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October 28, 2014

MEMORANDUM

TO: Council members

FROM: Tom Eckman, Power Division Director

SUBJECT: Briefing on Power Planning Under Uncertainty

BACKGROUND:

Presenter: Tom Eckman

Summary: Staff will present an overview of Council's approach to resource planning, focusing on how its analytical processes address the inherent uncertainty in major drivers of electricity demand, resource costs and risks. This is the second in a two-part series designed to provide Council members and interested stakeholders with background on the analytical methods used in plan development.

Relevance: The Council is engaged in the development of its 7th Power Plan. The product of that development process is a plan that represents the Council's collective assessment of resource development and other actions that will "assure the Pacific Northwest of an adequate, efficient, economical and reliable power supply."

Workplan: 1D - Prepare for Seventh Power Plan and maintain analytical capability

Background: In 1982, shortly after the Council was formed, Dr. Kai Lee, then a professor at the University of Washington and who later served as Washington Council member, authored a paper entitled, *The Path Along*

*the Ridge: Regional Planning in the Face of Uncertainty.*¹ In his paper Dr. Lee described how the Council's planning process departed from traditional utility power planning.

In the Council's power plans there is an explicit recognition that the future is uncertain and that risk management strategies to deal with that uncertainty are needed. For example, until the Council's first plan, utility resource planning was based on a single forecast of the region's most likely energy demand. Resources that took ten or 15 years to build were planned and constructed to that best guess; if the future turned out differently, the region faced the problem of either having under built or overbuilt resources. The cost of error on either side was enormous.

The Council explicitly recognizes that the future cannot be predicted accurately and that uncertainty is a fact of life in power planning. To accommodate this problem, the Council has developed plans to meet a broad range of potential growth in energy demand, setting a boundary of high and low load growth forecasts over the next 20 years. The Council's plans have also identified flexible resources such as conservation and options that shorten the lead time of generating resources.

This presentation will expand on the types of uncertainty the Council's planning process must address as well as describe the analytical methods used by the Council to evaluate and identify resource strategies that can be used to mitigate risk at an acceptable cost.

More Info: See linked paper "[An Overview of the Council's Planning Methods.](#)" From March 2011.

¹ Lee, Kai N. The Path Along the Ridge: Regional Planning in the Face of Uncertainty. University of Washington Law Review, 1982-1983, Volume 58, pp 317 – 342. (<https://digital.law.washington.edu/dspace-law/bitstream/handle/1773.1/104/volume%2058.pdf?sequence=1>)

Planning for Uncertainty

An Introduction to the Council's Power Planning Process

Tom Eckman

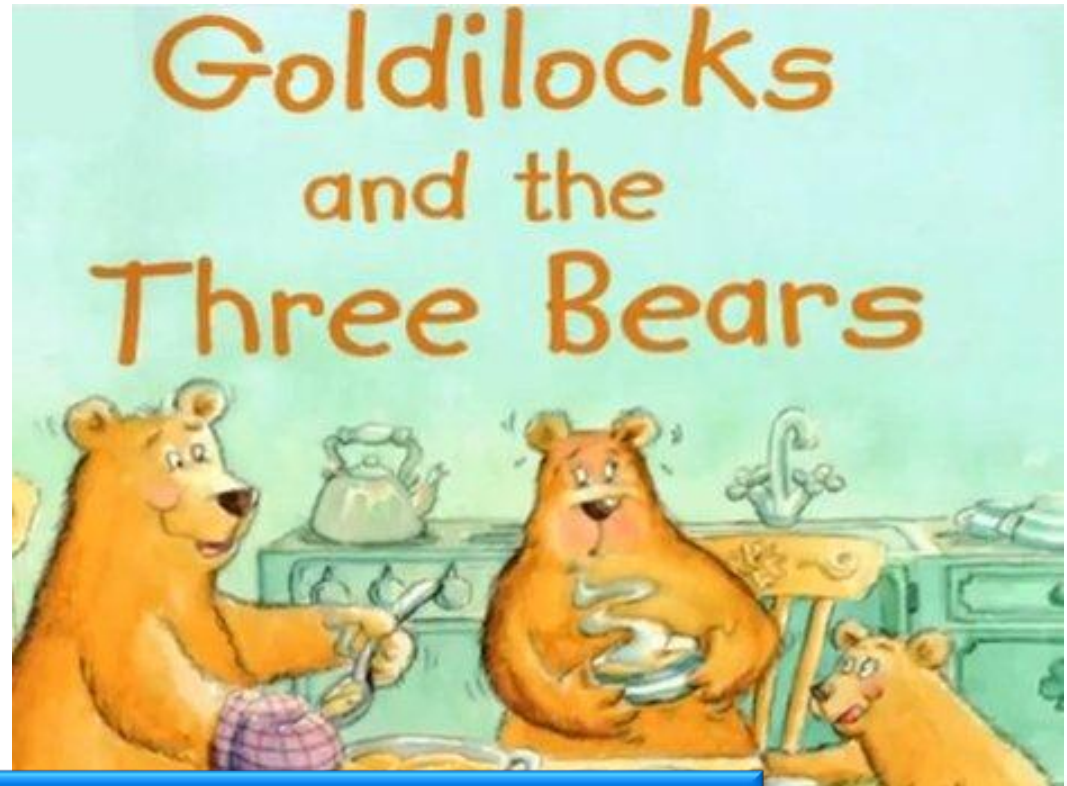
Director, Power Division

Northwest Power and Conservation Council

November 5, 2014

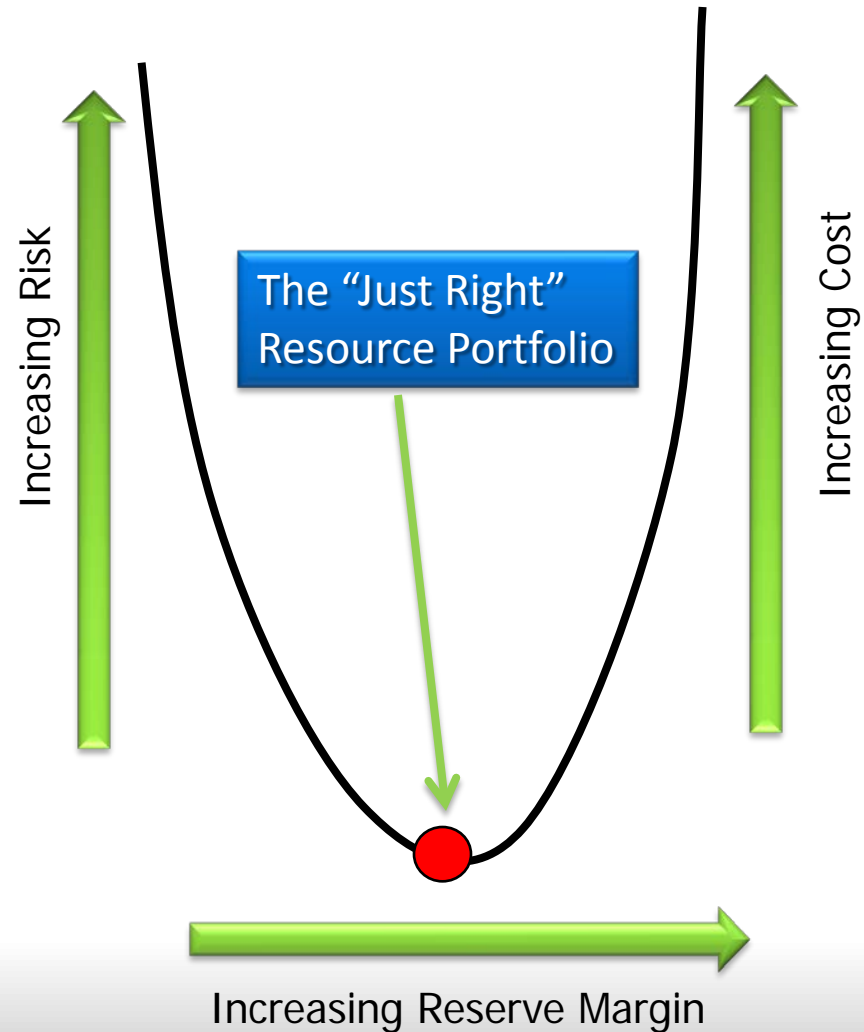
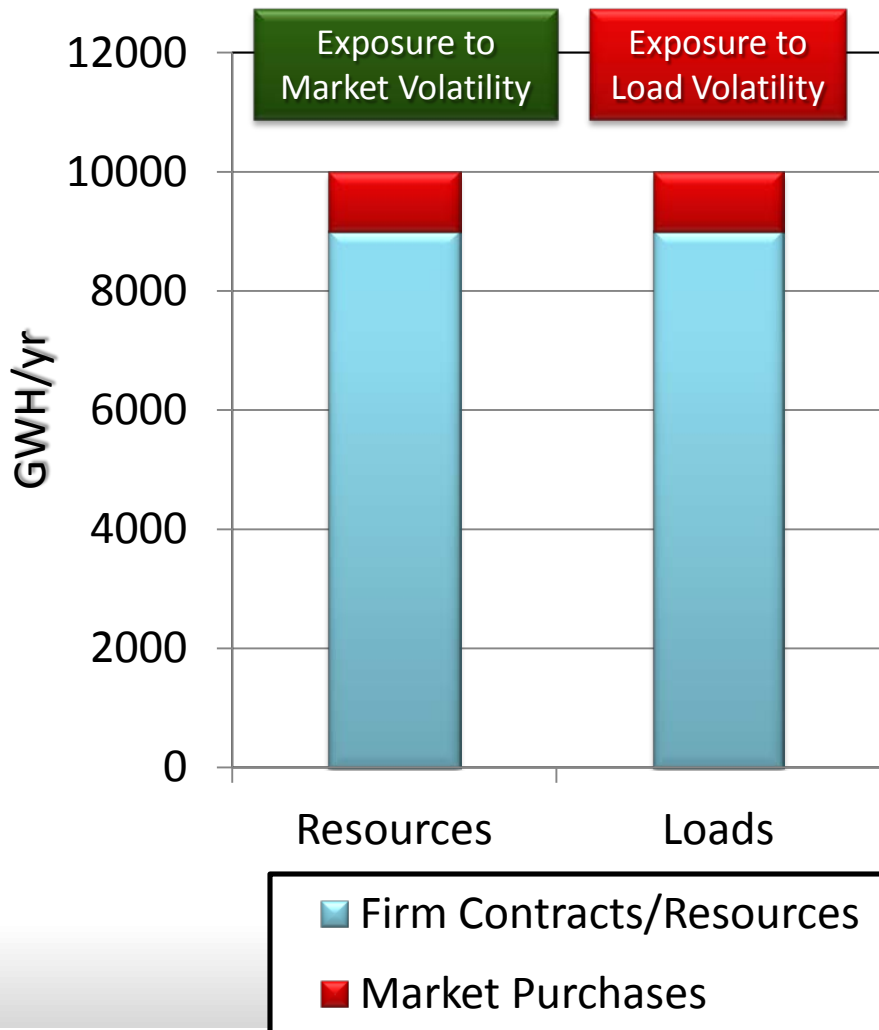
The Resource Planner's Problem

