Review of Utility Resource Plans in the West

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Overview of Presentation

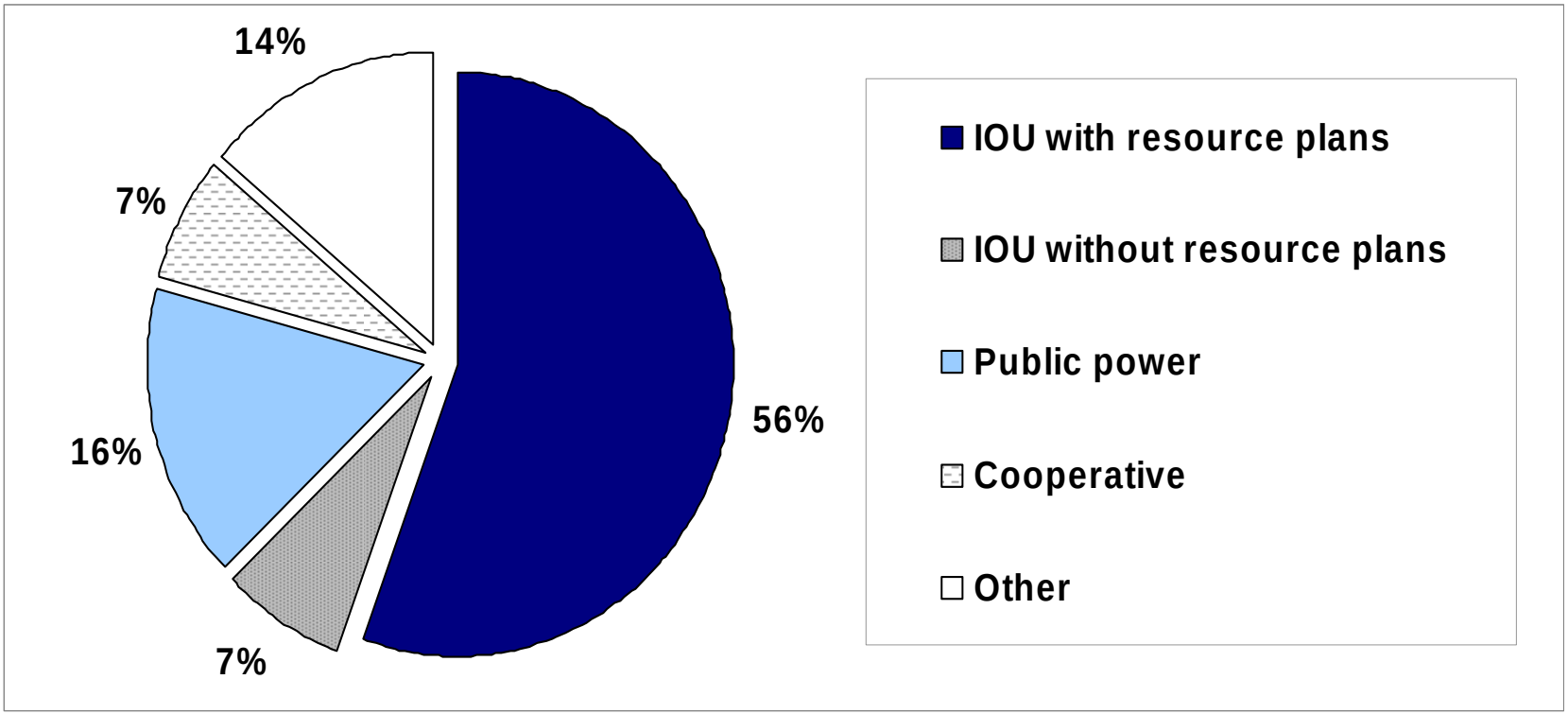
- Project overview: scope and objectives
- Resource Assessment, Need & Adequacy
- Treatment of Risk in IRP Plans
- Natural gas price risk
- Treatment of Energy Efficiency
- Treatment of Renewable Energy

Project Scope and Objectives

- **Project scope: Comparative analysis of recent resource plans filed by 14 utilities in the Western U.S. and Canada**

- **Project objectives:**
  - Analyze treatment of conventional & emerging resource options
  - Assess risk analysis & portfolio management
  - More standardized methods and conventions for resource assessment
  - Review resource adequacy criteria
- **Summarize how issues are handled in resource plans; identify "best practices"; offer recommendations**
- **Create information tools for CREPC that facilitates work on related projects (e.g. regional transmission planning)**

Utility resource plans are publicly available for much of the load in the Western U.S.



- All states in the Western U.S. except WY and AZ require IOUs to regularly file resource plans
- Municipally-owned utilities that purchase electricity from Western Area Power Administration are also required to prepare resource plans (but don't have to make the plans publicly available).

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Recent Utility Resource Plans in the West

Utility	Year and name of the resource plan
Avista Corp.	**2005 Electric Integrated Resource Plan**
BC Hydro	**2004 Integrated Electricity Plan**
Idaho Power Co.	**2004 Integrated Resource Plan**
Nevada Power	**2003 Integrated Resource Plan**
NorthWestern Energy Corp. (NWE)	**2004 Electric Default Supply Resource Procurement Plan**
PacifiCorp	**2004 Integrated Resource Plan**
Pacific Gas & Electric (PG&E)	**2004 Long-term Procurement Plan**
Portland General Electric (PGE)	**2002 Integrated Resource Plan**
Public Service Company of New Mexico (PNM)	**2005 Electric Supply Plans**
Public Service of Colorado (PSCO)	**2003 Least-Cost Resource Plan**
Puget Sound Energy (PSE)	**2005 Least Cost Plan**
San Diego Gas & Electric (SDG&E)	**2004 Long-term Resource Plan**
Sierra Pacific	**2005 Integrated Resource Plan**
Southern California Edison (SCE)	**2004 Long-term Procurement Plan**

Resource Assessment and Adequacy in Utility Resource Plans

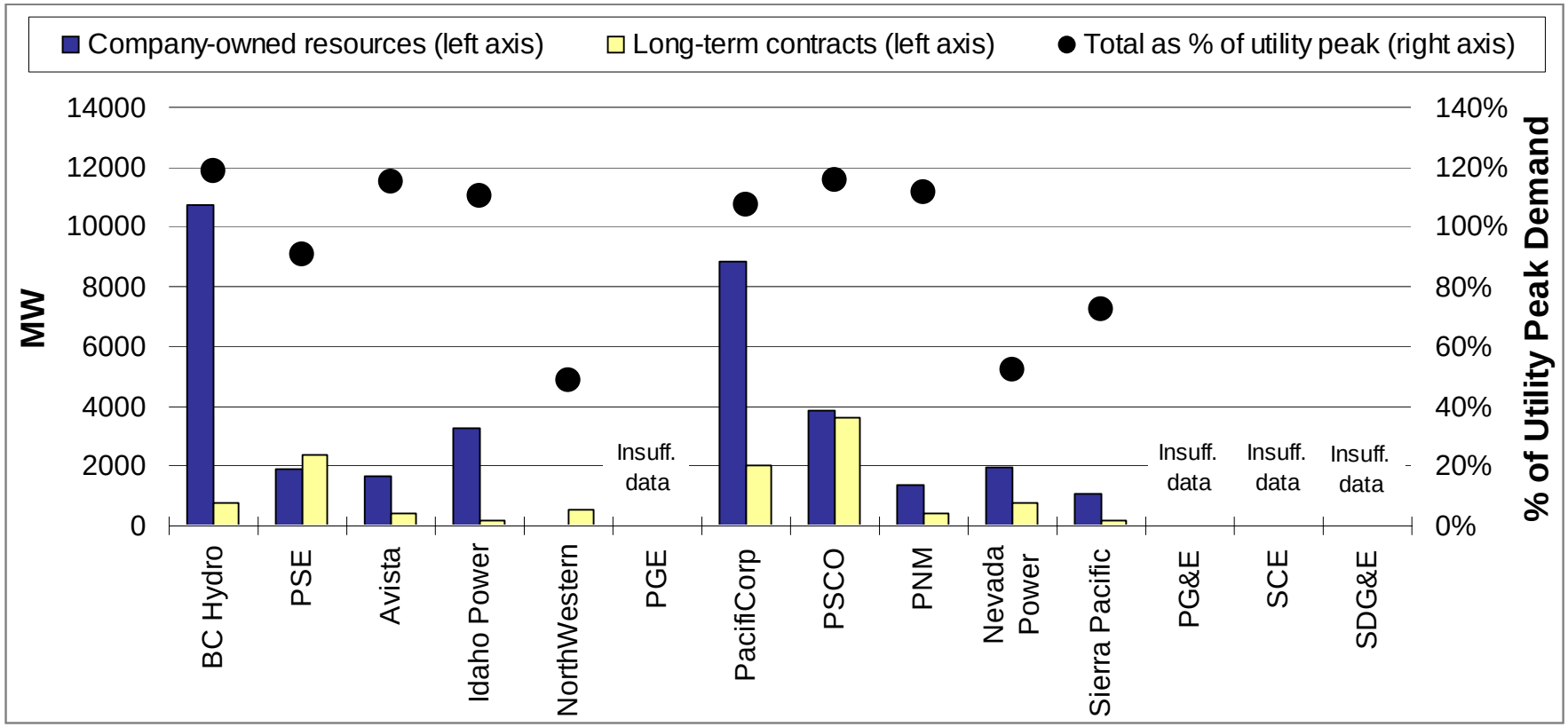
Resource Assessment and Adequacy

- Resource Adequacy:
  - What adequacy criteria & reserve margins are used by utilities?
- Resource Assessment
  - Utility's forecasted load growth? Existing resources?
  - How do the utilities propose to address resource needs, and within what timeframe?

Utility Approaches to Determine whether *Capacity* Resources are Sufficient

Approach to RA	Metric	Utility	Reserve Margin
WECC "Minimum Design Performance"	**Greater of R, or the Largest Risk + 5% of Load Responsibility**	Sierra Pacific	**No numeric planning margin is specified.**
	Two Largest Risks	Idaho Power	**Reserves to cover loss of Idaho Power's share of two Bridger units equates to a 12% margin.**
	1-in-10 Year LOLP	Nevada Power	**Maintain 12% and 17% reserves, respectively.**
		PSCO	
State RA Requirements	**Minimum Requirement**	PG&E	**Maintain resources to meet a planning reserve margin of 15-17%**
		SCE	
		SDG&E	
Alternative Approaches	**Temperature**	PSE	**Maintain resources to meet peak load plus operating reserves for a 16° F hour, or ~14.5-15% reserves.**
	No Specified Metric Stated in Resource Plan	Avista	**Planning margins are 10% of the peak hour load plus 90 MW, a reserve margin of ~ 15%**
		NWE	**Quantity of long vs. short-term capacity resources is optimized as part of the portfolio analysis.**
		PacifiCorp	**Maintain sufficient capacity resources to meet a reserve margin of 15%**
		PGE	**Maintain a 6% planning margin on top of 6% operating reserve, for a 12% margin.**

Utilities' Existing Long-Term Resources



- **Long-term resources include utility-owned generation and contract resources (QFs, PPAs, seasonal exchanges)**
- **Short-term contracts (<5 yrs) and market purchases fill in any remaining resource need**

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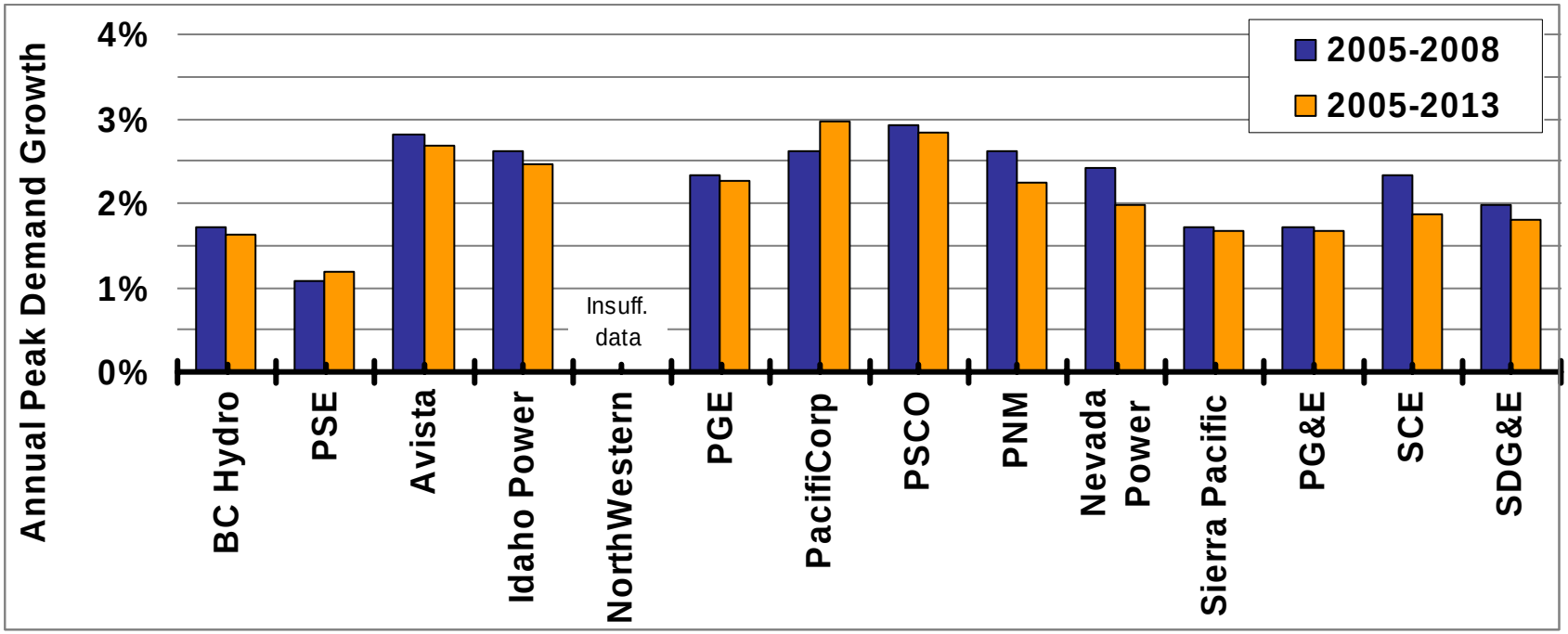
Projected Growth in Retail Peak Demand



- Average growth across West = 2.2% (2005-2008), 2.1% (2005-2013)
- Major issues/uncertainties:
  - Population growth (ID, NV)
  - National and regional economic trends/recovery
  - Load serving obligations and retail market development (OR, MT, NV)

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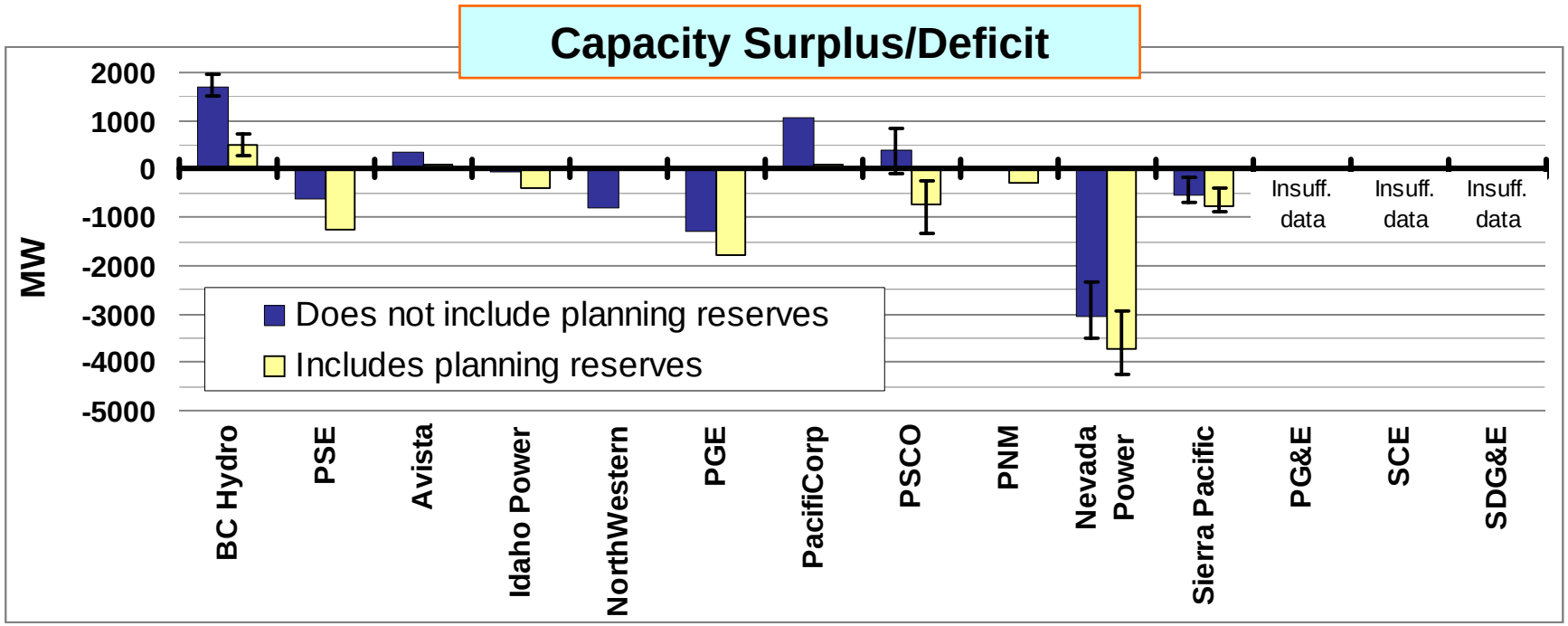
How Large are Utilities' Projected Resource Needs in 2008?



