integration and transmission costs, and capacity value, should continue to be refined and applied at successively higher wind penetration levels.

# Where Do We Go From Here...

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- 5) Exogenous caps on wind penetration should potentially be eliminated, especially as analysis of wind integration and transmission costs, and capacity value, improve.
- 6) Resource plans would ideally evaluate a broad range of possible fuel costs, and subject a large number of candidate portfolios to such analysis (and risk analysis more generally).
- 7) Environmental compliance risks could be more consistently and comprehensively evaluated.
- 8) Steps should be taken to ensure that each risk has, as is warranted or appropriate, an opportunity to impact portfolio selection.
- 9) Utilities and regulators should conduct research to evaluate ratepayer risk preferences.
- 10) Though there may be instances in which redaction of commercially sensitive information is warranted, more consistent and comprehensive data presentation in utility resource plans would allow for far better external review.



# For More Information...

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**Download the full report from:**

<http://eetd.lbl.gov/ea/ems/re-pubs.html>

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