- Don't have too many resources
- Don't have too few resources
- Have “just the right amount” of resources*

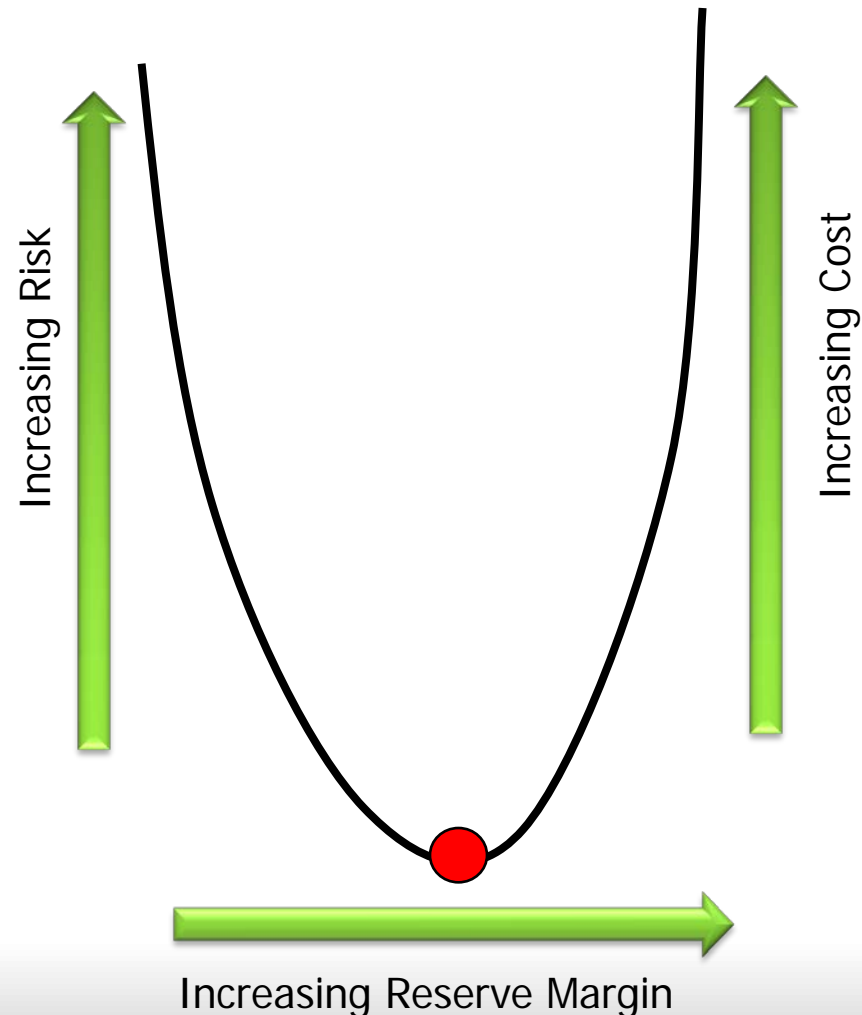
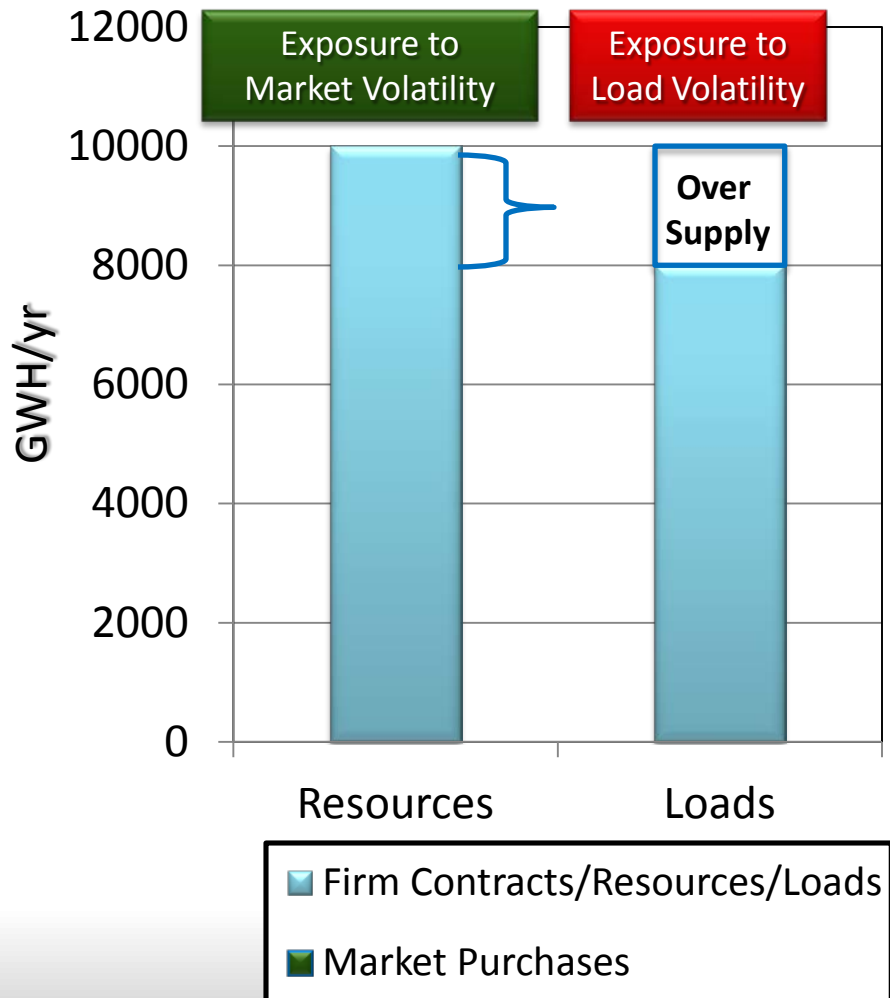


*Resources include energy, capacity, flexibility and other ancillary services needed for system reliability.