Surplus/Deficit without planning reserves **(% of Peak Demand)**	BC Hydro	PSE	Avista	Idaho Power	NorthWestern	PGE	PacifiCorp	PSCO	PNM	Nevada Power	Sierra Pacific	PG&E	SCE	SDG&E
	17%	-13%	19%	-2%	-69%	-32%	12%	6%	-1%	-55%	-30%	*	*	*

- **Projected difference between existing plus already-planned supply resources and forecasted peak demand**
- **"Error bars" indicate range based on high/low load forecasts**

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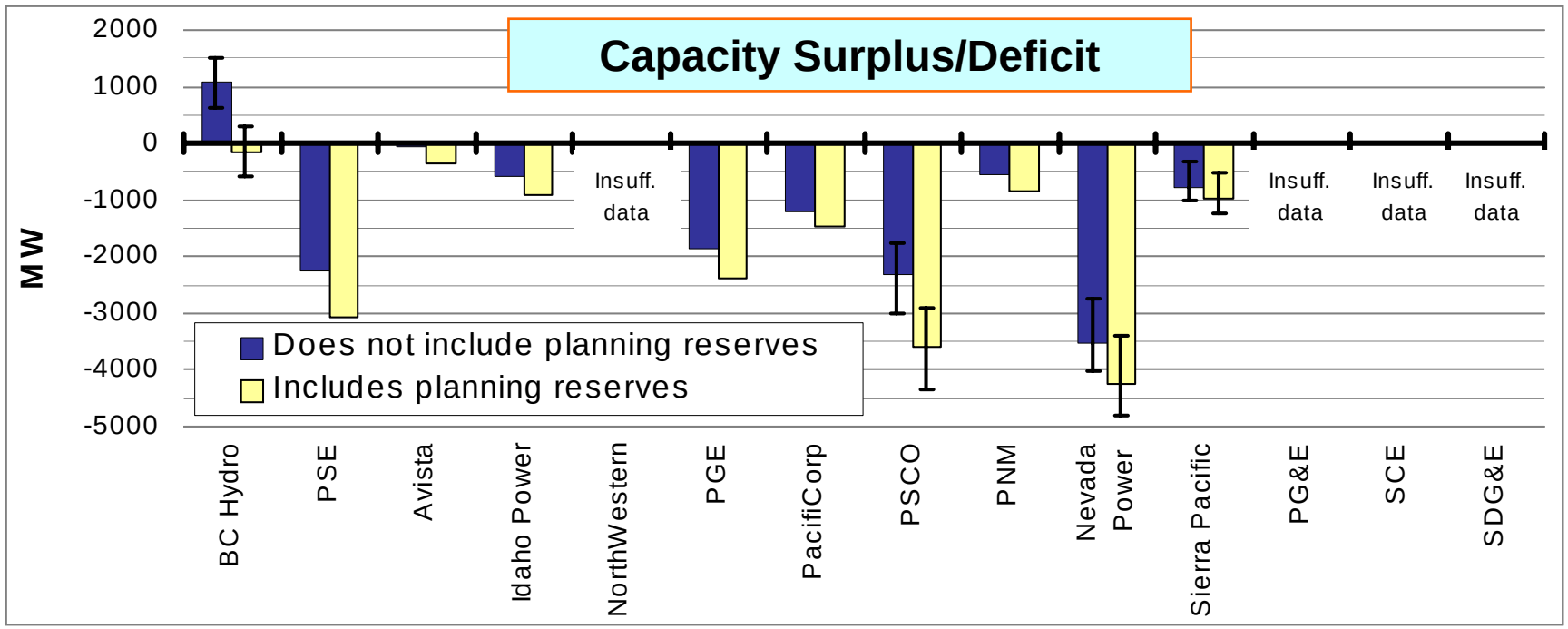
How Large are Utilities' Projected Resource Needs in 2013?



Surplus/Deficit without planning reserves **(% of Peak Demand)**	BC Hydro	PSE	Avista	Idaho Power	NorthWestern	PGE	PacifiCorp	PSCO	PNM	Nevada Power	Sierra Pacific	PG&E	SCE	SDG&E
	10%	-44%	-4%	-16%	*	-42%	-11%	-30%	-29%	-58%	-40%	*	*	*

- **Nearly all utilities project need for additional resources by 2013**

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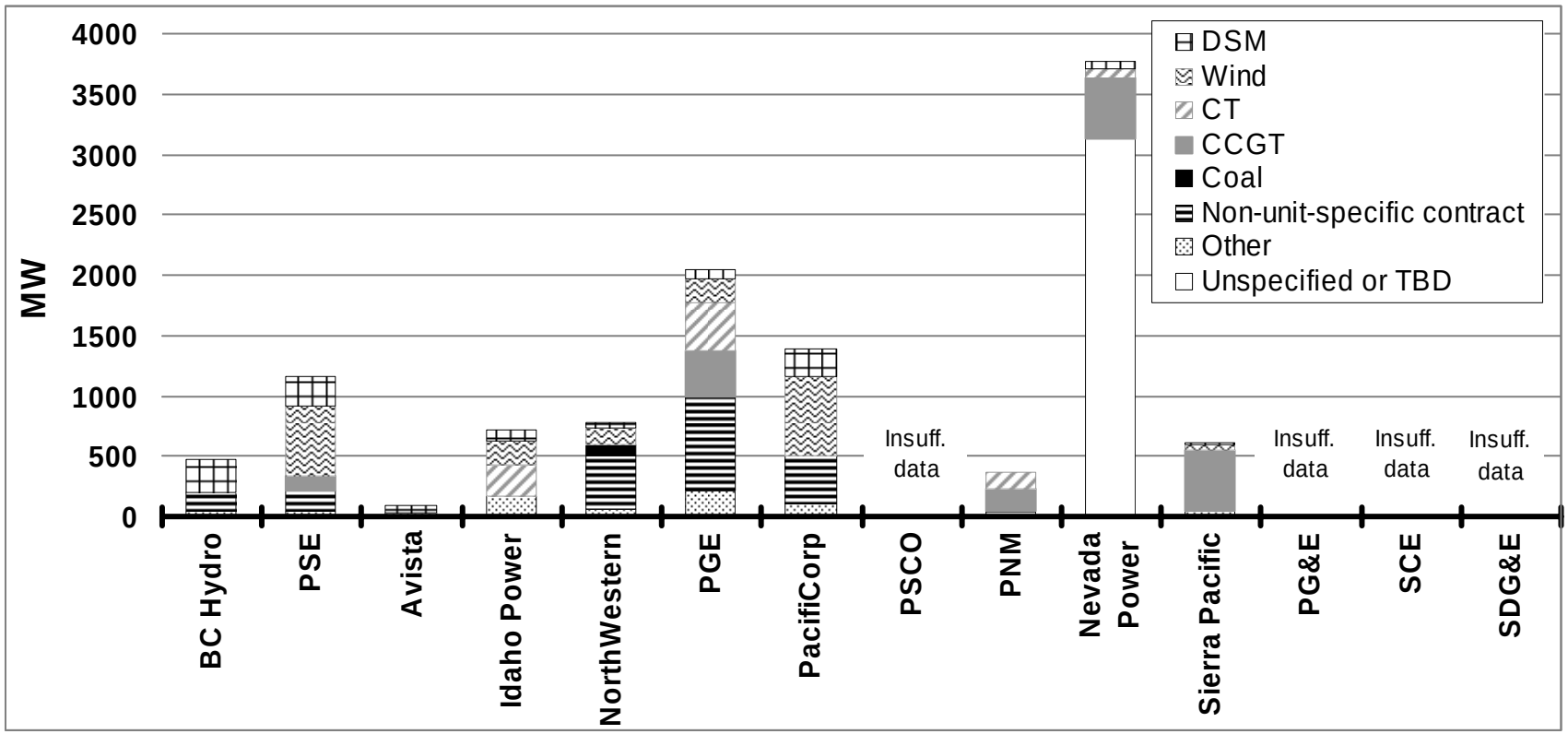
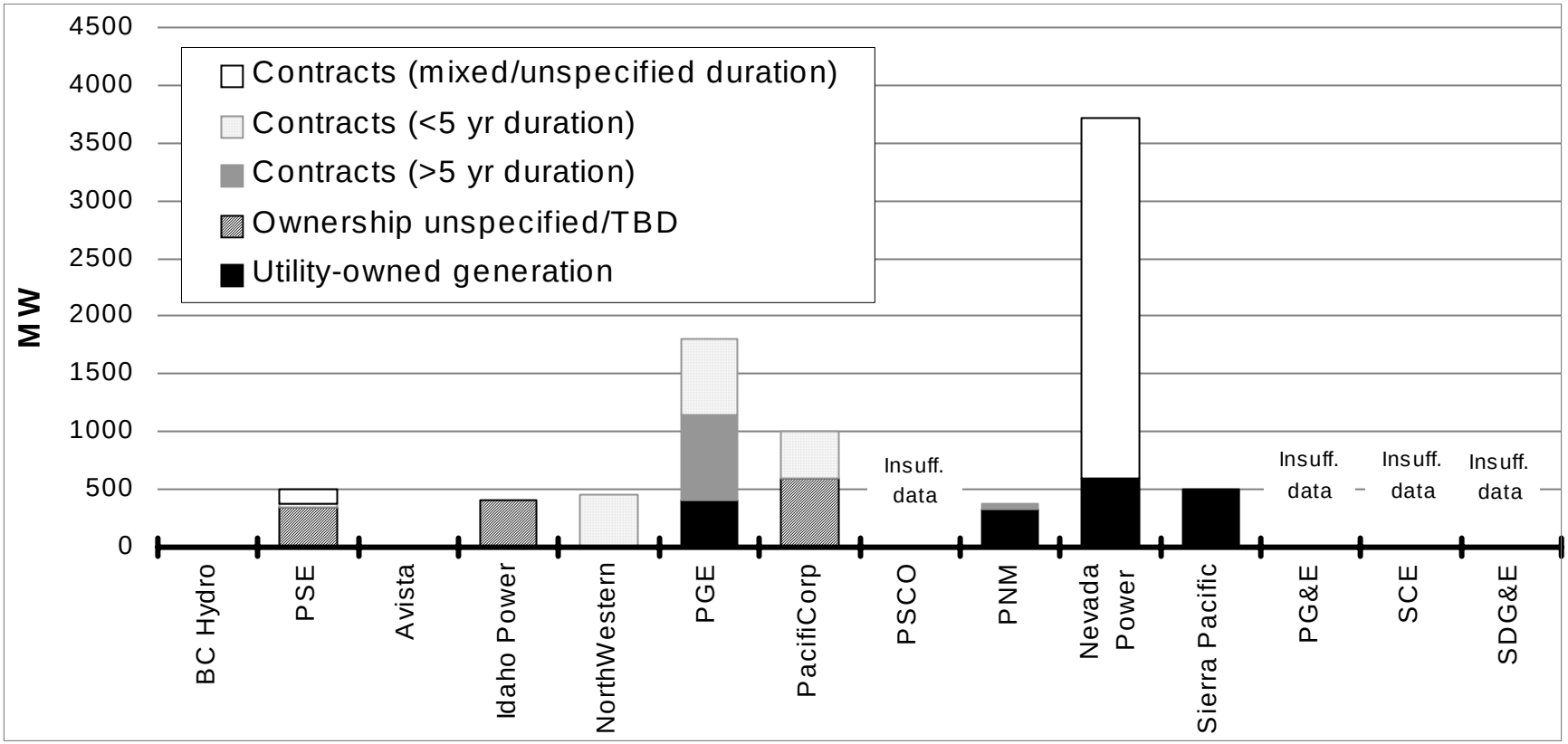
New Resources Proposed through 2008



- New additions are a combination of company-owned resources, contracted resources, and resources of unspecified ownership, depending on the plan.
- DSM represents about 10% of proposed new capacity additions; higher if CA data were available

New Resources Proposed through 2008: Ownership Type and Contract Length



- **Resource ownership specified in IRP or determined following RFP (PacifiCorp, PGE)**
- **Contract resources: PPAs, seasonal exchanges, tolling contracts, shaped products, etc.**

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Treatment of Risk in IRP Plans

General Treatment of Risk in Utility IRPs

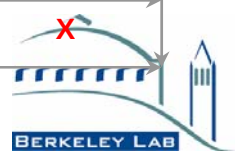
Three Different Kinds of Risk:

Each Merits Different Analysis Techniques

- Risk impacts and probabilities can be quantified (e.g., short-term gas price risk) → stochastic or scenario analysis
- Risks impacts can be quantified, but probabilities cannot be easily quantified (e.g., carbon regulations) → scenario/stress analysis
- Risks impacts and probabilities that cannot be quantified (e.g., FERC market redesign) → qualitative analysis

What Risks Are Addressed by Scenario or Stochastic Analysis in Western IRPs?

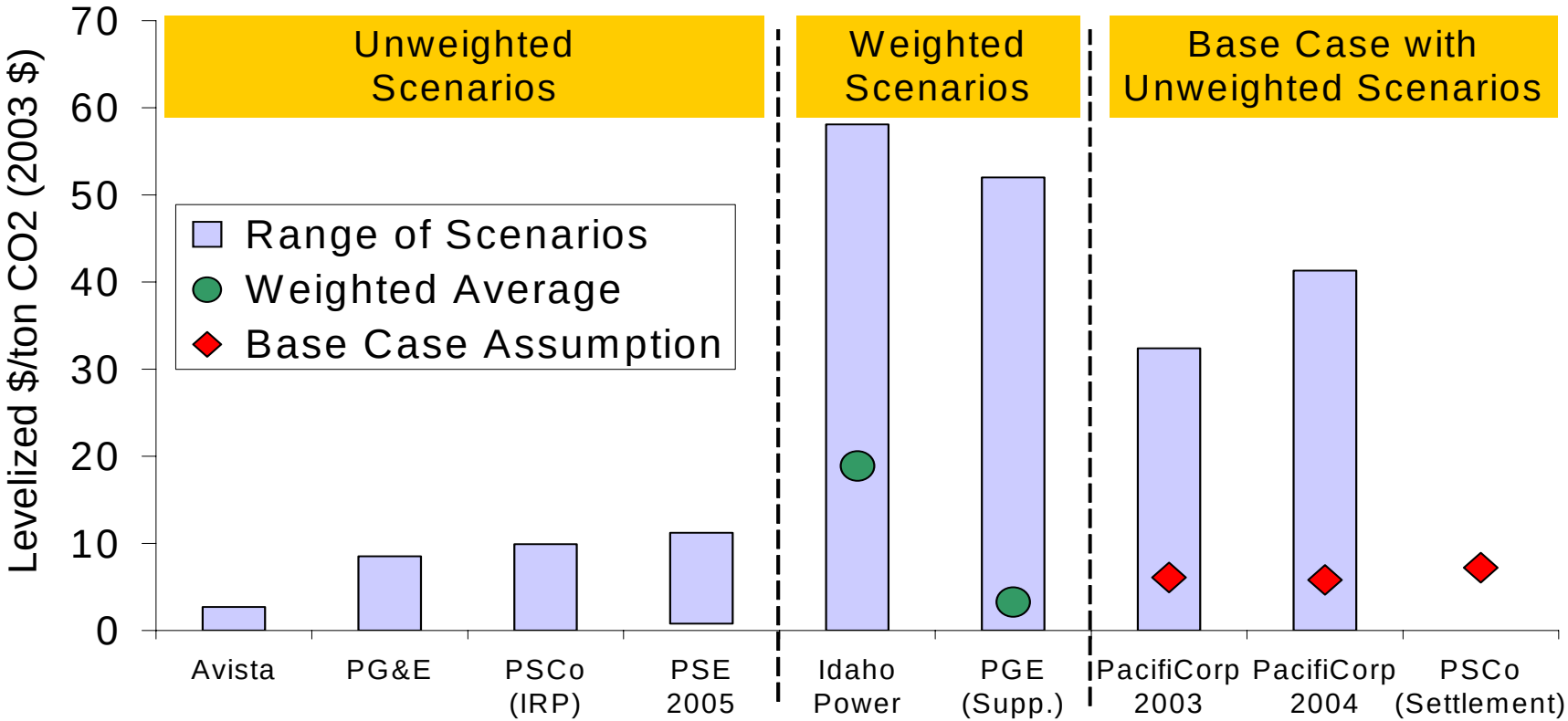
	Natural gas prices	Load growth	Electricity spot prices	Hydro variability	Departing load	Market structure	Carbon dioxide	Other emission regs
Avista	X	X	X	X	X	-	X	-
Idaho Power	X	X	x	X	-	-	X	X
Nevada Power	X	X	X	-	X	-	-	-
NWEnergy	X	X	X	X	X	-	-	-
Pacifcorp	X	X	X	X	X	-	X	X
PG&E	X	X	X	X	X	X	X	-
Portland General	X	X	X	X	-	-	X	-
PSCo	X	X	X	-	-	-	-	-
PSE	X	X	X	X	-	-	-	-
SDG&E	X	X	X	-	X	-	-	-
Sierra Pacific	X	X	X	X	X	-	-	-
SCE	X	X	X	X	X	X	-	X