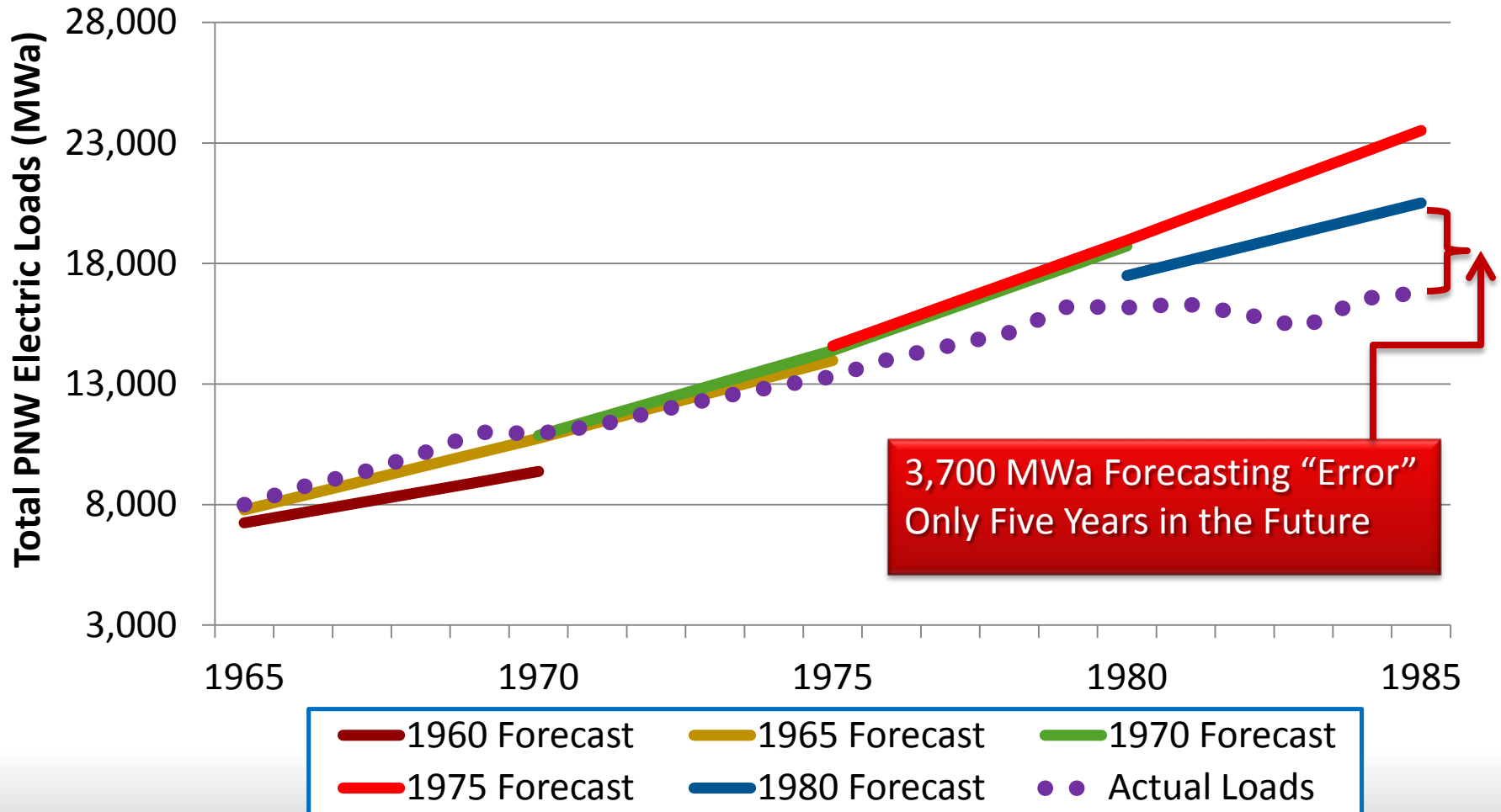
As A Utility's Resource Mix Changes So Does Its Cost and Risk



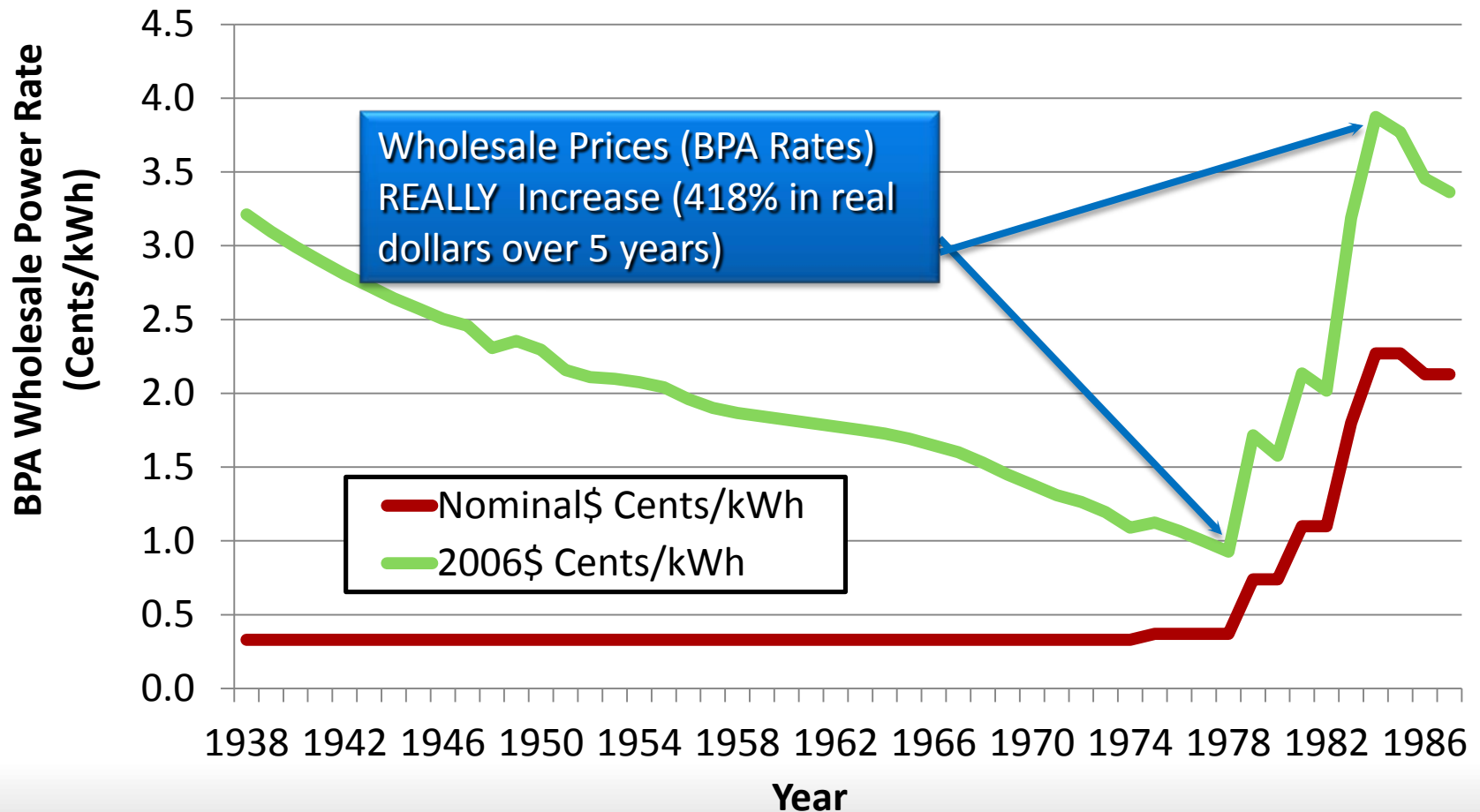
Increasing Firm Contracts/Resources Increases Load Volatility Risk