Western Resource Plans Are Increasingly Evaluating Carbon Regulatory Risk

- 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 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

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Treatment of Natural Gas Price Risk

Topics

Summarize treatment of natural gas price risk in Western utility resource plans

- **Motivation - Why Does Natural Gas Price Risk Matter?**
- **Treatment of Natural Gas Price Risk in Western IRPs**
  - Base-case gas price forecasts
  - Sensitivity analysis for gas price risk
    - Long-term risk
    - Short-term risk
  - Stochastic analysis for short- and long-term gas price risk
  - Other Issues
- **Best Practices, Recommendations, and Open Issues**

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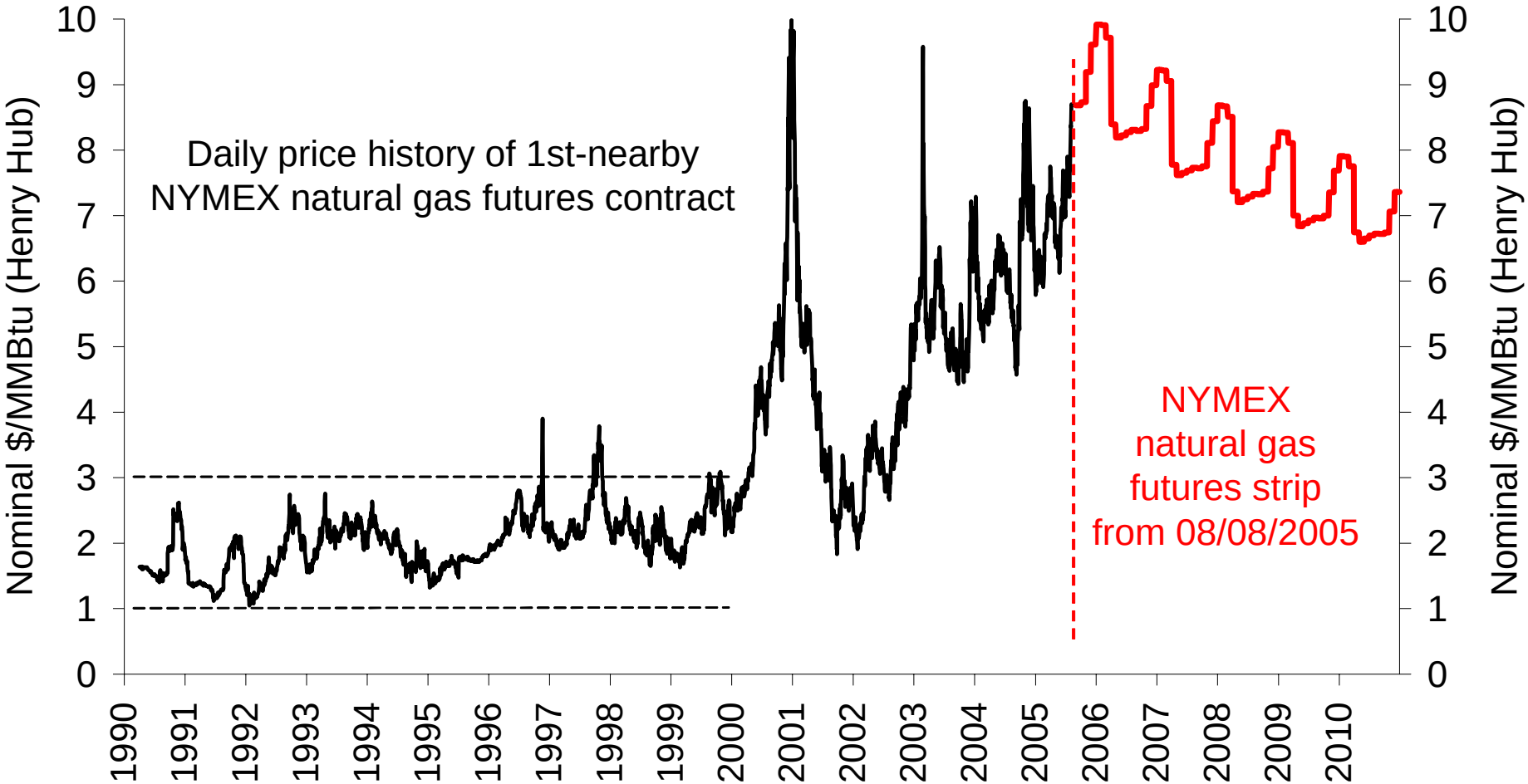
Natural Gas Prices are High and Volatile



Source: NYMEX

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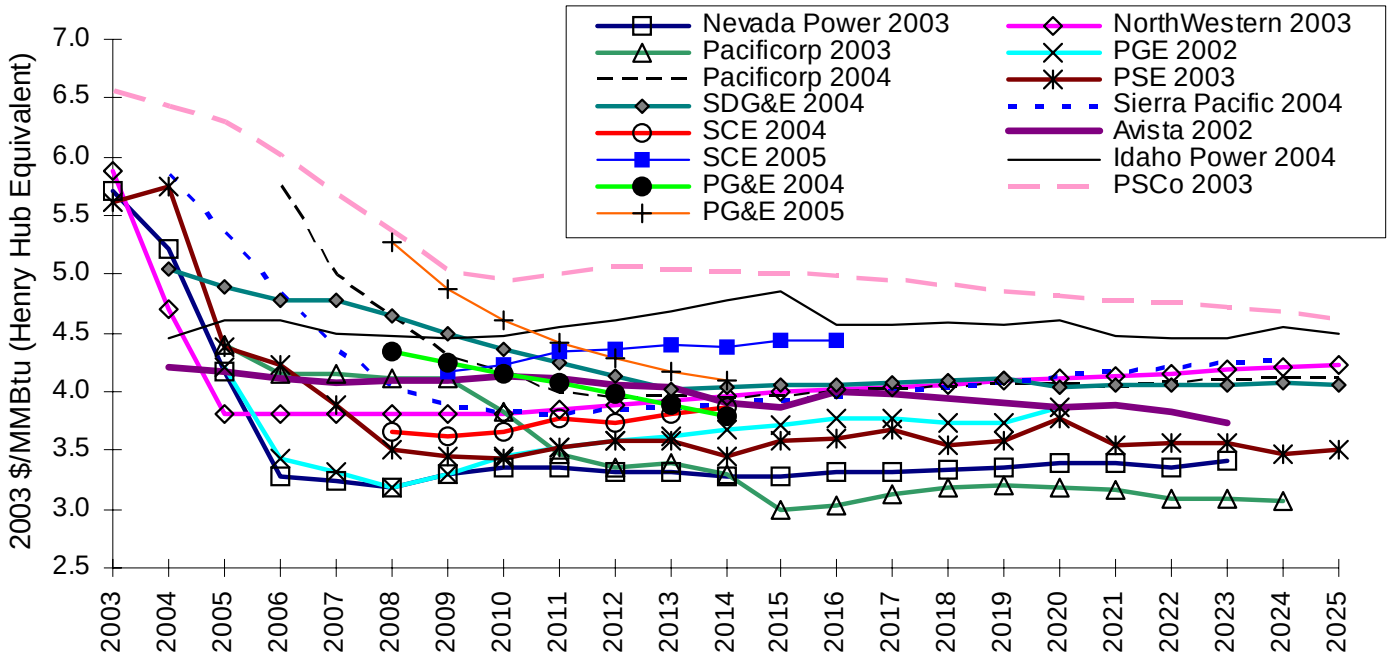
Mitigating Gas Price Risk Poses Challenges

- Gas-fired generation is still expected to play a major role in new capacity additions
- A variety of tools can be used to mitigate price risk, but because mitigation options are not “ideal”, no single solution will do!
  - **Coal Generation:** environmental damages, risk of future carbon regulations, and heightened environmental restrictions
  - **Renewable Energy and Energy Efficiency:** question over how much of a contribution they can provide
  - **Gas Storage and Fuel Switching:** can be useful for short-term price fluctuations
  - **Fixed-Price Gas Hedging:** useful for short-term risk exposure, but long-term hedges (both fixed-price gas and, consequently, fixed price gas-fired power) are illiquid and subject to credit risk

Base-Case Natural Gas Price Forecasts Vary Considerable 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

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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	✓	✓*
NorthWestern	✓	✓
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

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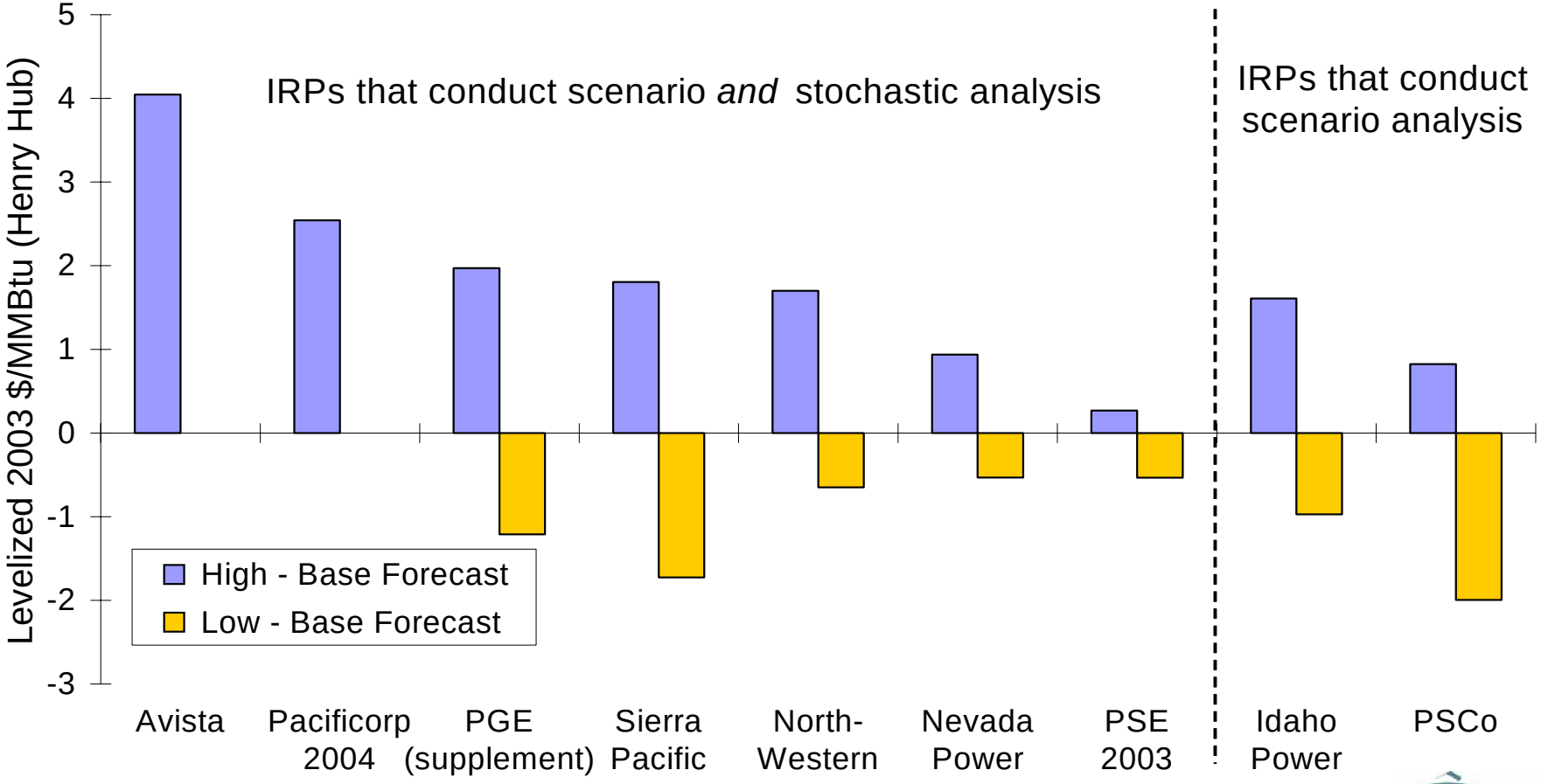
Treatment of Long-Term Gas Price Uncertainty: Sensitivity Analysis

A number of IRPs conduct only sensitivity analysis, while others do so as a *supplement* to stochastic analysis. Range of high/low sensitivity cases, relative to base, varies across plans:



Treatment of Long- and Short-Term Gas Price Uncertainty: Stochastic Analysis

- **Stochastic analysis is increasingly used to evaluate short- and long-term gas price risks in Western IRPs**
- **Range of potential gas price forecasts are developed in conjunction with other key variables (electricity prices, hydro availability, etc)**

- **Northwestern Energy**
- **Avista**
- **PSE**
- **PacifiCorp**
- **Portland General Electric**
- **Southern California Edison**
- **Pacific Gas & Electric**
- **San Diego Gas & Electric**

Basecase gas prices, and other stochastic variables → Application of statistical methods → Numerous, unique sets of input data (probability distributions) → Statistical sampling, and numerous iterations by the model → Several hundred unique sets of results

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Best Practices and Recommendations: Suggestions for Characterizing Gas Risks

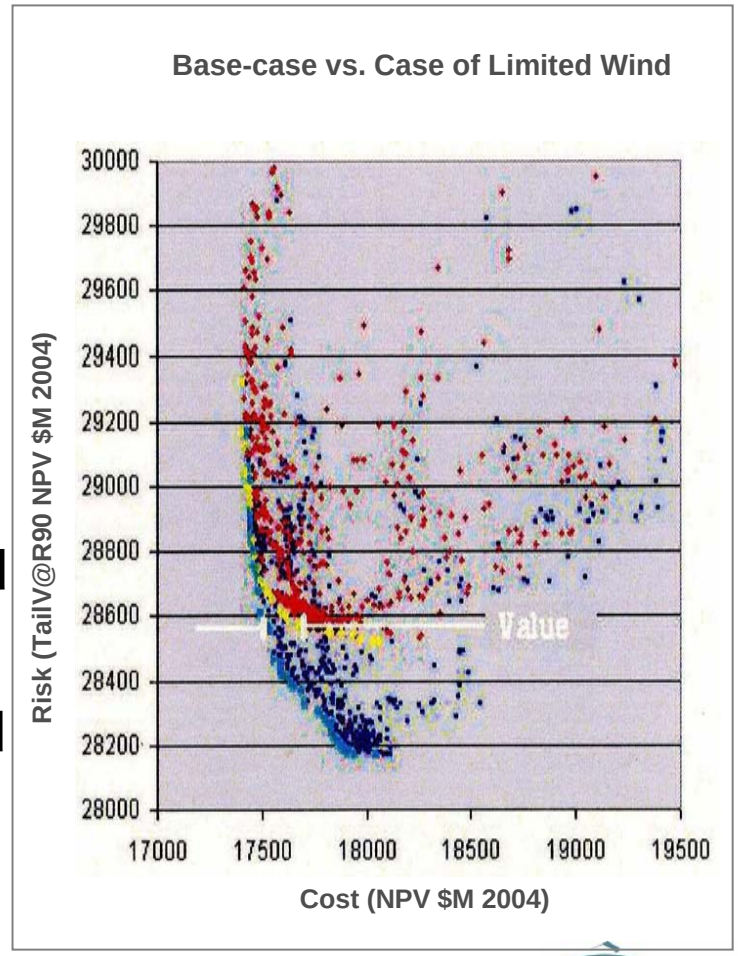
- **Risk analysis tools have become sophisticated:** use them
- **Forward markets arguably are the best predictor of gas prices:** if utility price forecasts diverge significantly from 5-year NYMEX forward curve, an explanation is warranted
- **Future gas prices are highly uncertain:** be humble, and do not put much weight on the base-case forecast
- **Interactions between different risk elements affecting gas prices are important:** consider linkages between gas costs, hydro availability, weather, load, etc.

Best Practices and Recommendations: Resource Portfolio Considerations

- **Develop portfolio choices that mitigate risks:** portfolio choices to mitigate risk need to be well specified
  - Numerous portfolios should be considered: risks should be identified and analyzed, and mitigation options should be explored
  - Subset of portfolios should be designed to explore impact of certain resources on gas risks (e.g., a portfolio focusing on increased renewables and gas – relative to base portfolio) is not likely to show the beneficial effects of renewables on risk reduction)
- **Multiple hedging options exist:** understand the options and their limitations
  - short-term uncertainty can be hedged through natural-gas-based derivatives, fixed-price gas contracts, and gas storage
  - long-term uncertainty may be hedged physically through non-gas resources

Issues to Discuss with your PUC on cost vs. risk

- **Portfolio Selection: Balancing Cost and Risk**
  - Acting as agents on behalf of customers, regulators arguably need to provide guidance to utilities on cost/risk preferences: risk management goals, performance, and expectations must be established
  - What analysis needs are necessary to better understand this tradeoff, and should that analysis be pursued jointly?



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Treatment of Energy Efficiency

Energy Efficiency Topics:

- **Treatment of Energy Efficiency (EE):**
  - Why does it matter?
  - Framework for tracking EE resources over time
- **Energy Efficiency in Utility Resource Plans:**
  - Common Inconsistencies and Data Problems
  - Results: Role of EE in Current Resource Plans
- **Recommendations for tracking and reporting EE in future resource plans to support West-wide goals and analysis**

Why Does Treatment of Energy Efficiency (EE) in Resource Plans Matter?

- **EE is or is likely to become a significant resource**
  - **In some states, cumulative EE impacts may approach or exceed resource adequacy requirements**
- **Growing need for long-term tracking of EE resources in several venues**
  - **WGA Clean Energy initiative:**
    - Reduce electricity use by 20% from projected levels by 2020
    - Need ability to track EE contribution over time
  - **Regional resource assessment/adequacy:**
    - EE affects the level of supply resources needed to meet resource adequacy requirements
    - inconsistencies in EE treatment and insufficient EE data in utility resource plans contribute to uncertainty
  - **Voluntary Climate change initiatives?**

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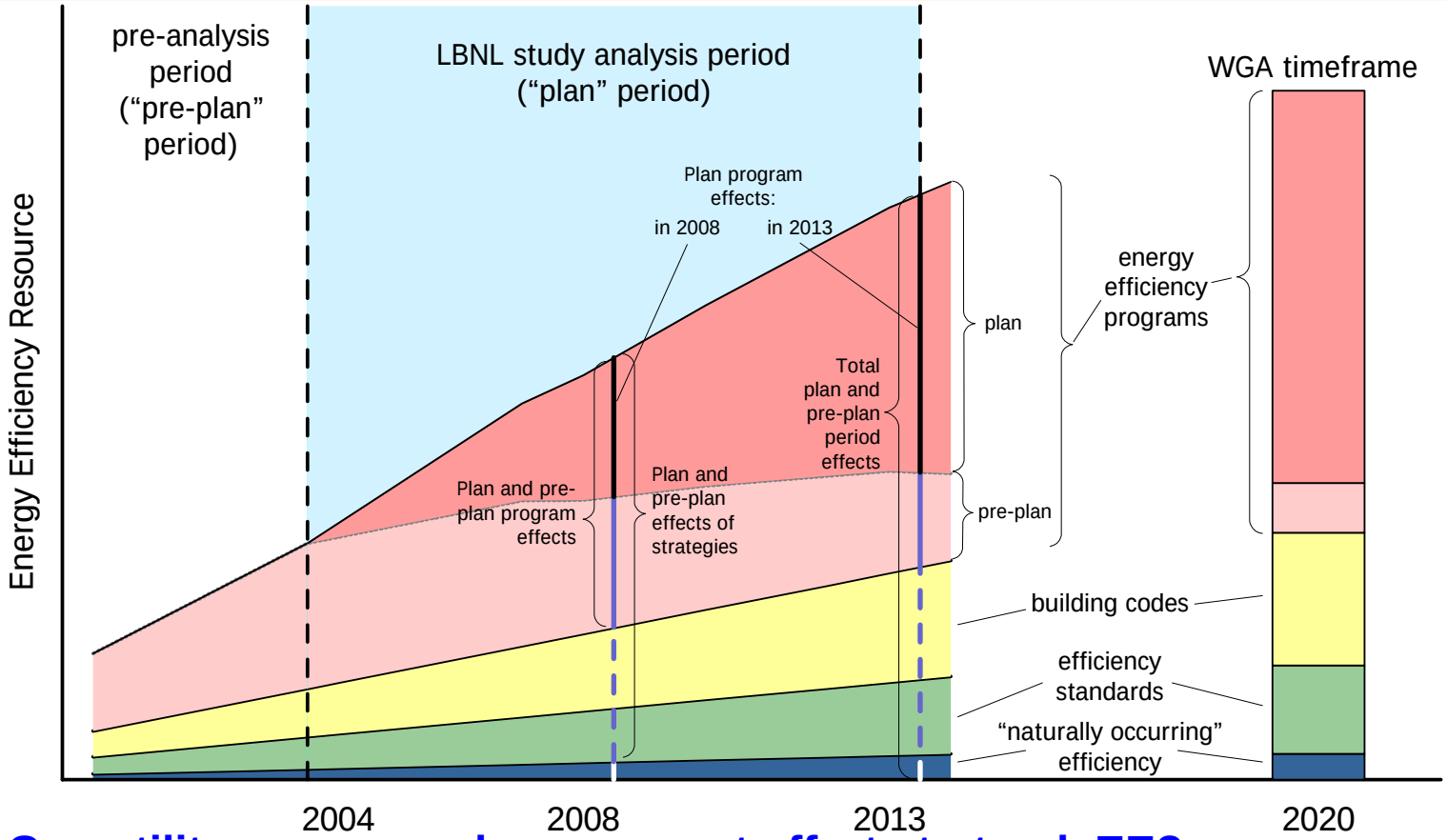
Accounting for Energy Efficiency Resources Over Time



- **Can utility resource plans support efforts to track EE?**
- **Need to distinguish among EE resource strategies:**
  - **EE programs, building codes and EE standards**
- **And EE proposed in resource plans from residual savings from "pre-plan" EE**

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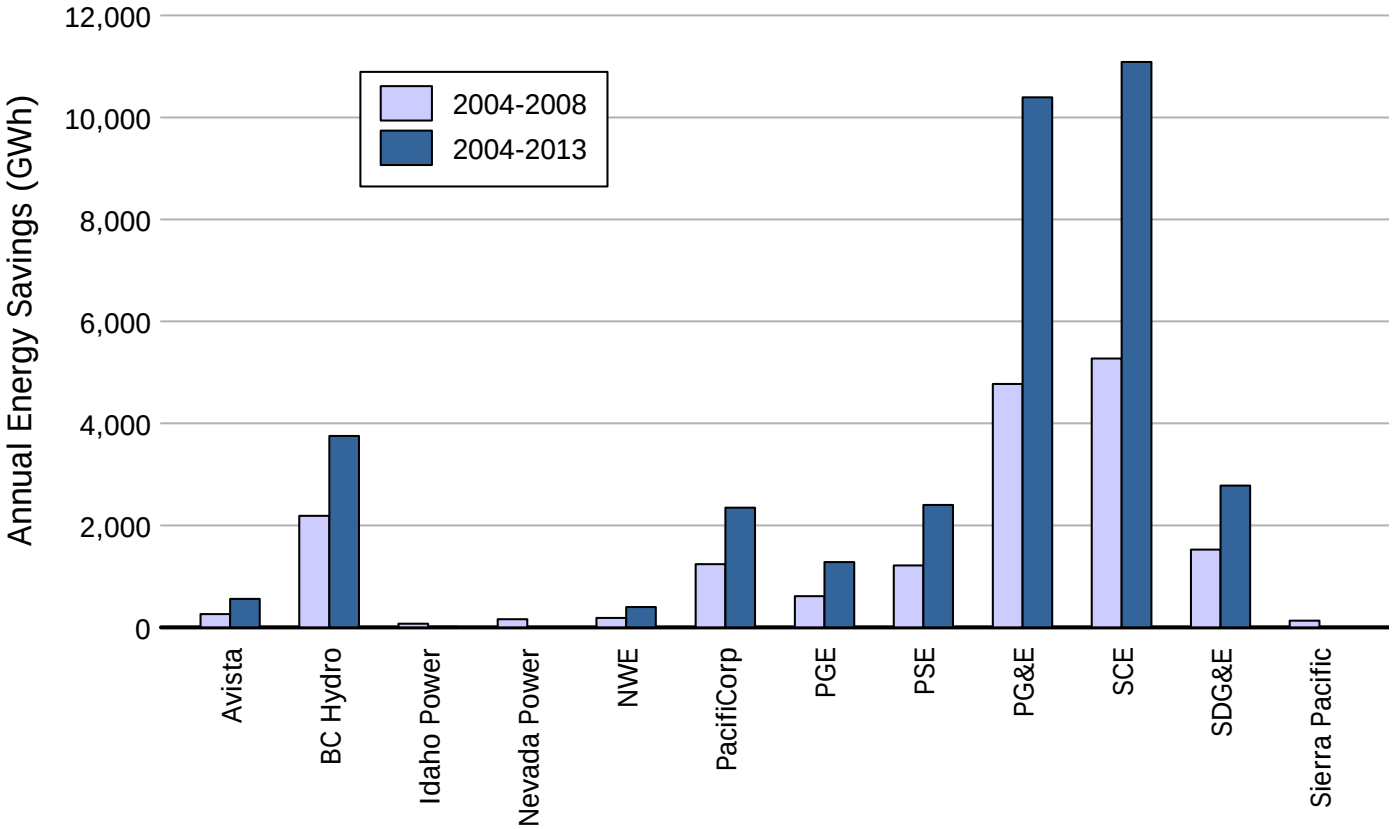
Inconsistencies and Insufficient Data in Current Western Resource Plans

- **Data reported does not include all EE resources**
  - only EE program effects reported (no EE standards or building codes)
  - only effects of EE programs proposed in the current plan — no savings from previous investments reported
  - plan and pre-plan savings not reported separately
- **Energy efficiency often embedded in the load forecast**
  - Difficult to assess impacts of utility EE programs, other EE strategies (codes, standards), and "naturally occurring" EE
- **Planning and time horizon issues**
  - tends to be short for EE resources vs. 10-15 years for resource plans
  - short-term EE program plans (2-5 years) vs. longer-term EE/DSM targets
- **Limited data on peak demand impacts (MW) in the Pacific Northwest**
  - Data either not reported or refers to winter peak
- **Unclear how the *level* of EE resources is determined**
  - May be based on other factors (budgets, prior agreements, etc.)?
  - Generally does not appear to be based on EE potential or cost-effectiveness analysis
- **Lack of transparency—redaction of key data**
- **Assumptions not clearly documented**

Incremental EE Program Effects Reported in Western Utility Resource Plans: Energy Savings



	Avista	BC Hydro	Idaho Power	Nevada Power	NWE	PacifiCorp	PGE	PSE	PG&E	SCE	SDG&E	Sierra Pacific
% of energy demand* growth (2008):	34%	64%	5%	*8%*	26%	69%	31%	100%	74%	76%	91%	*28%*

* Energy demand does not include load reductions from EE programs, or reserve margins

- **The majority of energy-efficiency program activity is projected to occur in California and the Pacific Northwest**
- **Four utilities plan to meet >70% of load growth with EE; four other utilities plan to offset 30-60% of load growth with EE**

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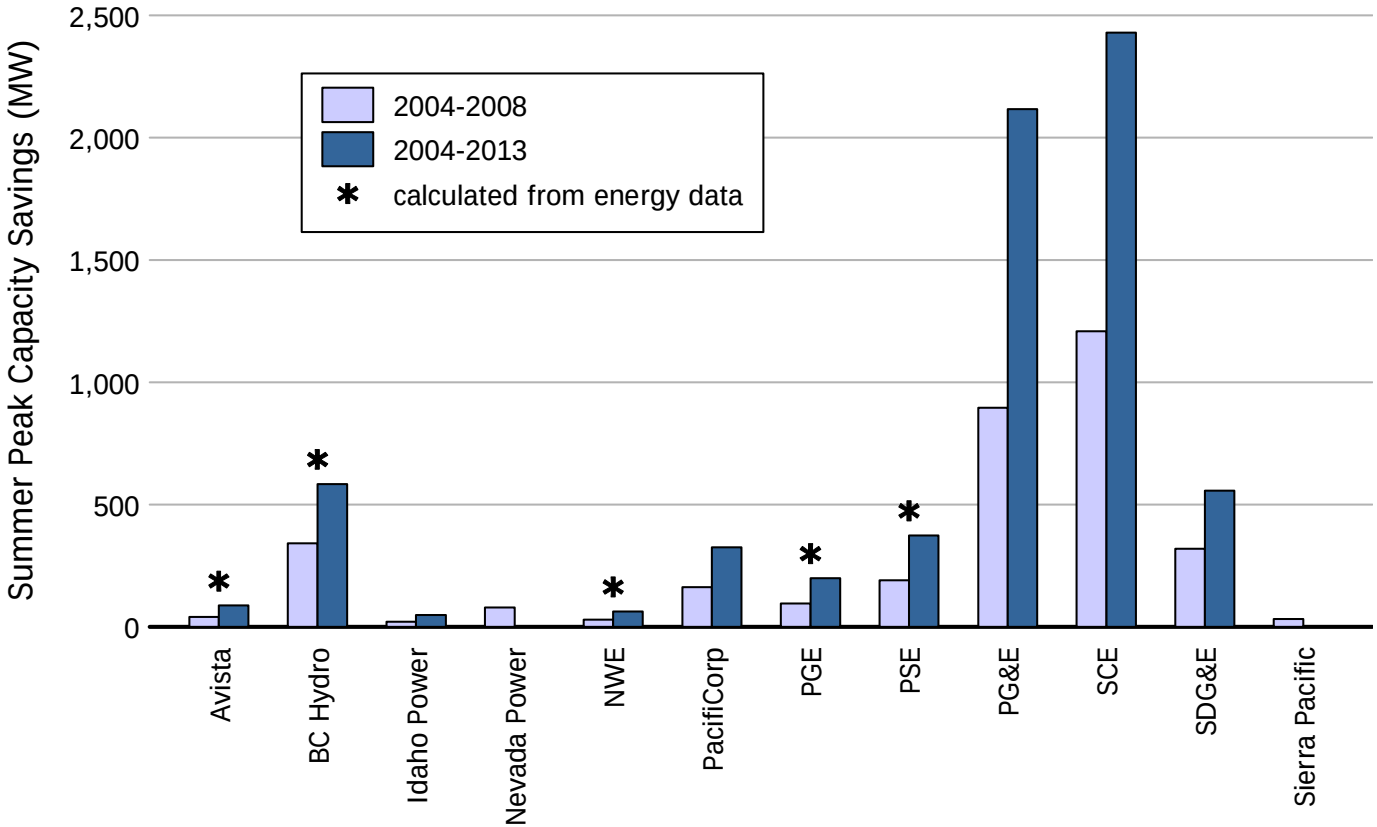
Incremental EE Program Effects: Summer Peak Capacity Savings



% of summer peak demand growth (2008):	Avista	BC Hydro	Idaho Power	Nevada Power	NWE	PacifiCorp	PGE	PSE	PG&E	SCE	SDG&E	Sierra Pacific
	29%	*63%*	6%	*15%*	--	23%	*36%*	*123%*	62%	53%	74%	*24%*

* Summer peak demand does not include load reductions from EE programs, or reserve margins

- **Somewhat larger range in utilities' summer-peak capacity savings**
- **Caveat: Most utilities in Pacific Northwest did not report peak demand savings (MW)**