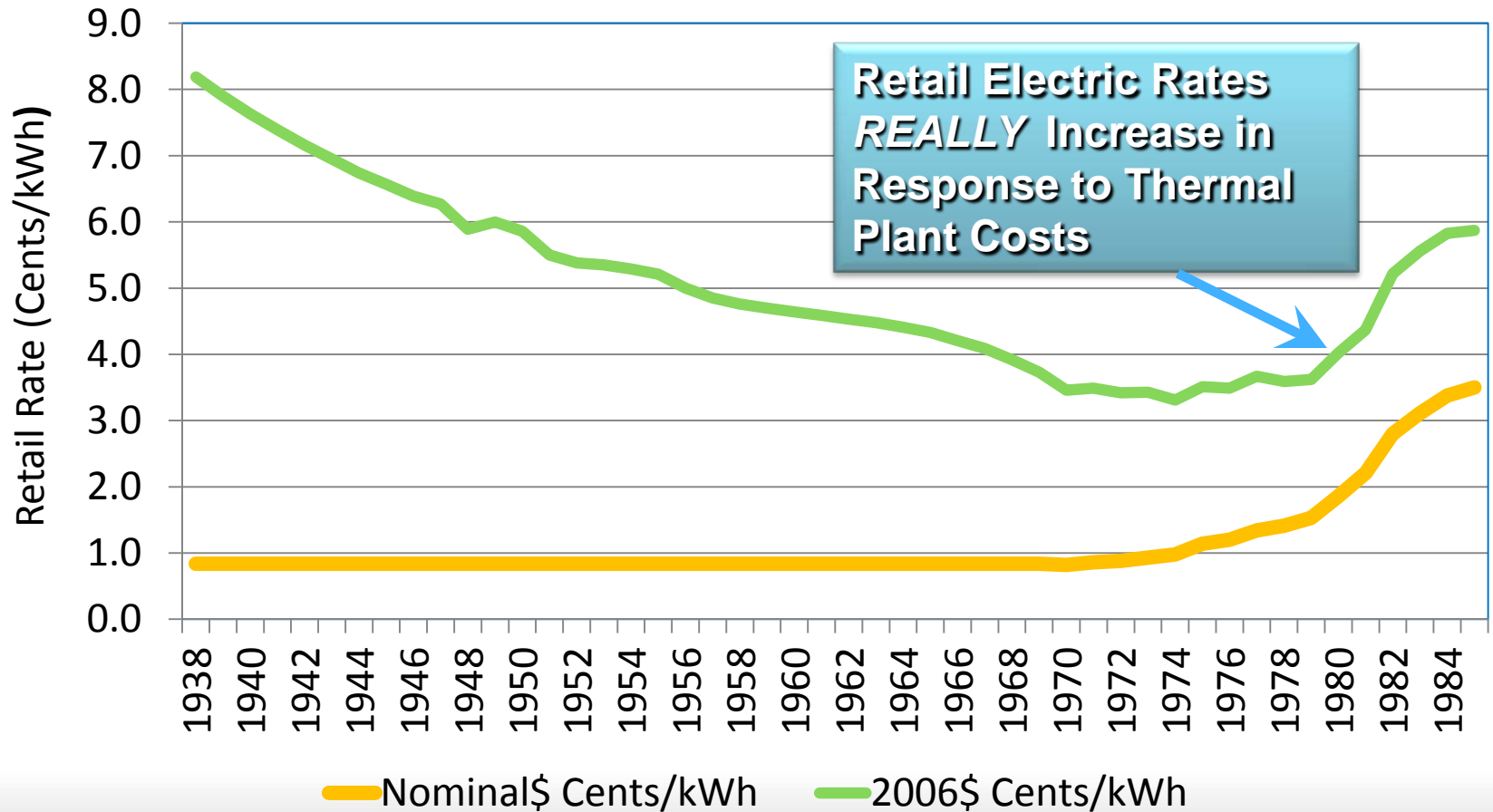
The Region Has Experienced Overbuilding



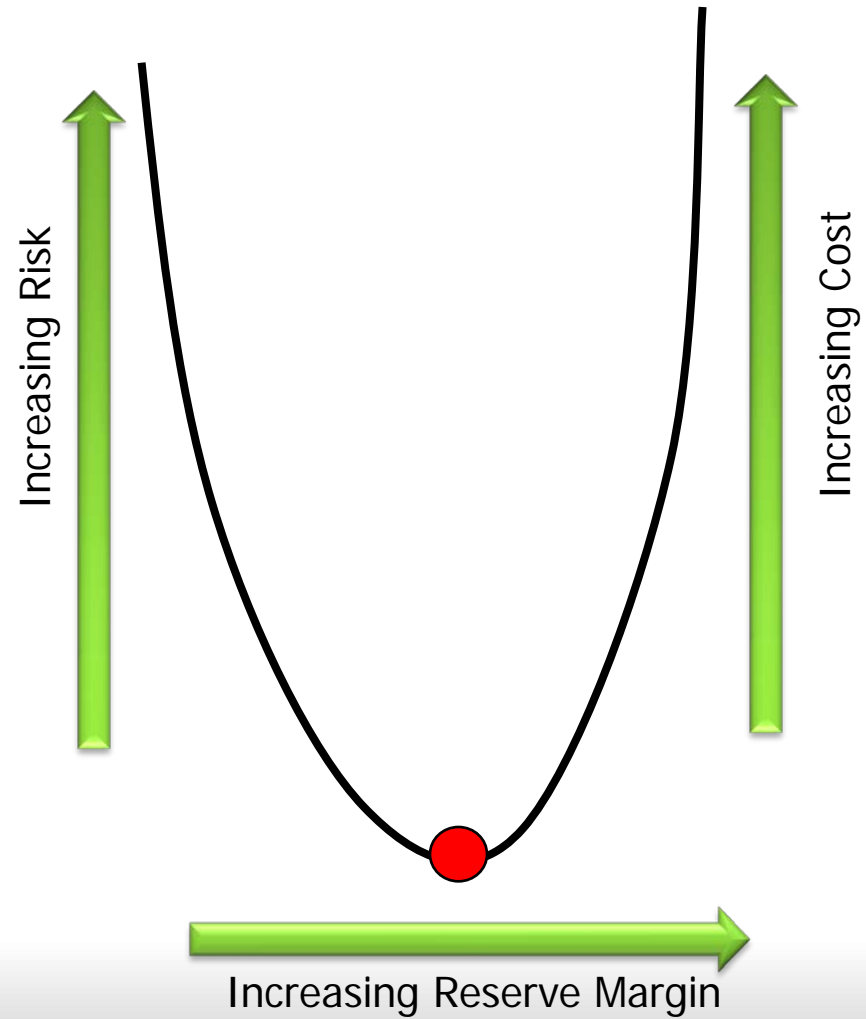
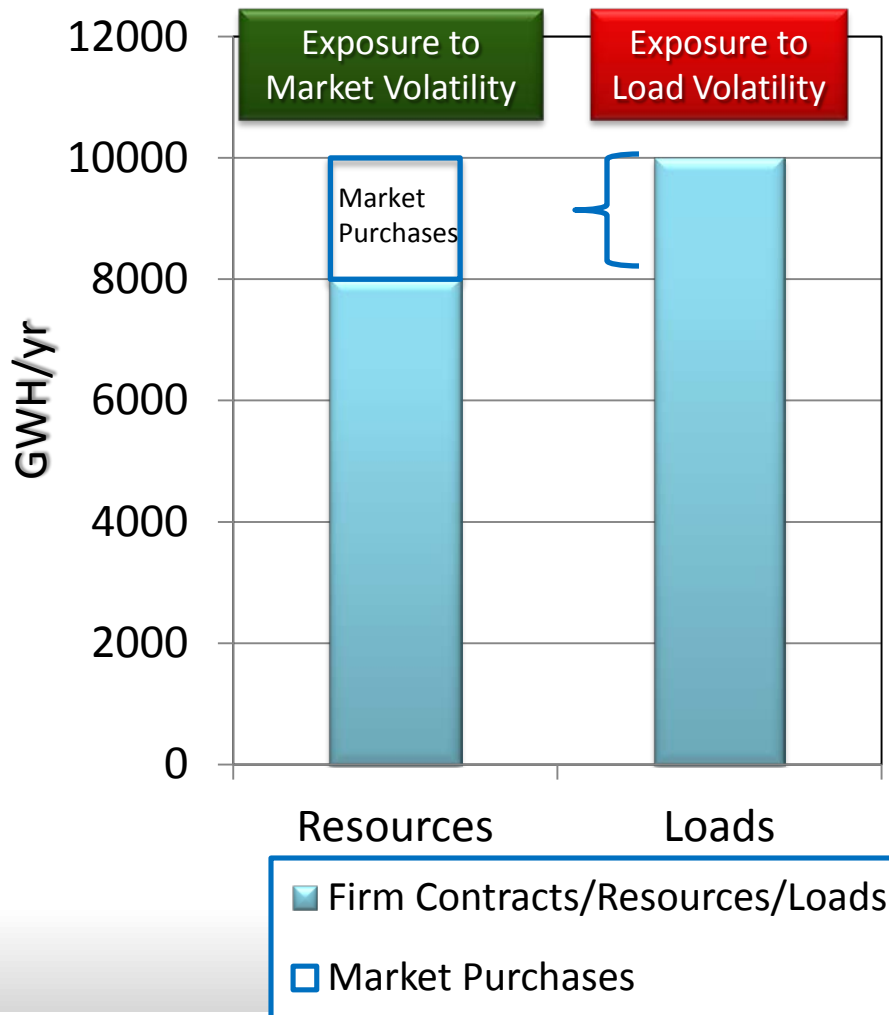
Real World Example of the Cost of "Too Many Resources"



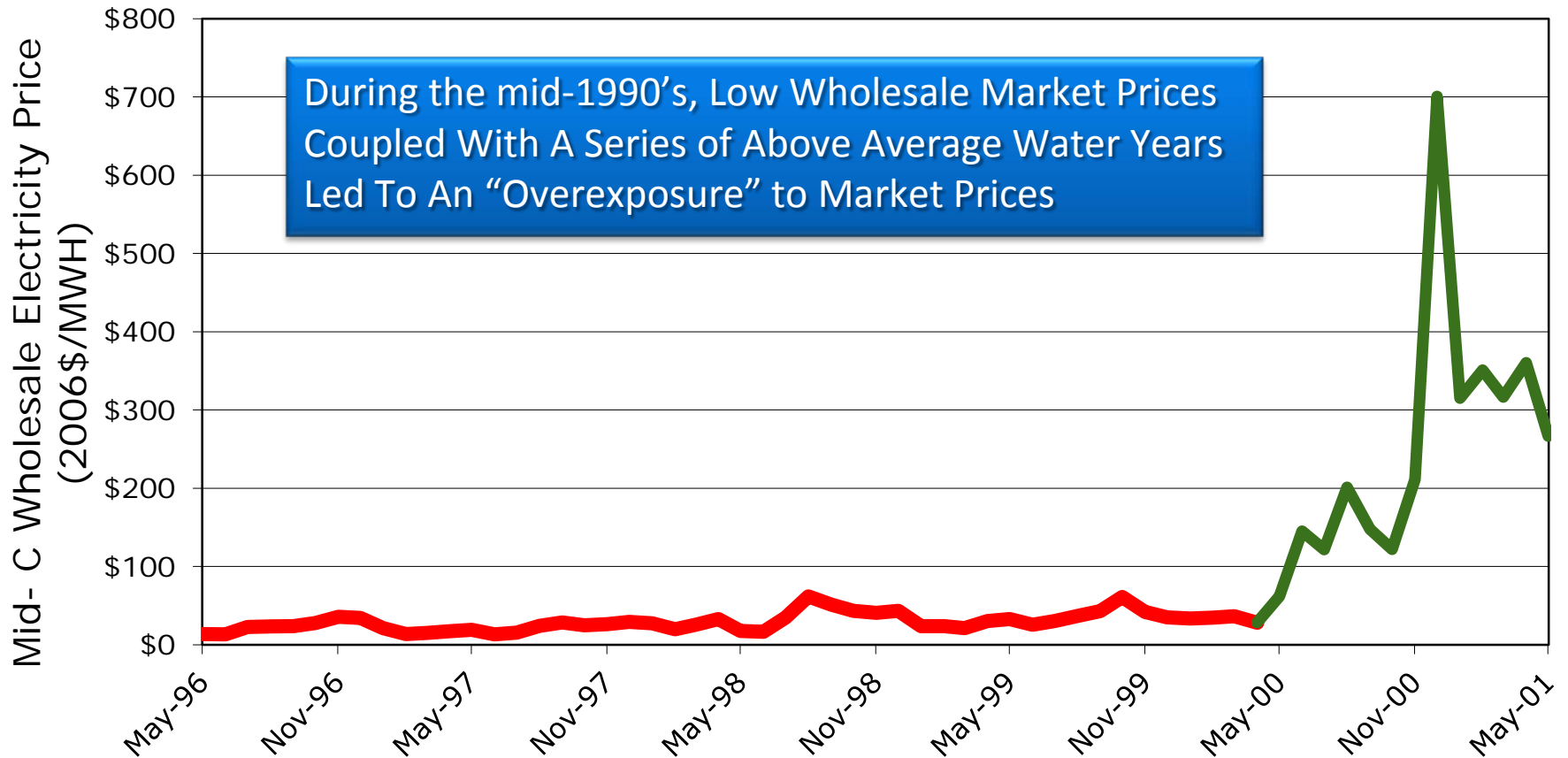
PNW Retail Electric Rates 1938 - 1985



Decreasing Firm Contracts/Resources Increases Market Risk...