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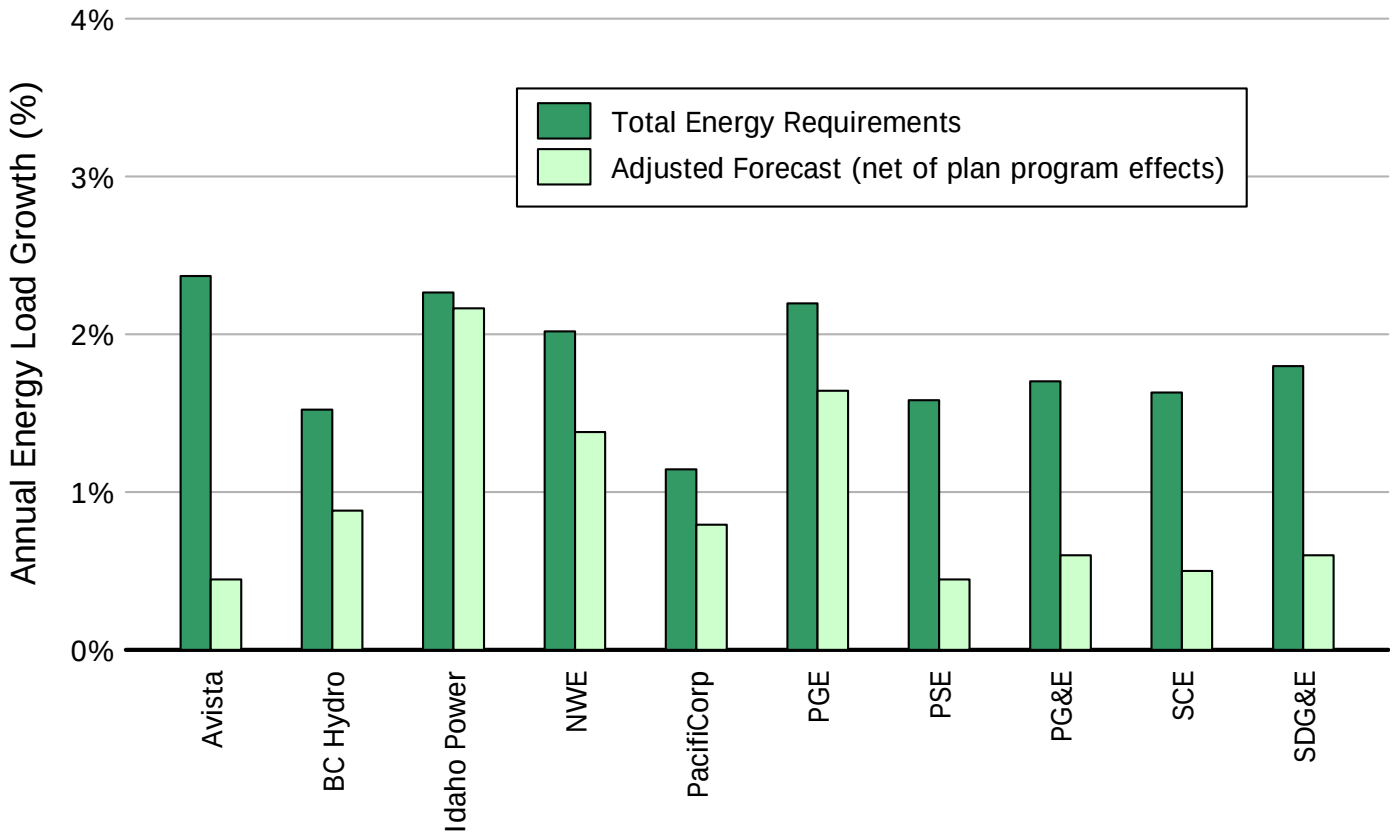
Impact of EE programs in reducing utility load growth (2004-2013)



- **Utilities' forecasted load growth without EE ranges from 1.1% to 2.4% annually**
- **EE programs projected to reduce growth to 0.4–2.2%**
  - **greatest reduction for Avista (81% decline in average annual load growth)**
  - **smallest for Idaho Power (only 4% decline)**
- **Impacts of other EE strategies (efficiency standards, building codes) not included**

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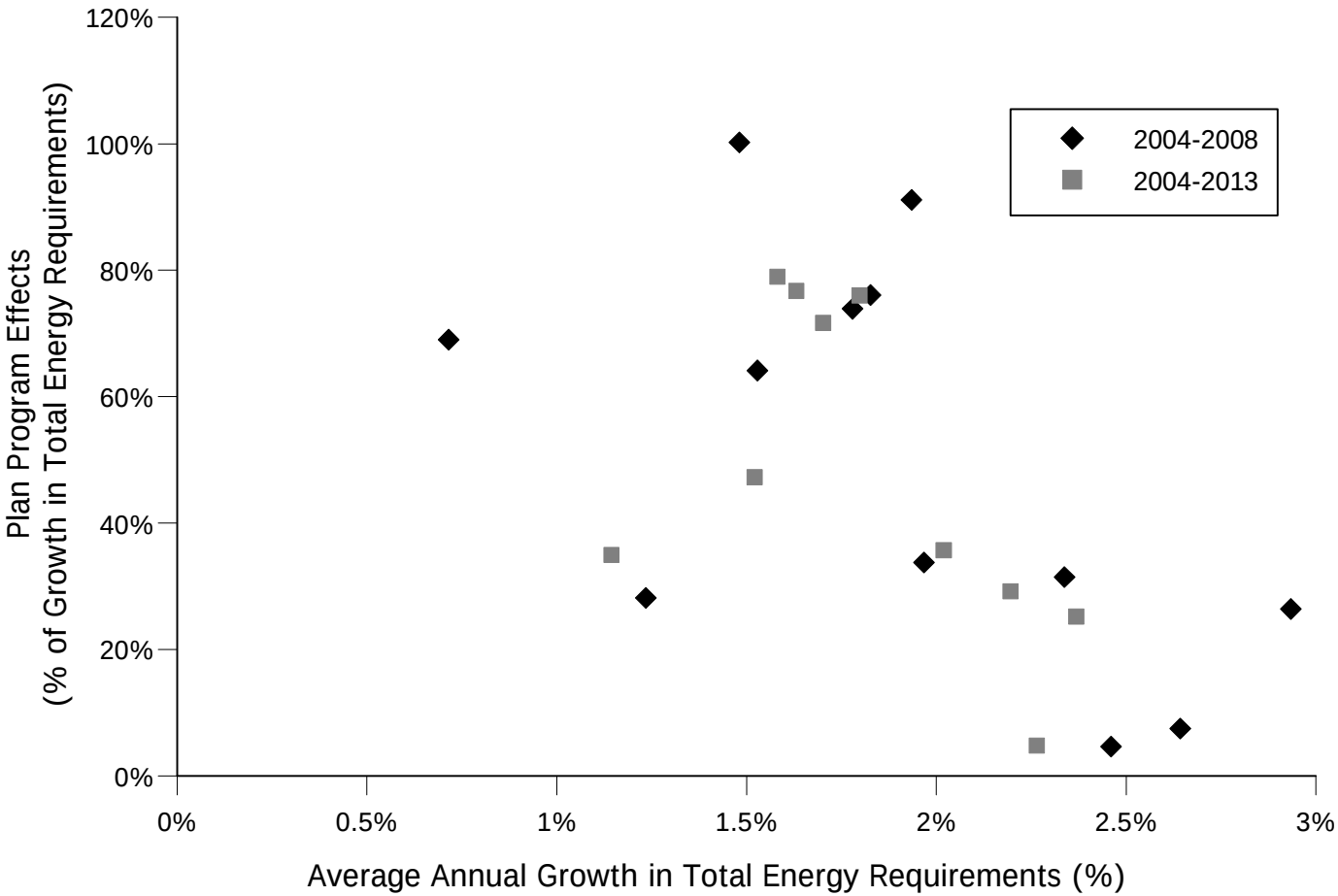
Can EE programs achieve significant load reductions in high load growth states?



- **It may be harder for utilities with high forecasted load growth to meet a large share of that growth with energy efficiency**
- **BUT—greater EE opportunities exist for fast-growing utilities (e.g., new construction)**

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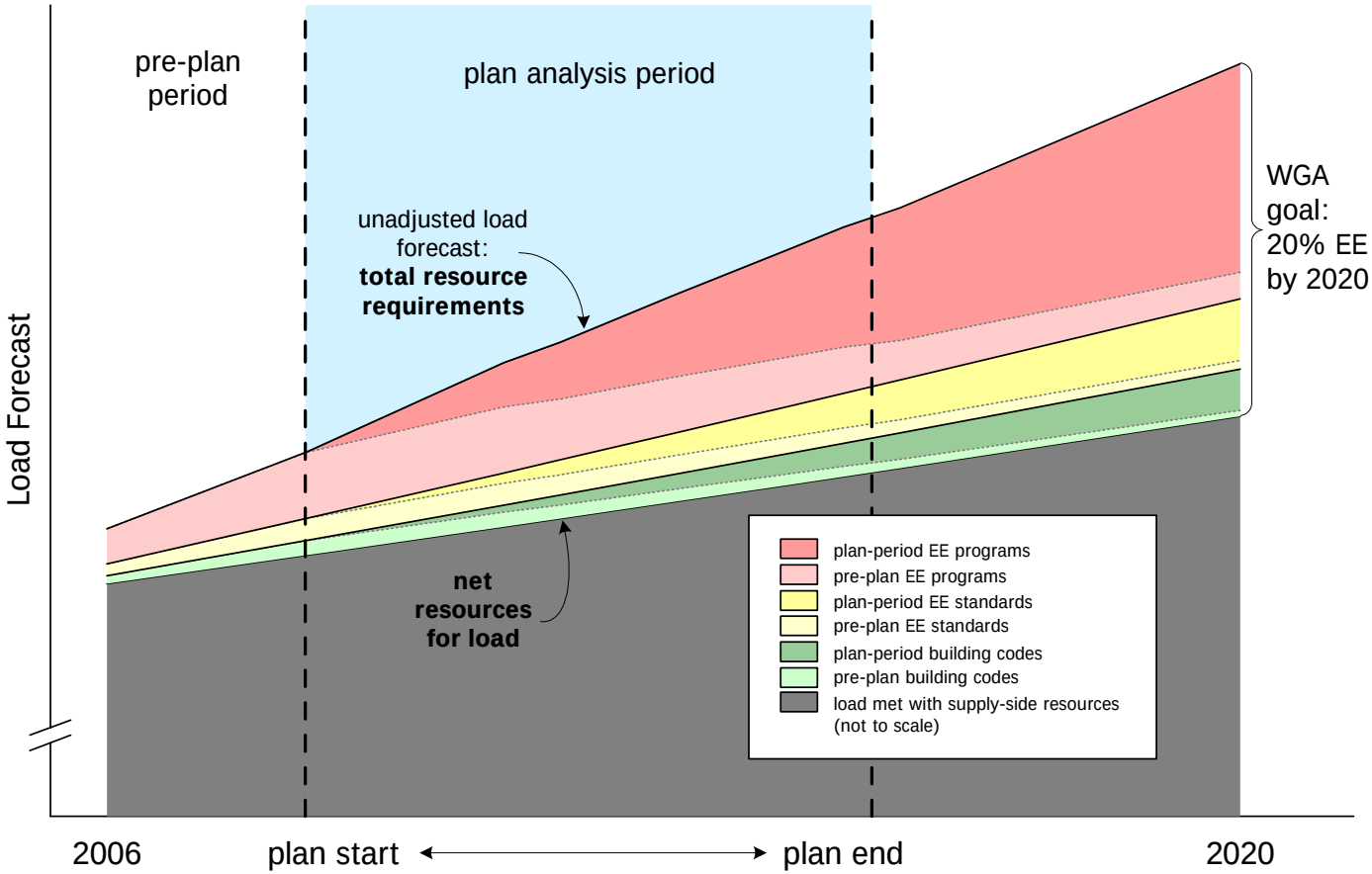
Recommendation:
Track EE Explicitly in Load Forecasts



Total resource requirements = load forecast ***not*** including demand reductions from EE strategies or reserve margins; losses are included.

Net Resources for Load = load forecast ***including*** demand reductions from EE strategies. Does not include reserve margins; losses are included.

- **Clearly track EE strategies in load forecast to establish progress toward WGA goal:**
  - **by type (EE programs, EE standards, building codes)**
  - **by implementation period (pre-plan EE, plan-period EE)**
- **To fully capture the value of EE, calculate planning margins based on Net Resources for Load**

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Treatment of Renewable Energy

Renewable Energy Topics

Summarize treatment of renewable energy (RE) in Western utility resource plans

- Planned Renewable Energy Additions in Western Resource Plans
- Portfolio Construction
- Wind Power Cost and Performance Assumptions
  - Busbar costs, transmission costs, integration costs, capacity value
- Balancing Cost and Risk

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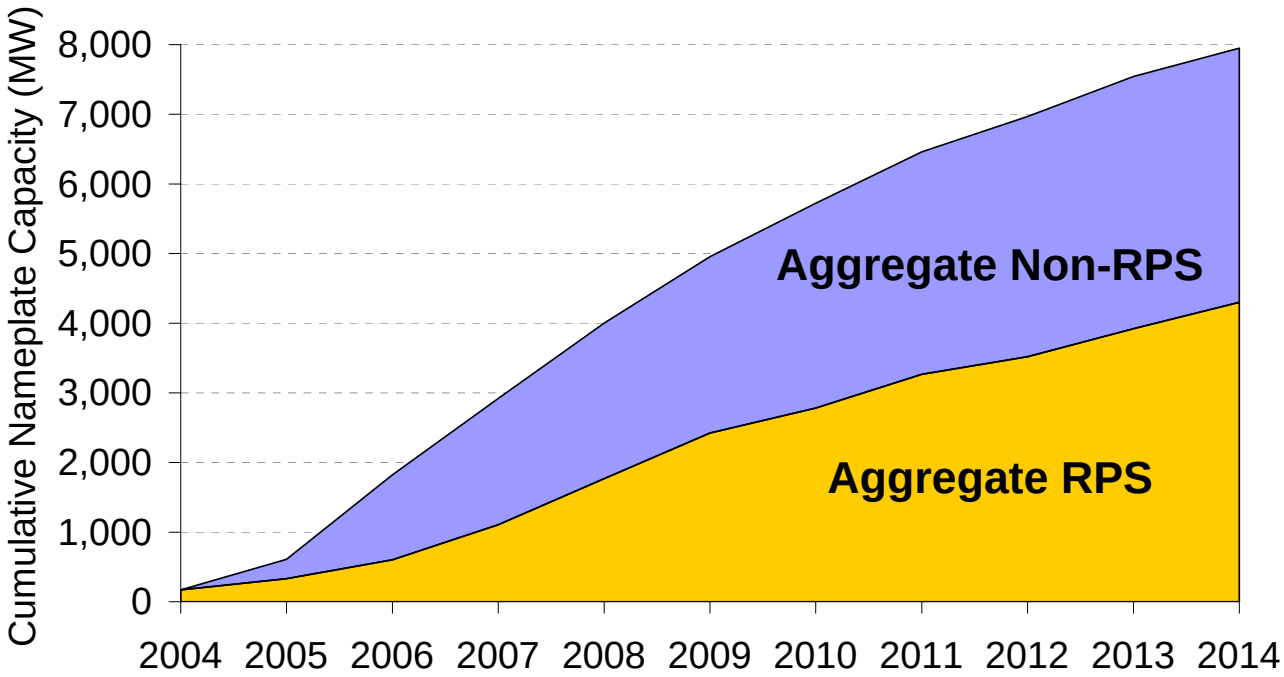
Policy Drivers: Renewables Portfolio Standard?

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
Non-RPS	0	1,420	0	745	115	500	450	0	195	150	0	75
RPS	2,150	NA	1,021	NA	630	NA	NA	361	NA	NA	137	NA
Total	2,150	1,420	1,021	745	745	500	450	361	195	150	137	75

Planned Renewable Energy Additions Are Affected By…

- 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

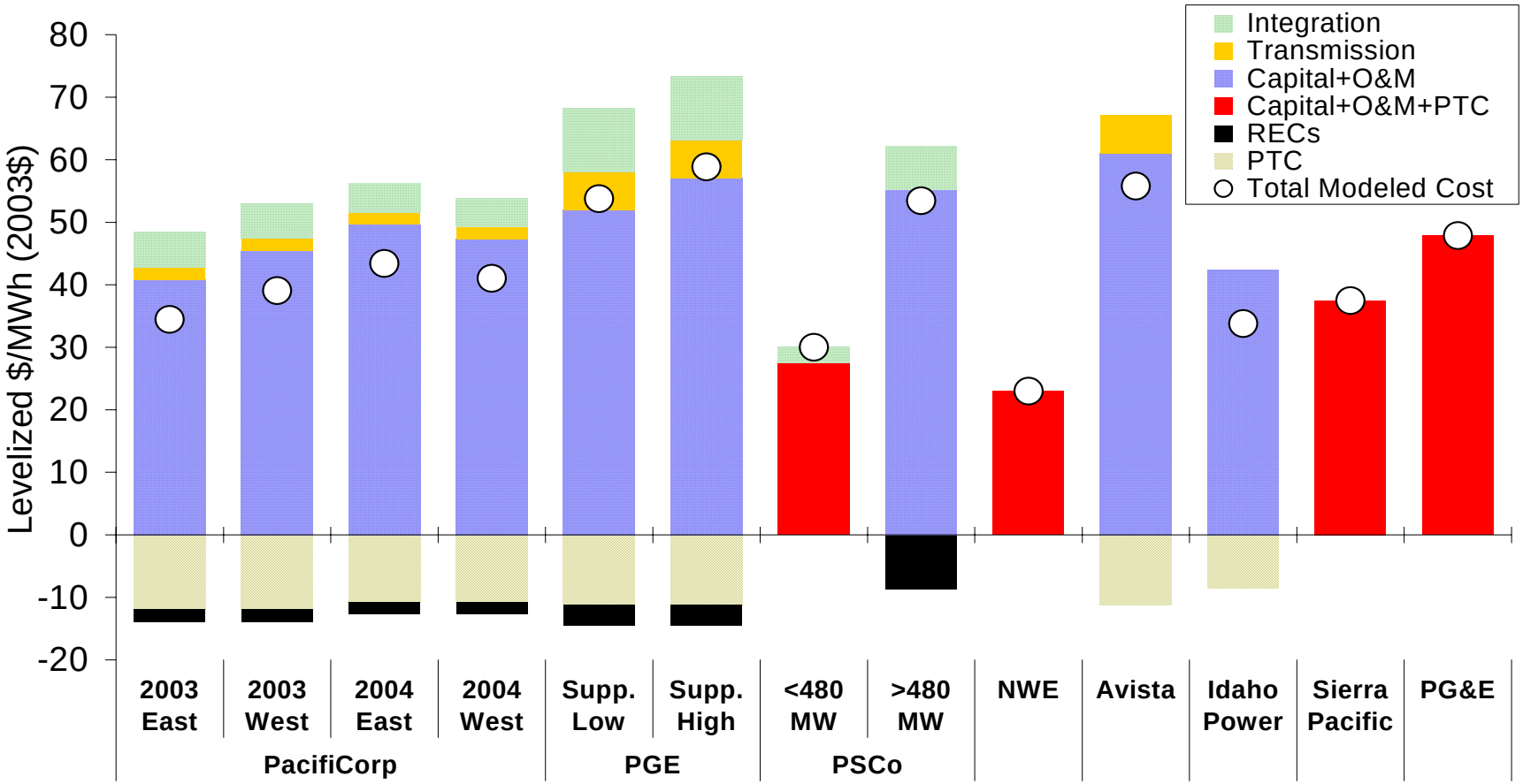
Construction of Candidate Portfolios

One of the goals of resource planning is to evaluate different possible resource portfolios

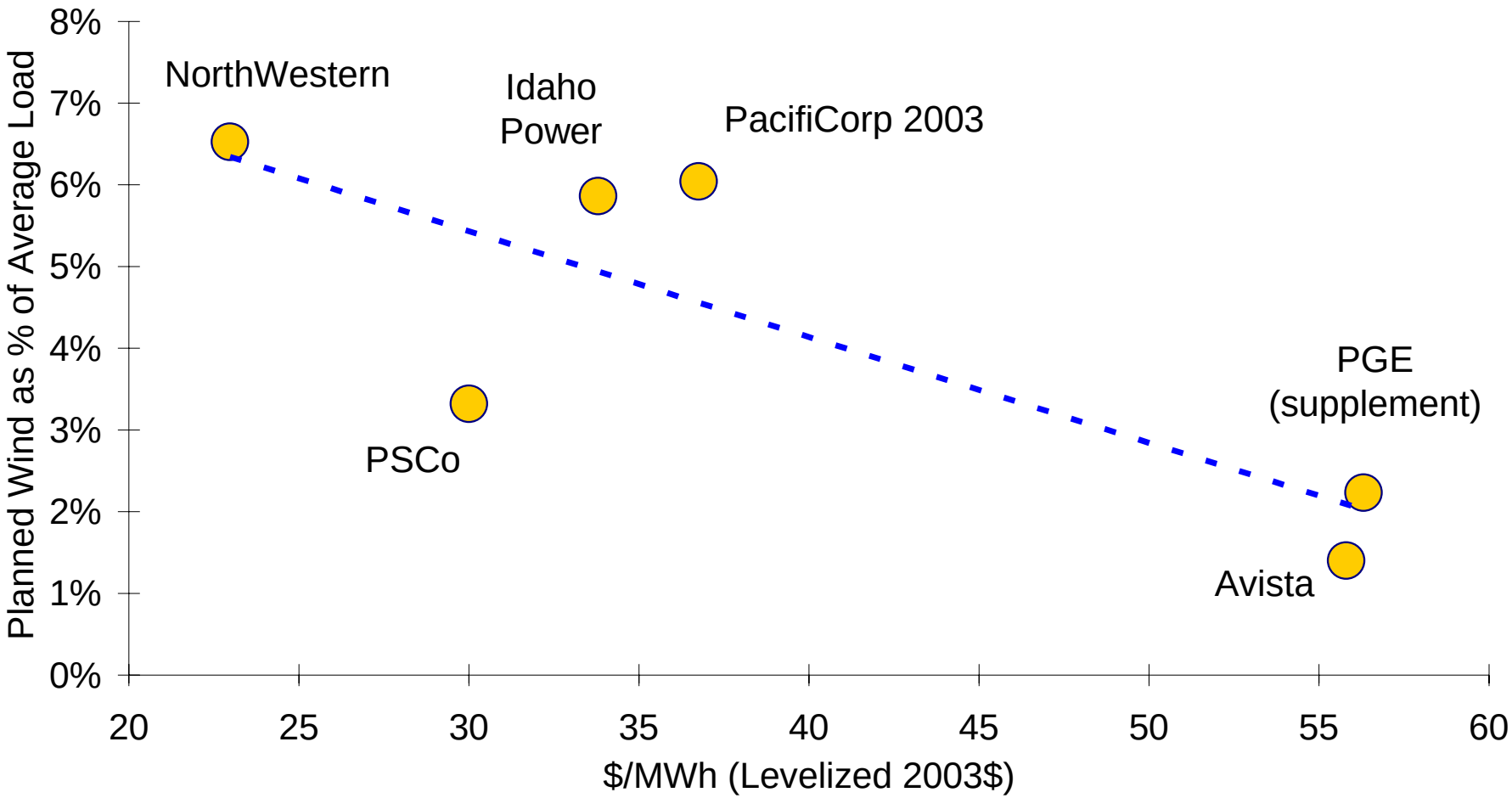
- Most utilities create the candidate portfolios by hand, making the composition of these portfolios all the more important
  - Although Avista and PSCo use an optimization process to construct portfolios
- Resource plans in states with RPS obligations frequently do little to analyze the potential value 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; 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)

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



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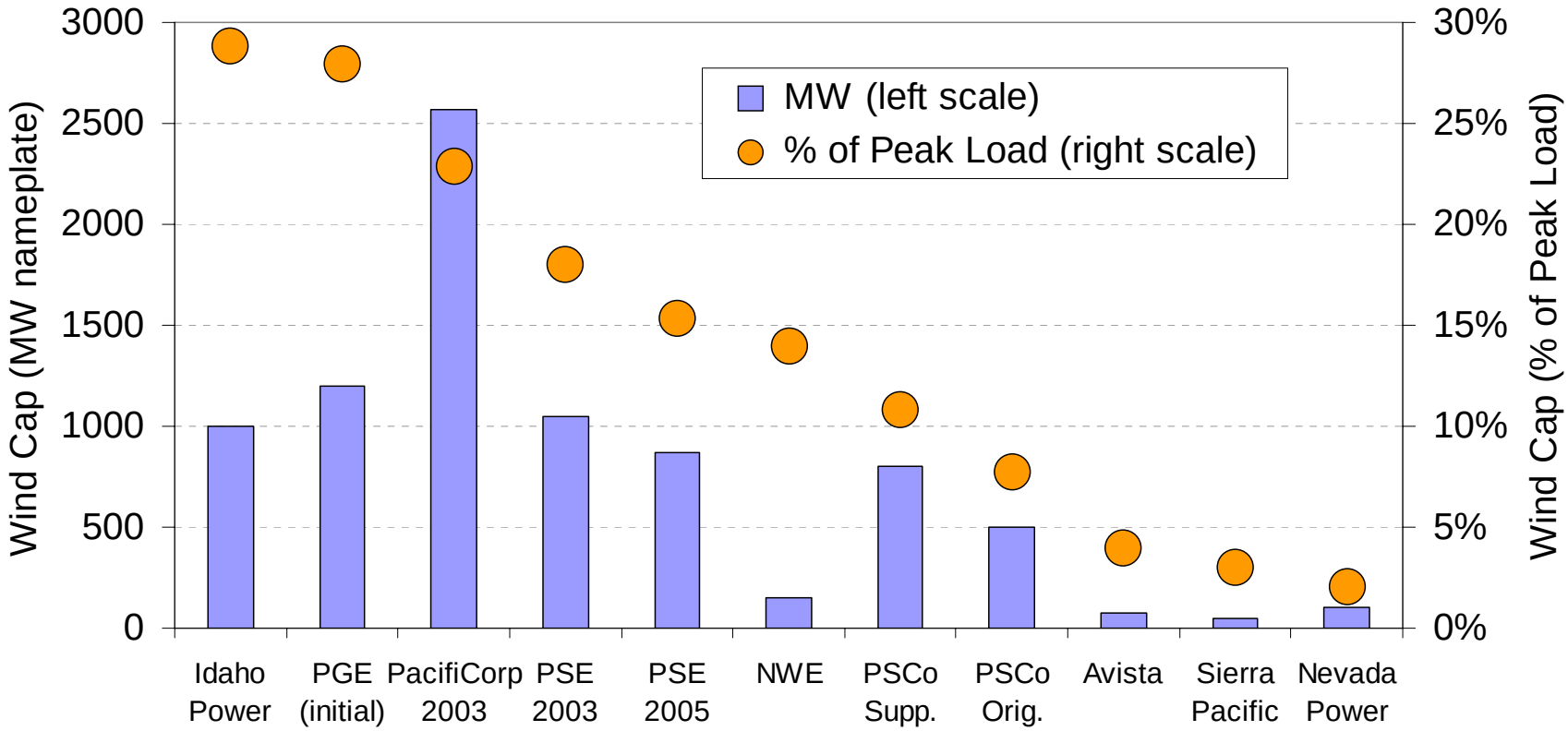
Exogenous Build Limits "Cap" the Amount of Wind Selected by Some Resource Plans



- 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)

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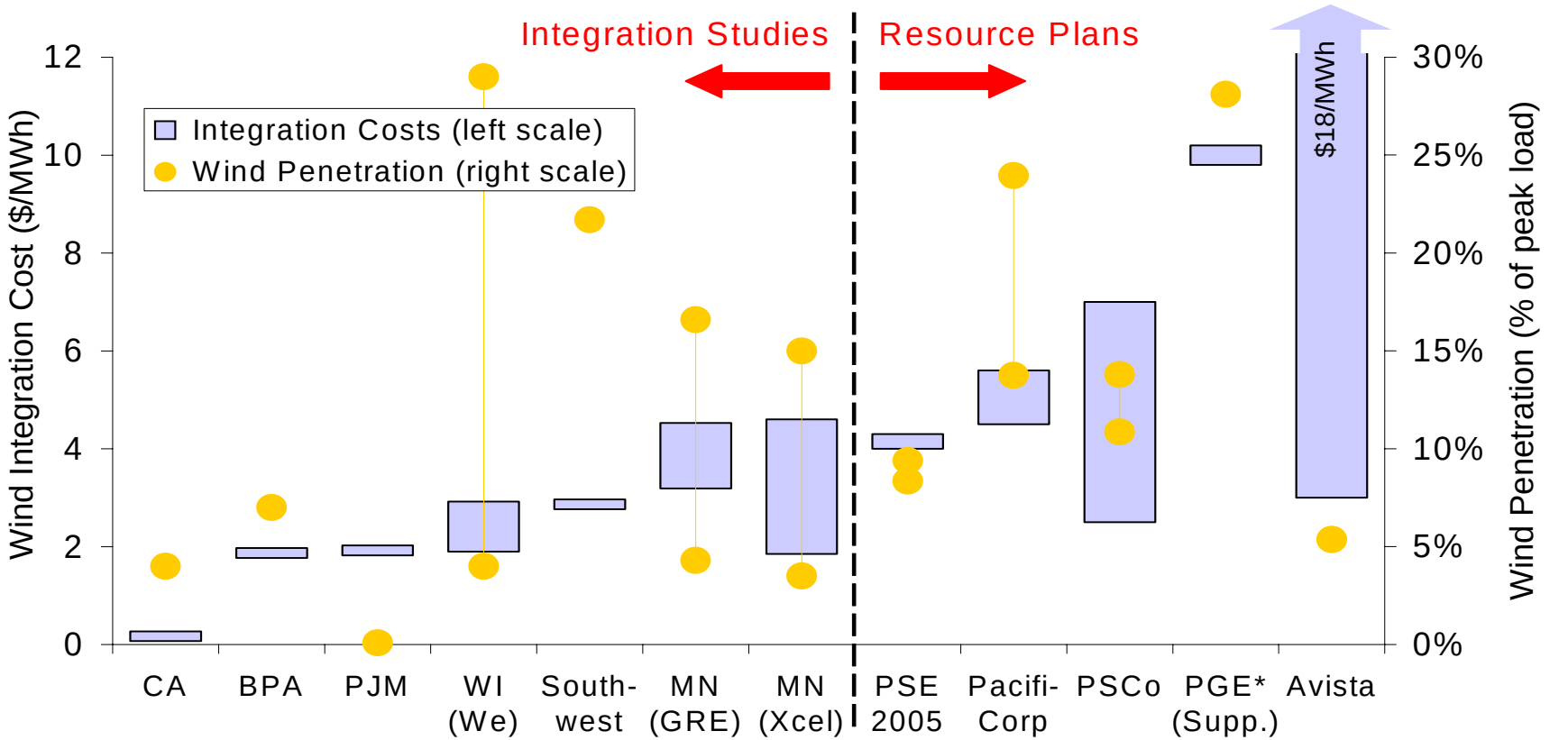
Wind Integration Costs: Resource Plans vs. Recent Analysis Studies



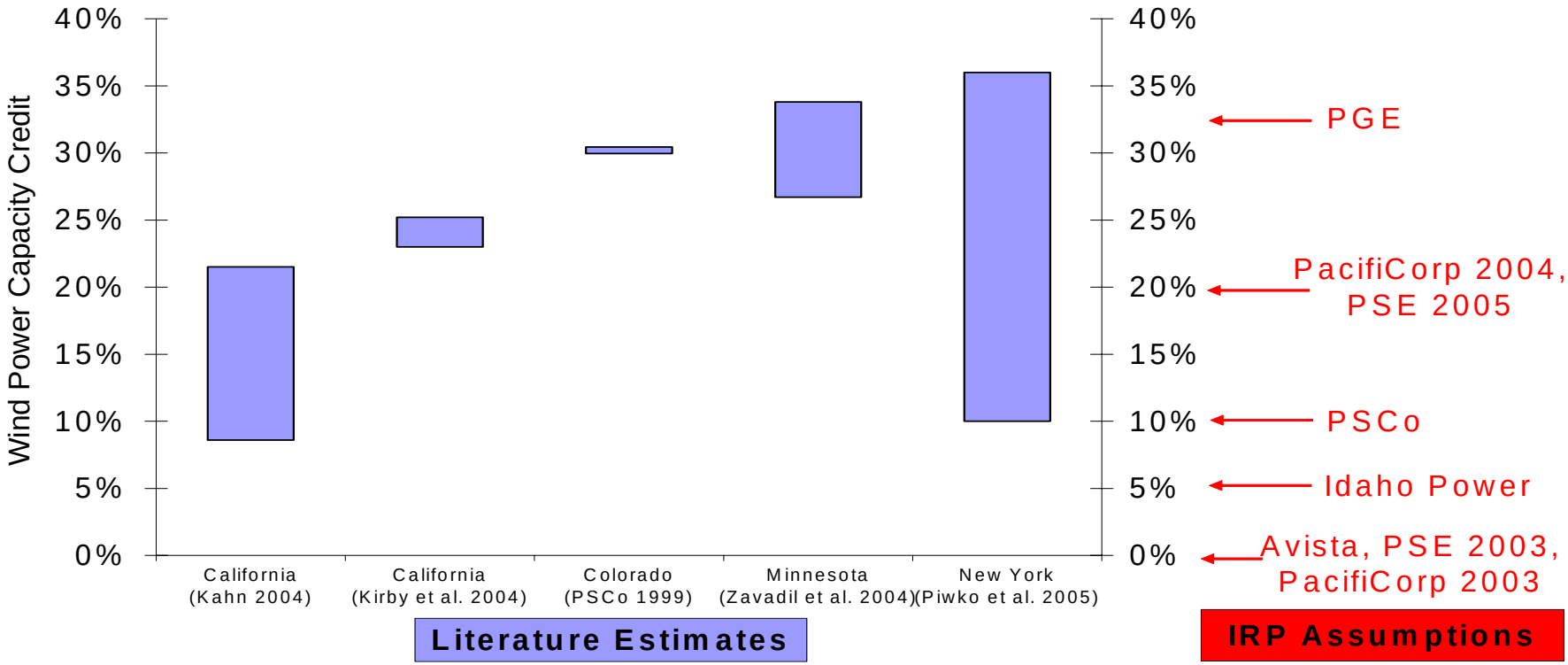
**PGE's supplemental IRP estimates the cost of creating a flat, base-load block of power out of variable wind production, rather than simply the cost of integrating variable wind production. As such, its cost estimates are not directly comparable to the others.*

- 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)

Wind Capacity Value Assumptions Are Low in Resource plans 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**



Balancing Cost and Risk

Ultimately, resource plans must balance portfolios that have different cost and risk characteristics; how this occurs can effect how well renewable projects fare

- 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

Balancing Cost and Risk: Concerns for Renewable Energy

- Plans often model RE primarily as wind power, assume a low capacity value, and apply low-limits to wind penetration
  - → 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 portfolio choice towards coal more than renewable energy
- Fuel 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

Renewable Energy Summary: Where Do We Go From Here…

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.