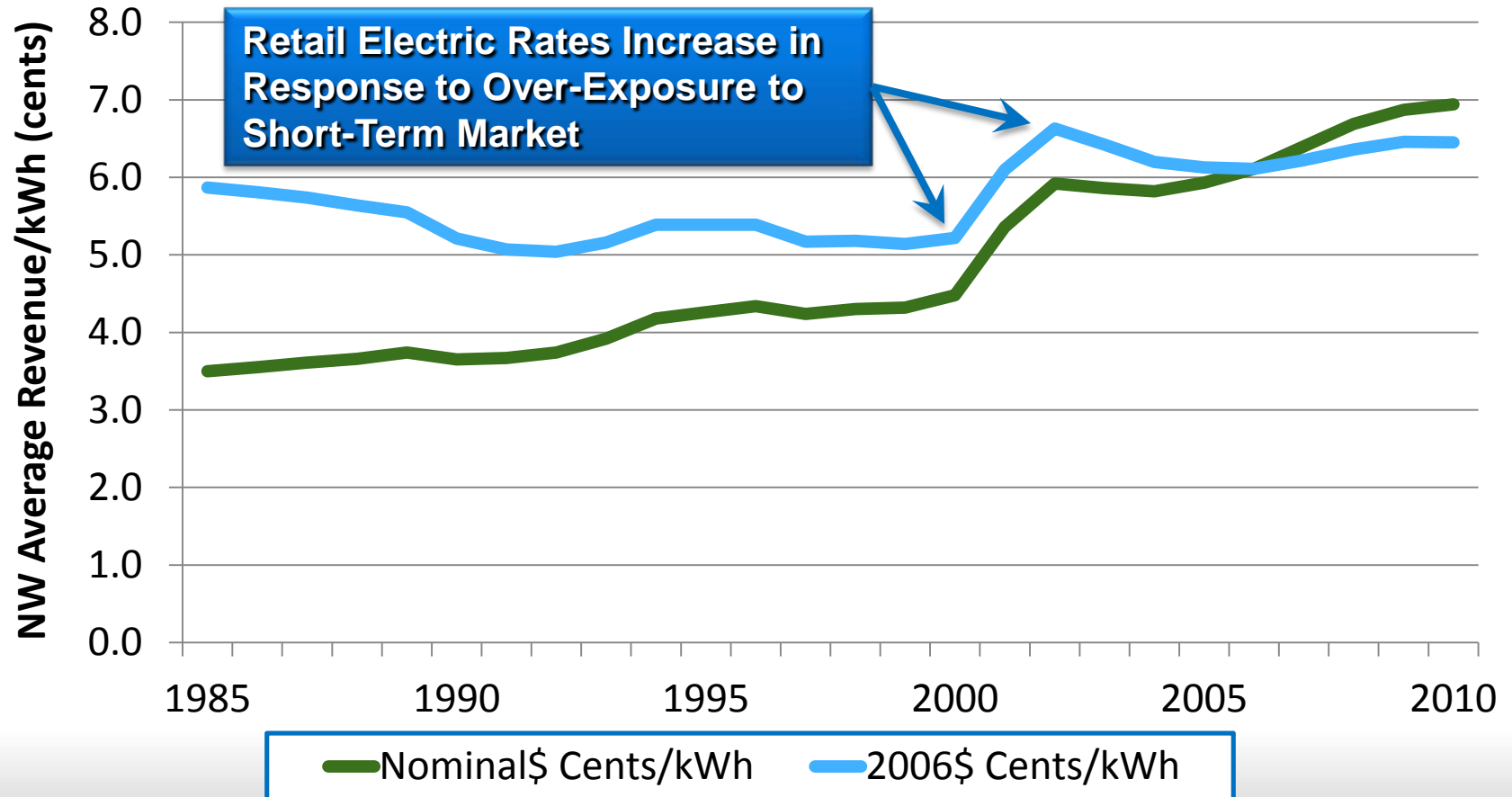


The Region Has Also Experienced Underbuilding

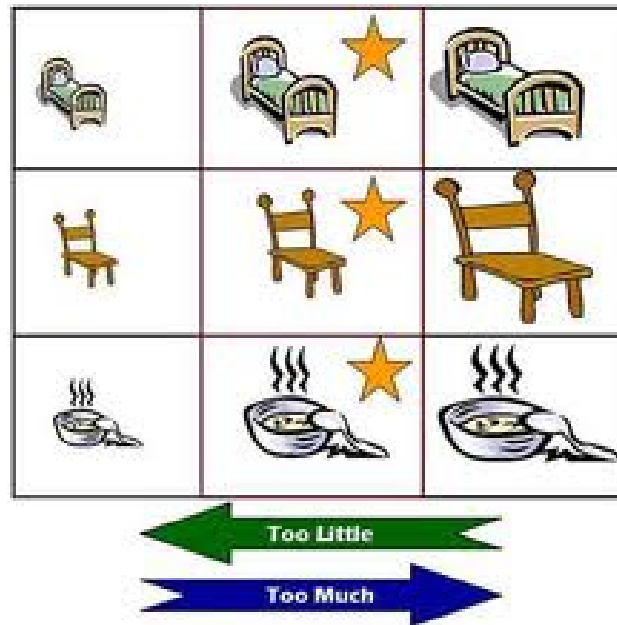


Real World Example of the Cost of "Too Few Resources"

PNW Retail Electric Rates 1985 - 2010



How The Council Addresses The



“Goldilocks” Problem?

First, We've Broken the Problem Into Six Simple Questions

- 1. When Will We Need Resources?*
- 2. How Much Will We Need?*
- 3. What Should We Build/Buy?*
- 4. How Much Will It Cost?*
- 5. What's the Risk?*
- 6. Who Can We Blame If We Get It Wrong?*

(Answer – the Staff)

All Plans Require Assumptions About the Future



Perfect
Foresight (i.e.,
prescience) is
not possible.