Renewable Energy Summary: Where Do We Go From Here…(Cont.)

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) Utilities and regulators should conduct research to evaluate ratepayer risk preferences.

9) 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.

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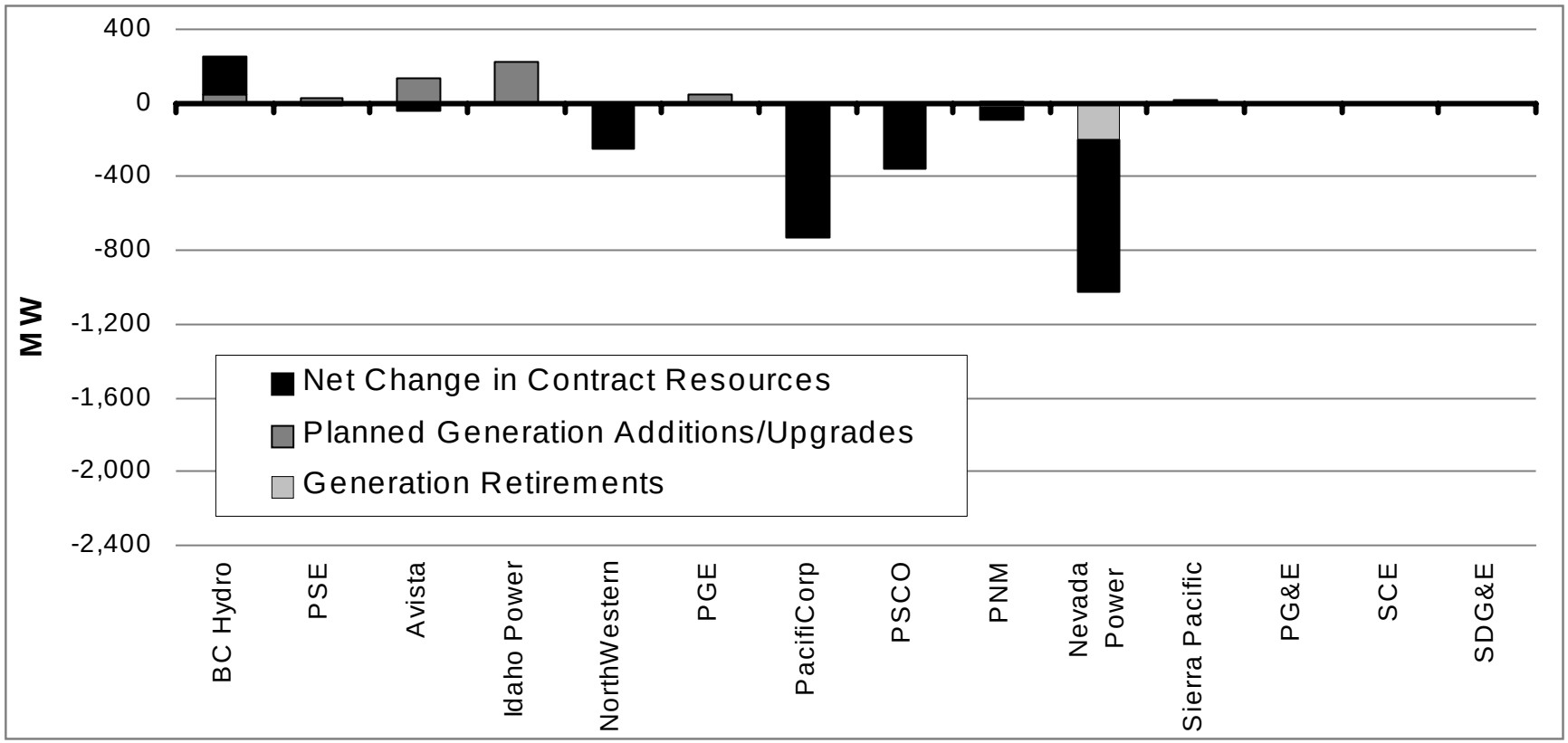
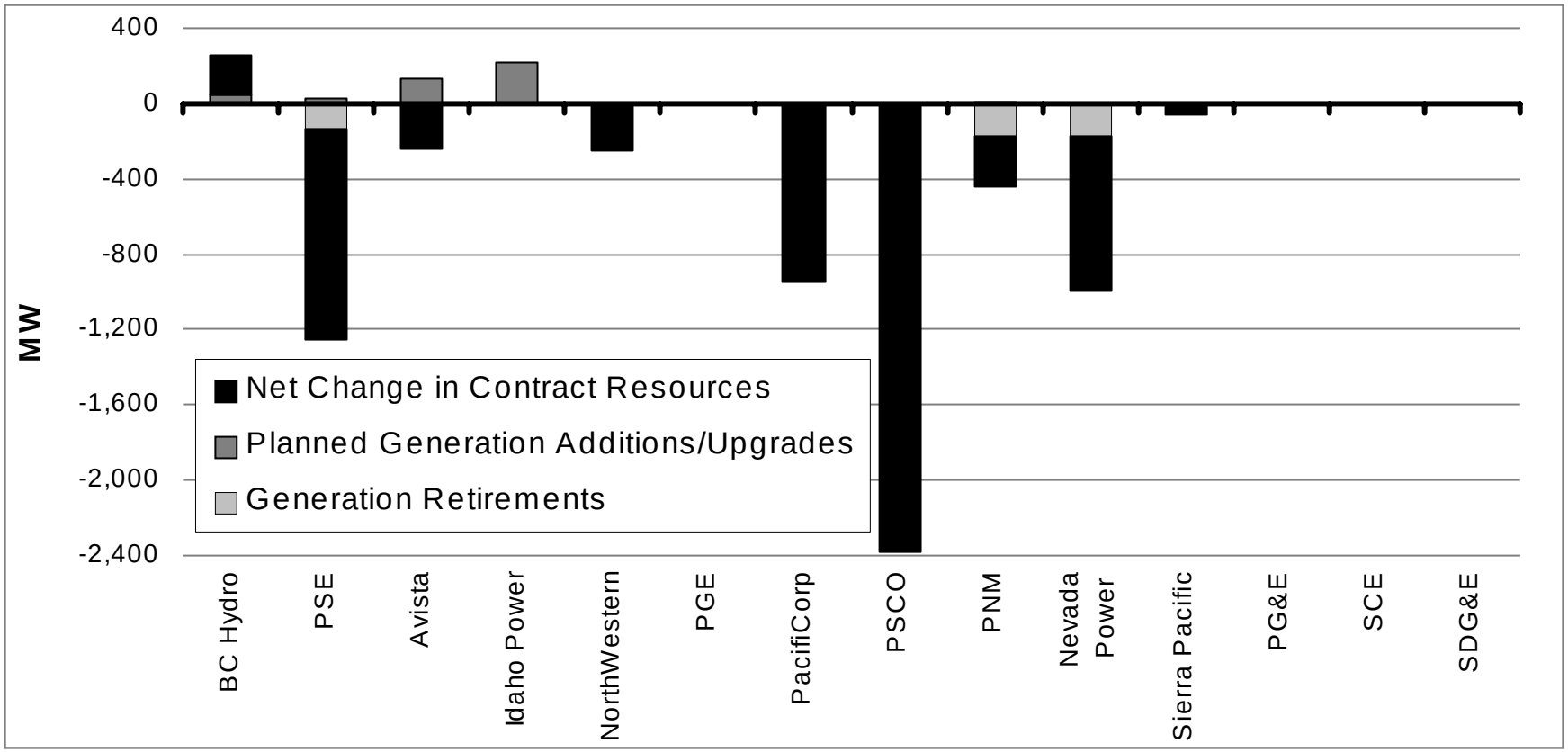
BACKGROUND SLIDES

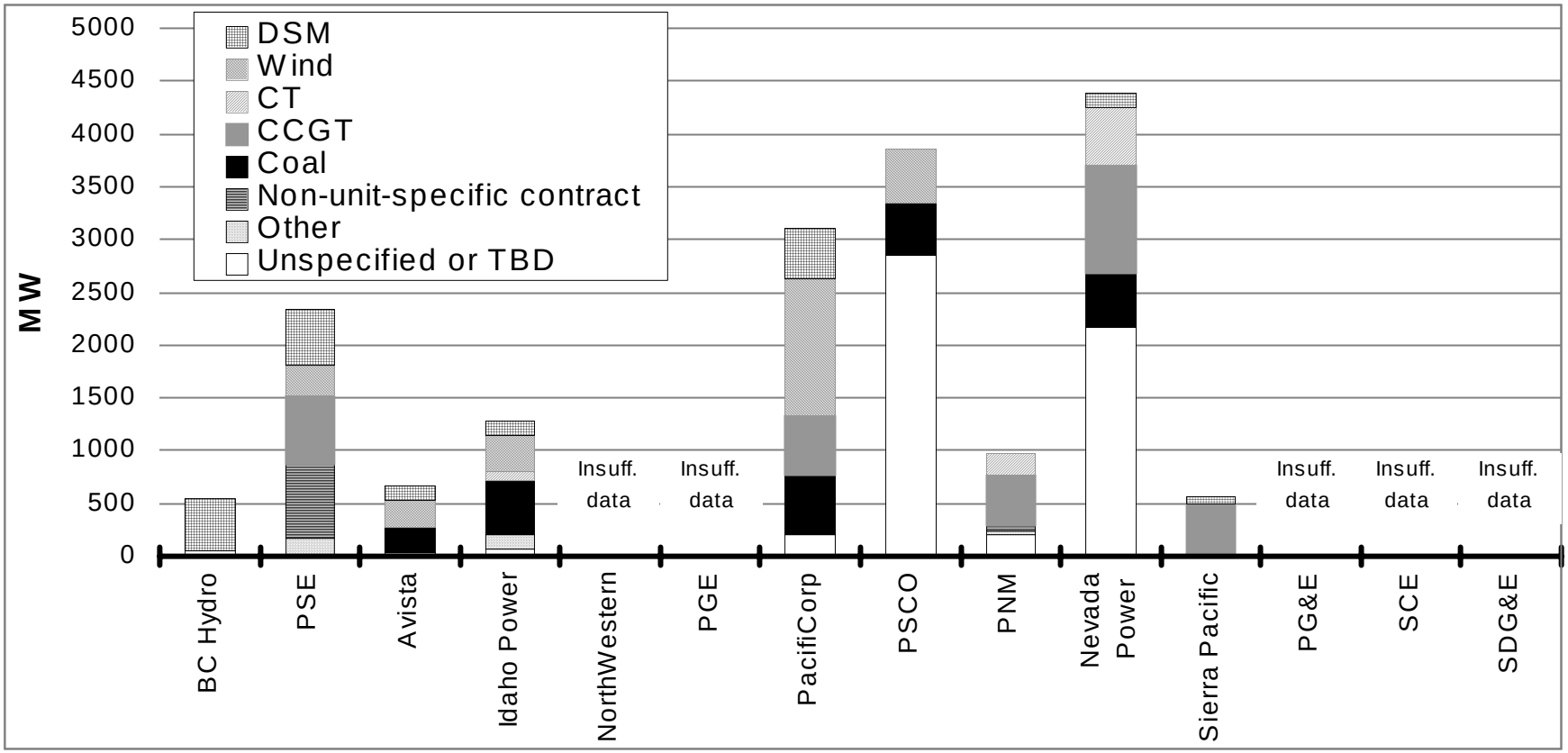
Changes to Utilities' Existing Resource Base: 2005-2008



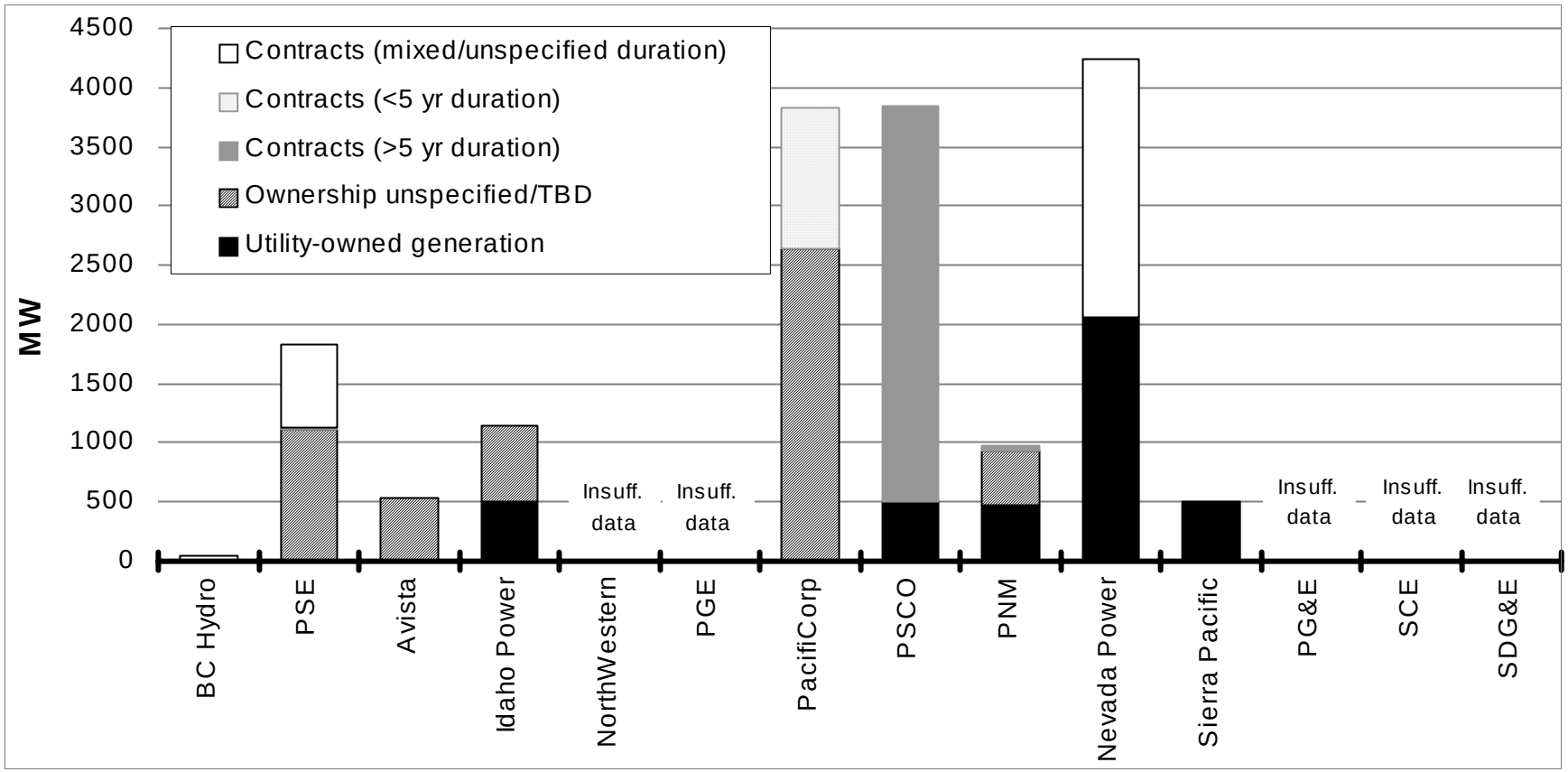
Changes to Utilities' Existing Resource Base: 2005-2013



New Resources Proposed through 2013: Resource Types

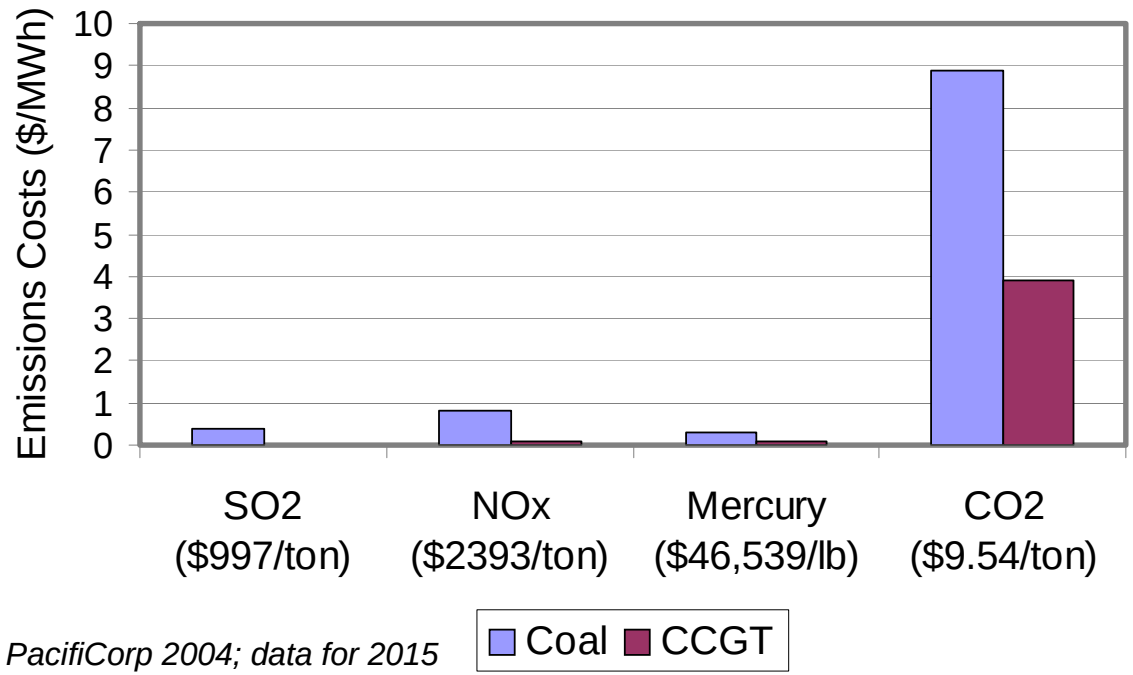


New Resources Proposed through 2013: Ownership Type and Contract Length



Environmental Regulatory Risk

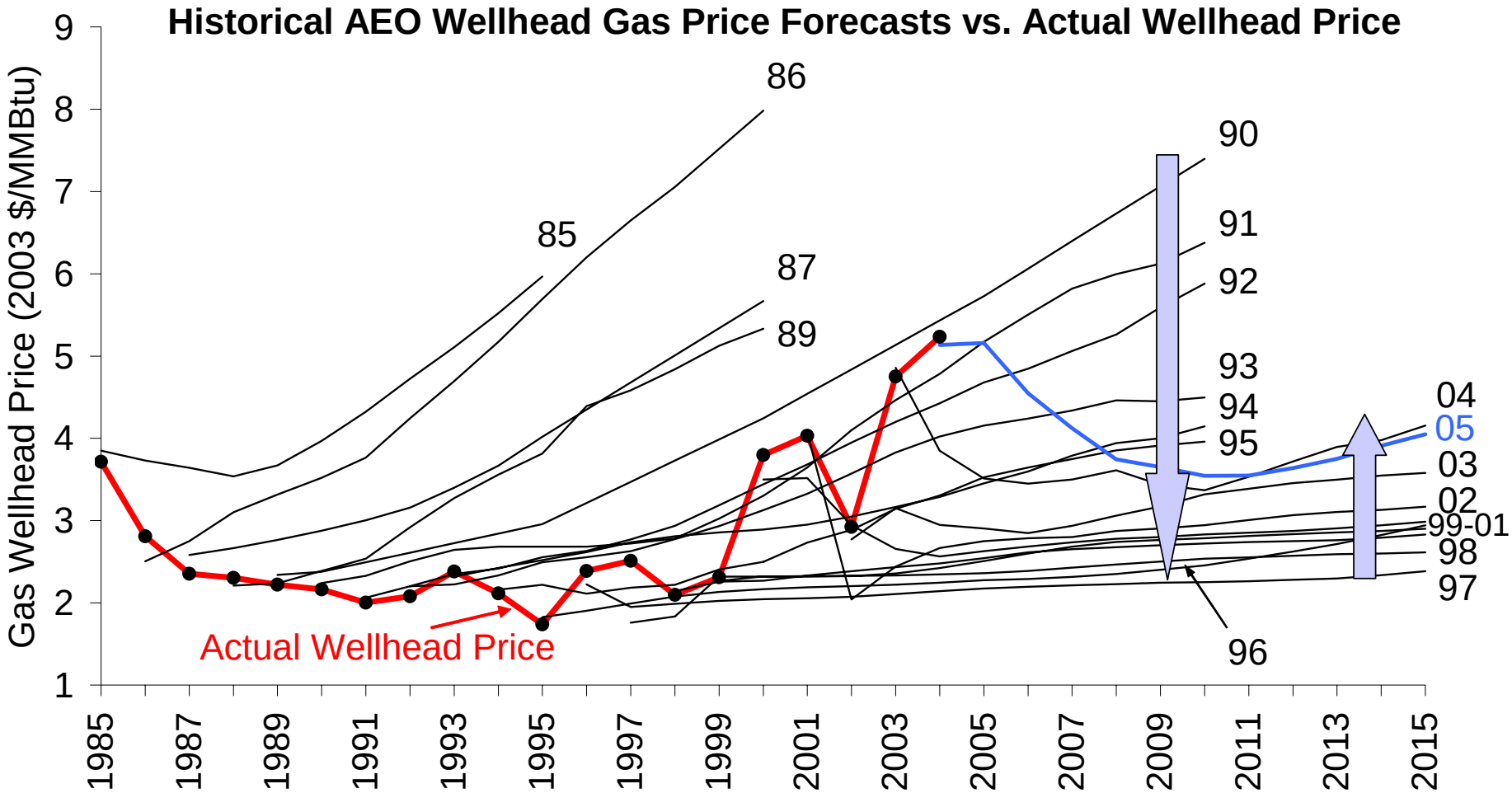
Environmental regulations are likely to change over the course of electric supply investments, and utility planning should evaluate these risks, and mitigate them if cost-effective to do so



PacifiCorp 2004; data for 2015

Risk of carbon regulation – at the state or federal level – is likely the most important to consider, but risk of strengthened regulations of SO2, NOx and mercury also deserve note

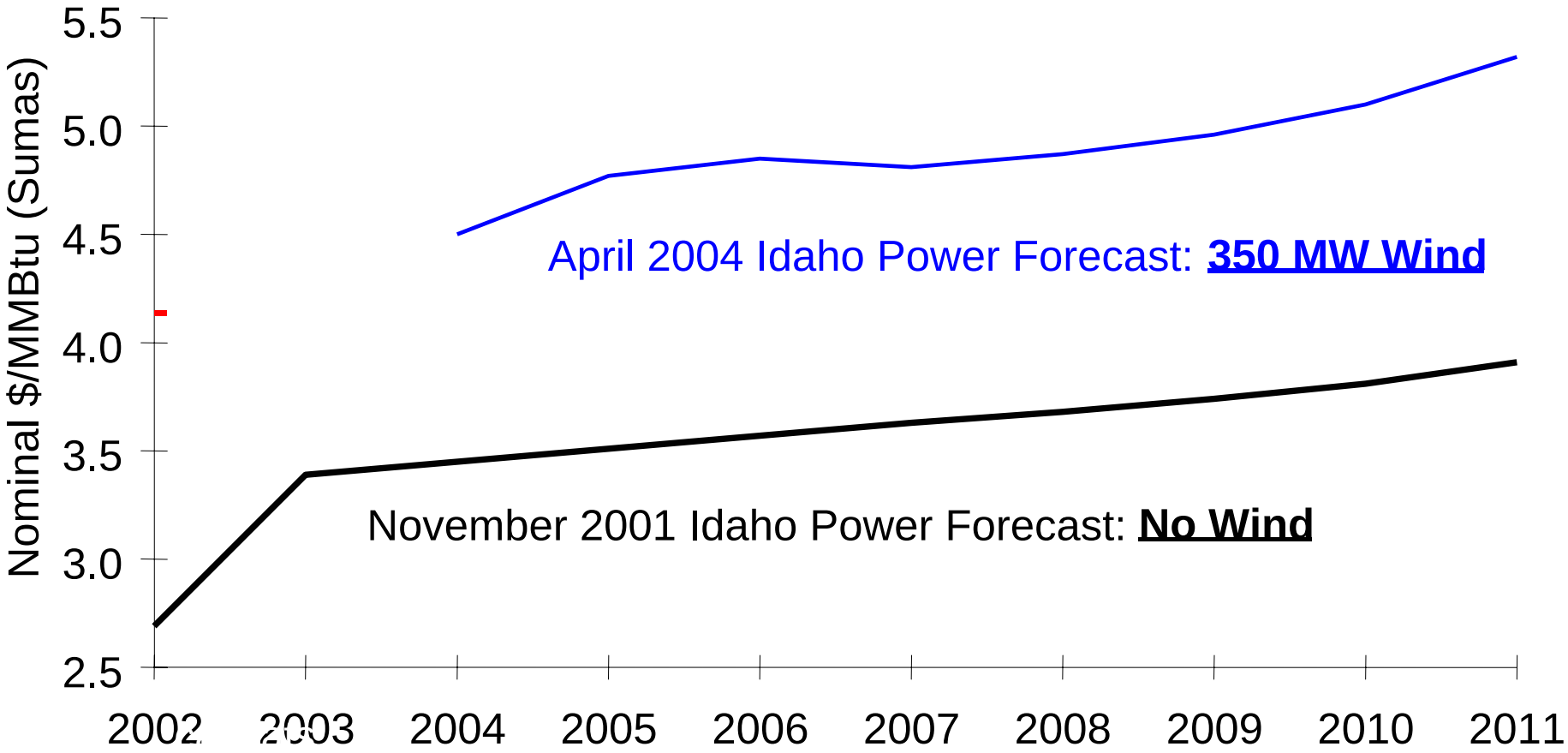
Gas Price Forecasts Are Unreliable



Source: EIA

The Base-Case Matters: Example from Recent Idaho Power IRPs

Higher gas prices and other factors led to increased wind in latest Idaho Power IRP



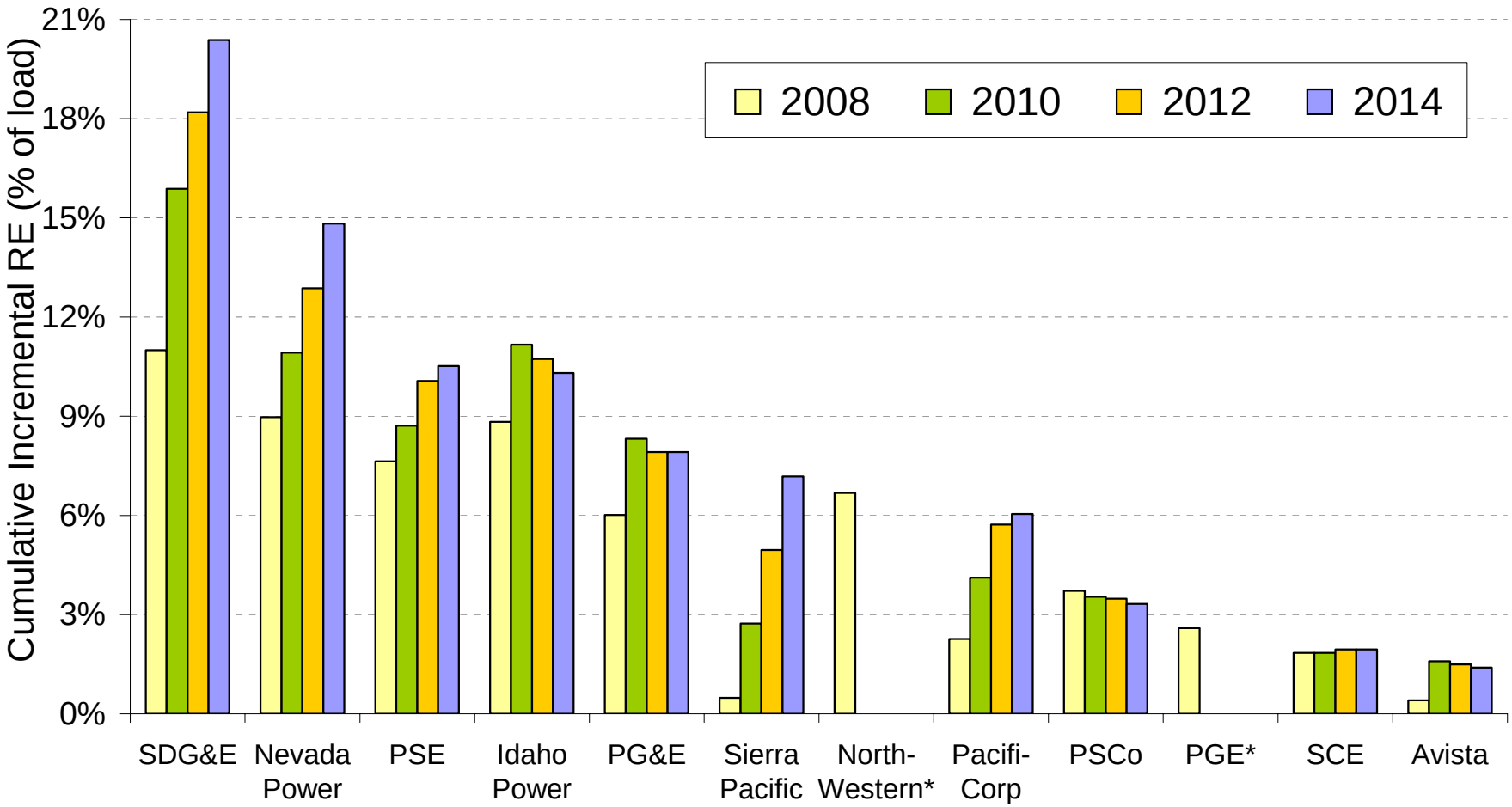
Treatment of Short-Term Gas Price Uncertainty: Sensitivity Analysis

- **Some utilities also conduct sensitivity analysis on short-term gas price volatility/shocks, e.g.:**
  - **Nevada Power**
    - Super-high gas and electricity prices in 2012 only
    - Gas delivered to SoCal $8.36/mmBtu as compared to $4.06/mmBtu in base case and $4.86/mmBtu in high case
  - **Sierra Pacific**
    - Super-high gas and electricity prices in 2012 only
    - Gas delivered to Malin $8.56/mmBtu as compared to $4.28/mmBtu in base case and $5.95/mmBtu in high case

Other Important - Yet Often Overlooked – Issues related to Gas Price Risk

- Impact of Reductions in Gas Demand on Gas Prices
  - Increasing number of studies show that increased deployment of RE and EE (or any non-gas resource) may dramatically reduce gas prices in near term, with more modest long-term effects
  - IRPs do not account for this potential *consumer* benefit of non-gas resources (this impact is only significant if viewed on a larger regional basis)
- Treatment of Risk Correlations
  - Gas prices plausibly correlated with hydro conditions, weather, load, oil/coal prices, spot electricity prices, etc.
  - Western IRPs treat these correlations inconsistently; correlations are most consistently addressed when stochastic simulation is used
- Selection of Discount Rate
  - Affects relative apparent cost of different cash flow streams, but no clear "right" approach: utility WACC, customer opportunity cost of capital, risk adjusted rates
  - Western IRPs typically use utility WACC, though some use variations

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



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

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Are the Assumptions Underlying Total Modeled Wind Power Costs Reasonable?

- **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 length time horizon, and do not evaluate 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