*However, it is an occupational hazard of
planners!*

Plan Must Address Three Major Sources of Uncertainty

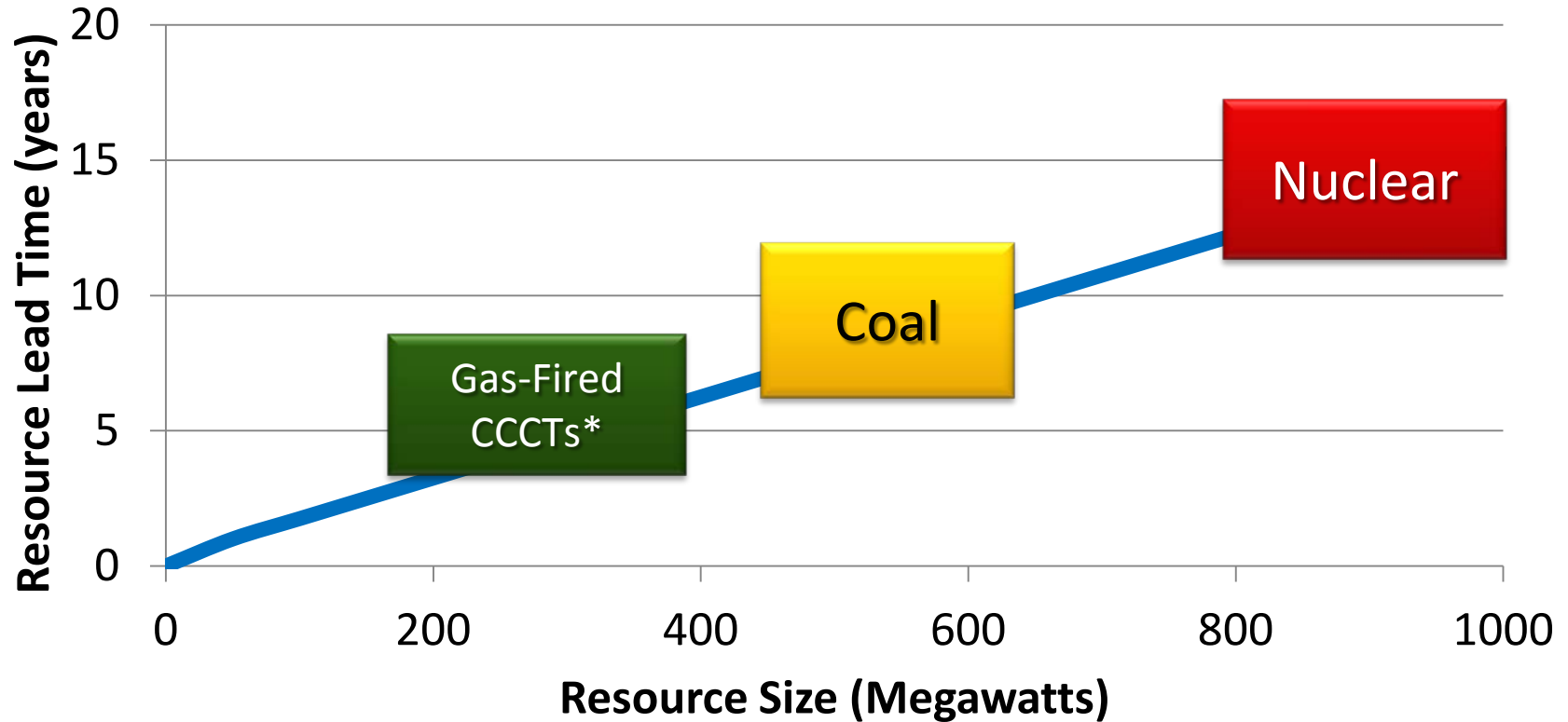
1. Load Uncertainty

2. Resource Uncertainty

- Output
- Cost
- Construction Lead Times

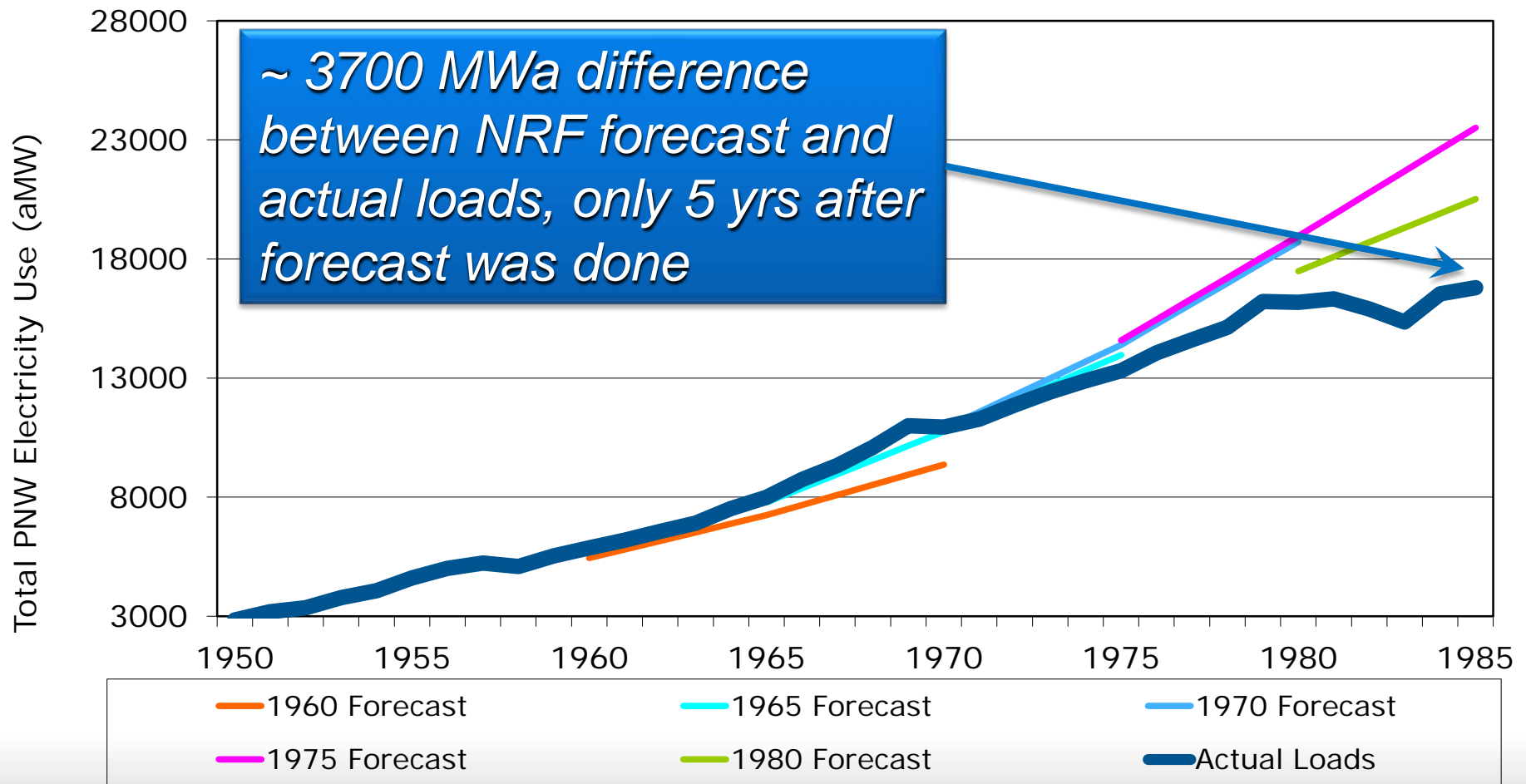
3. Wholesale Electricity Market Price Uncertainty

Load Uncertainty Is Particularly A Problem When Generating Resources Have Long Lead Times and Large Sizes



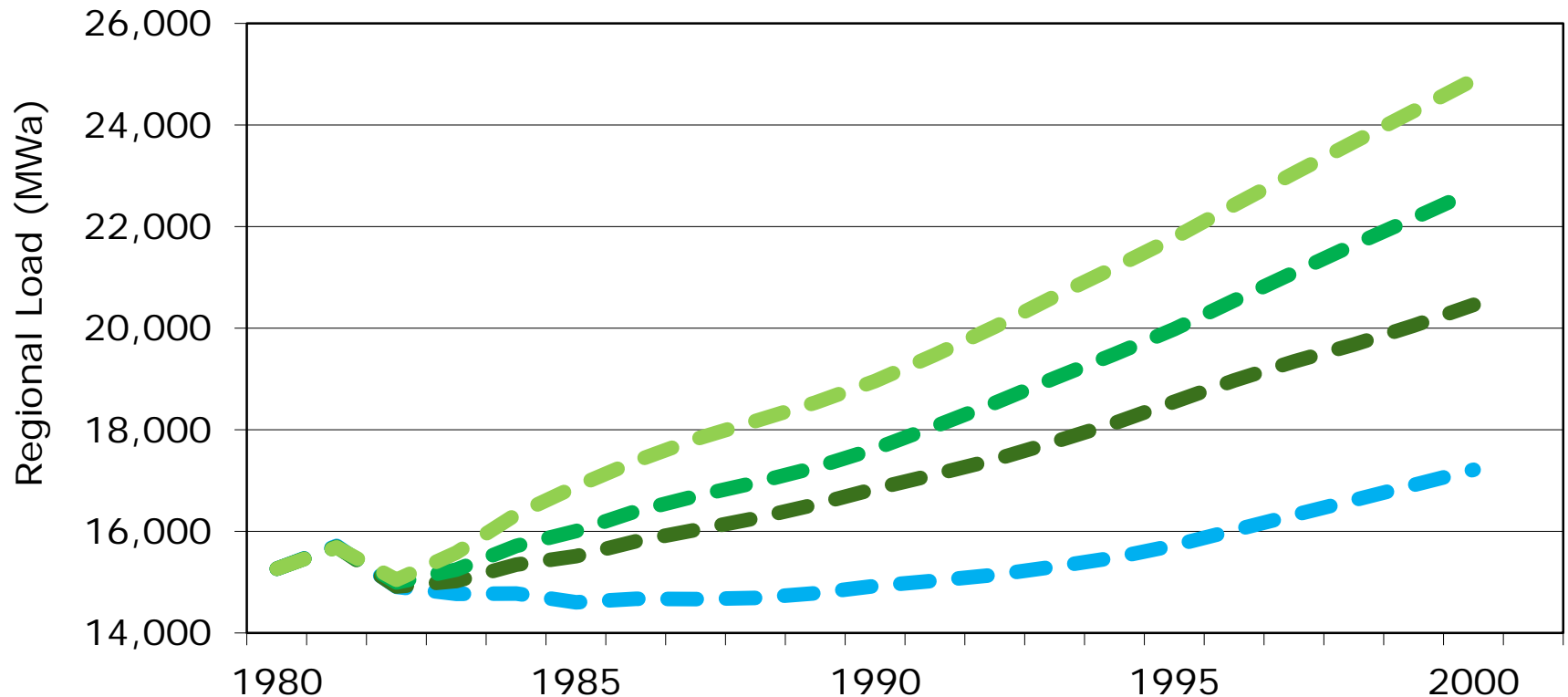
*Power Plant and Industrial Fuel Use Act of 1978 limited natural gas fired turbines run times to 1500 hours per year. (Repealed in 1987)

Generating Resource Long Lead Times Combined with Significant Load Uncertainty Created the Risk of **Under** and **Over** Building



Council Approach to Load Forecasting Assumes Lack of Perfect Foresight (We Admit We Aren't *Prescient*)

Plan 1 – Load Forecast Range

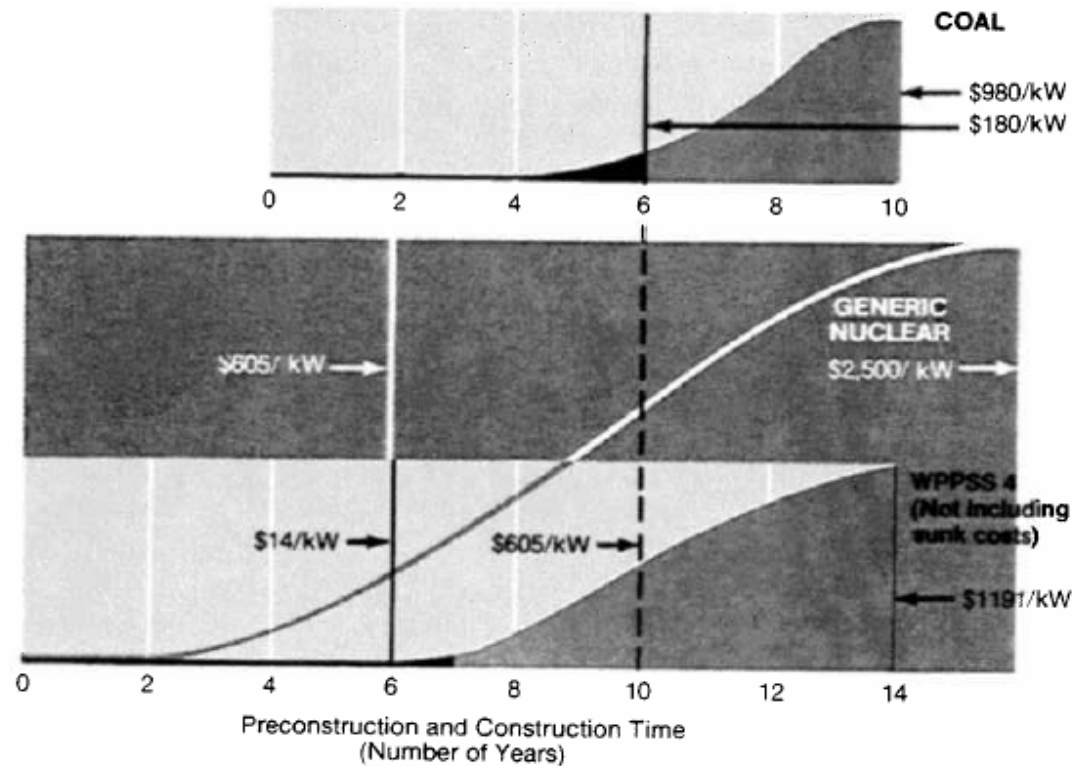


● 1983 - Low ● 1983 Med-Low ● 1983 Med-High ● 1983 High

First Plan's Response to Load Uncertainty

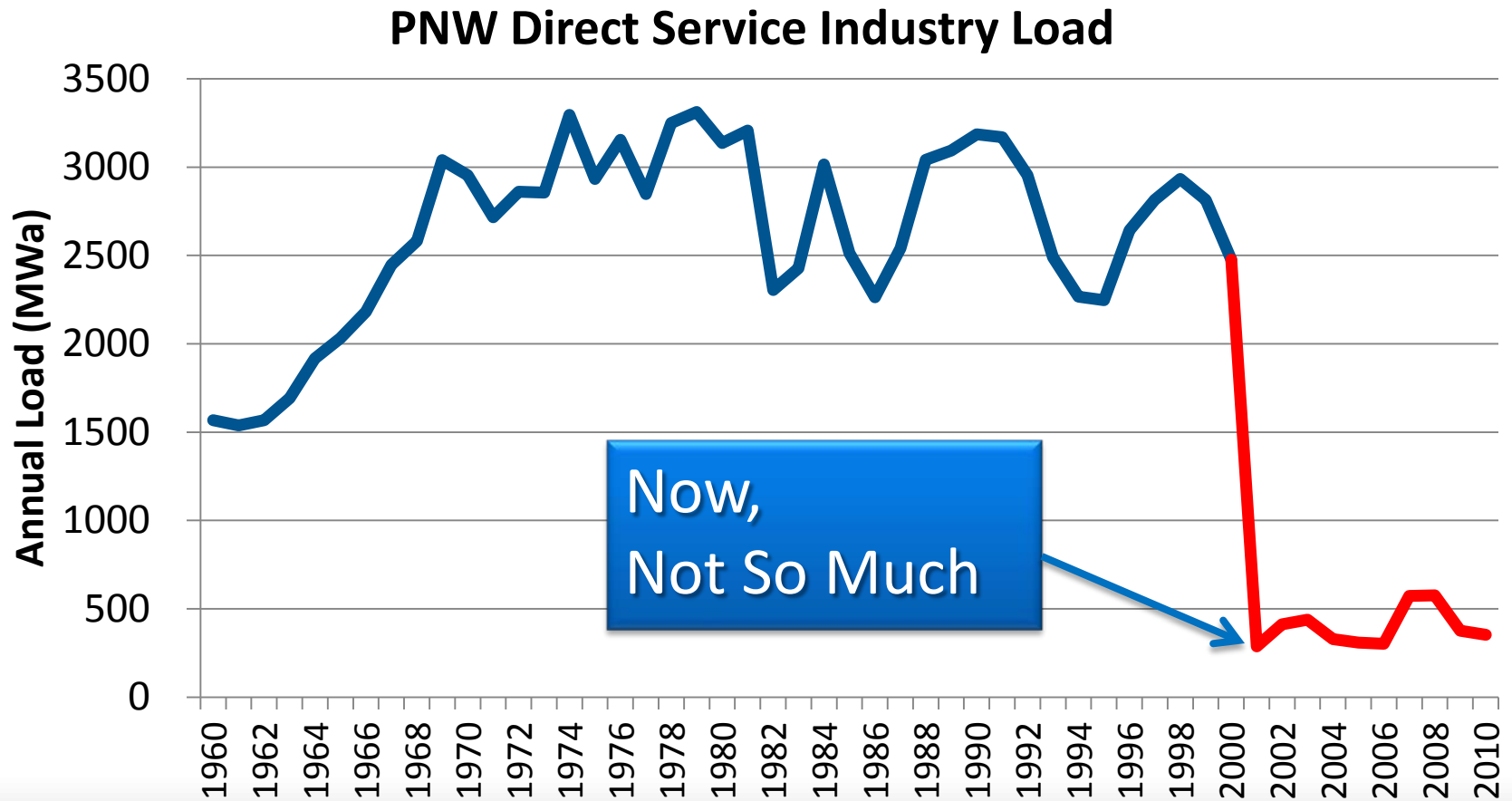
- Rely on efficiency due to lower cost, short lead times and ability to match development to scale of load growth
- Develop “options” on thermal projects with long lead times
 - Get the siting and licensing out of the way so that construction can commence when actual load growth requires development

Options Concept Was Designed to Address Load Uncertainty and Long Resource Development Cycles

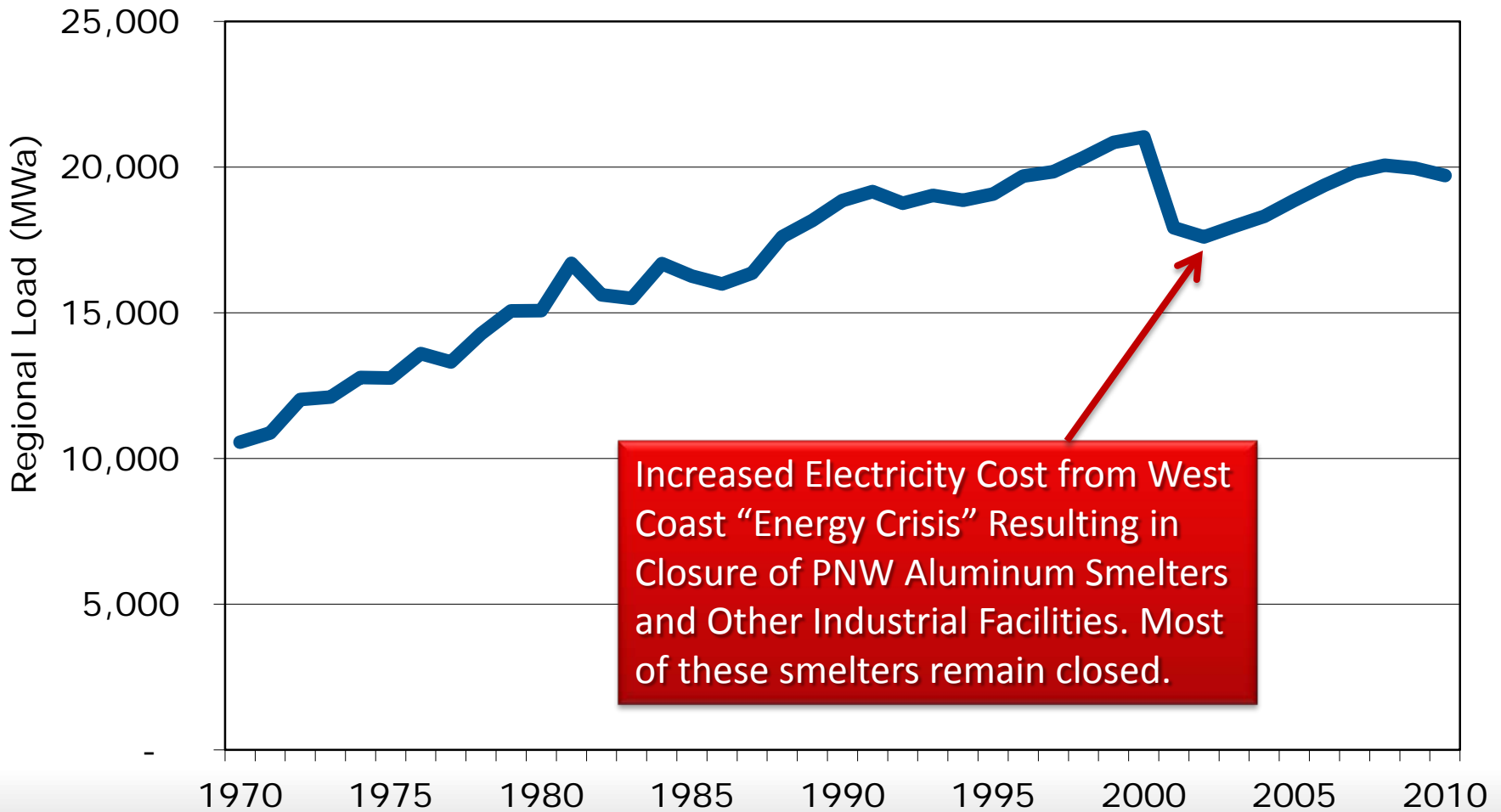


Source: 1983 Northwest Power and Conservation Plan

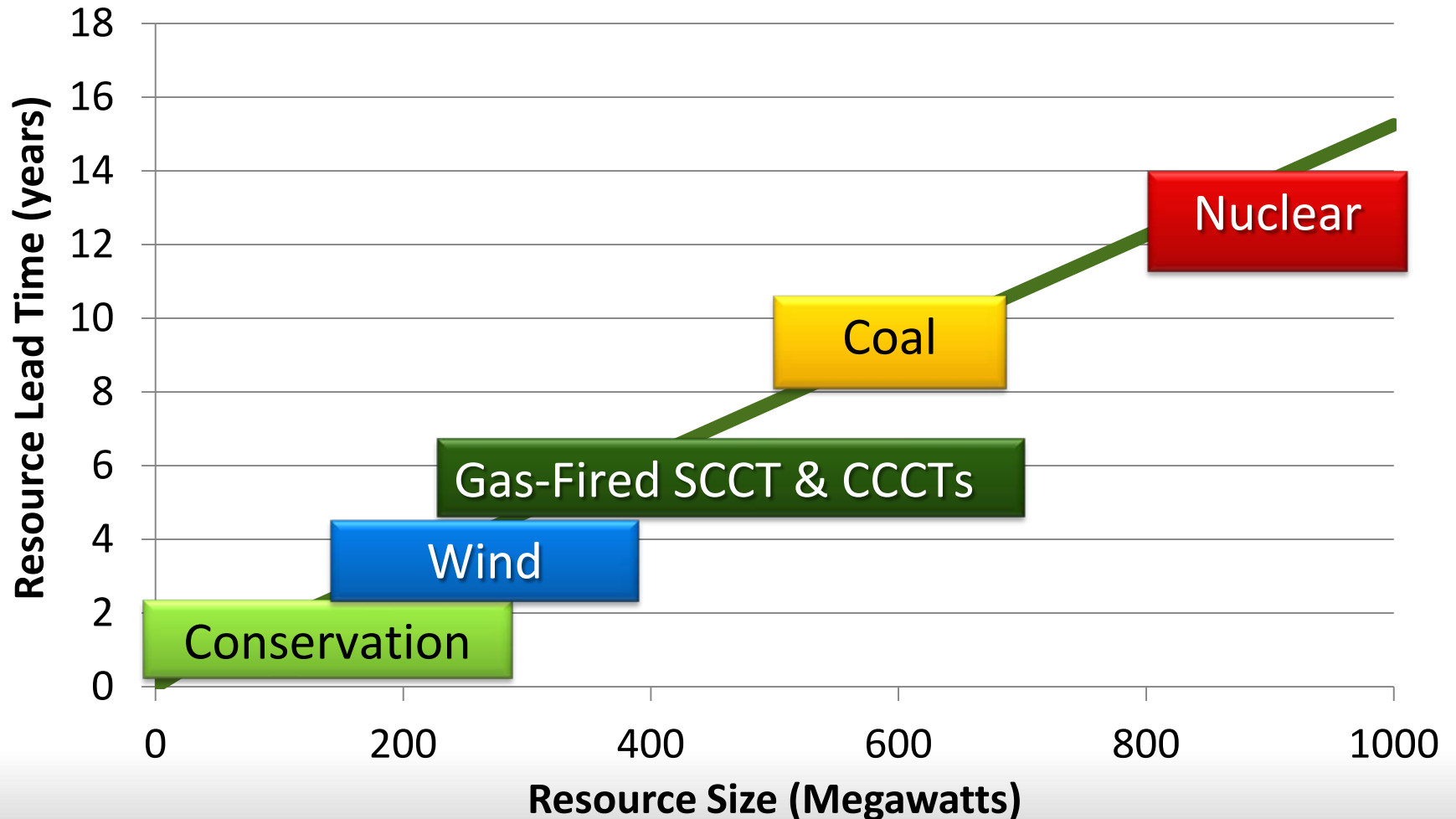
Historical Levels of Load Uncertainty Were Often Driven by Large Industrial Load



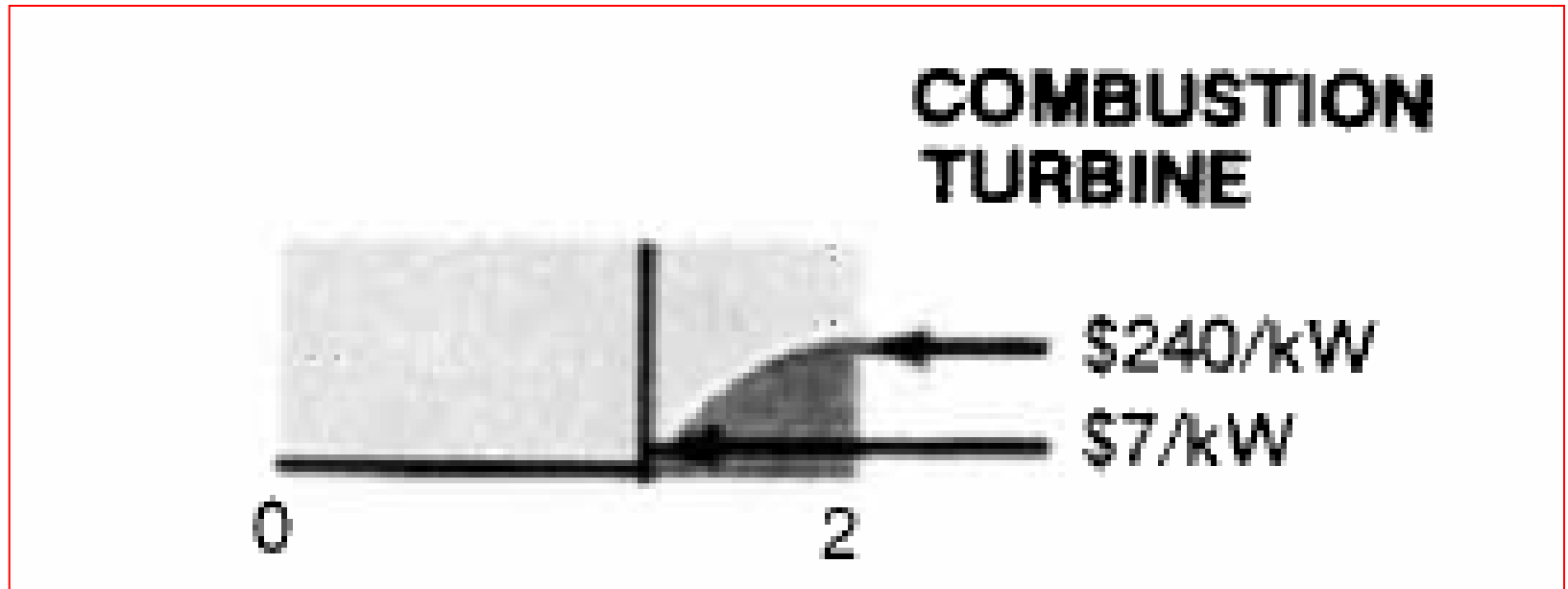
As A Result, Load Uncertainty Still Exists, But Near Term Volatility Is Lower



In Addition, Conservation and Shortened Lead Times and Smaller Sizes For Some Generating Resources Have Made Them More Flexible



Now, Short Lead Time, Smaller Resources Are Available, Reducing the Risk and Cost Mitigation Value of "Resource Optioning"



Source: 1983 Northwest Power and Conservation Plan

Plan Must Address Three Major Sources of Uncertainty

1. Load Uncertainty

2. Resource Uncertainty

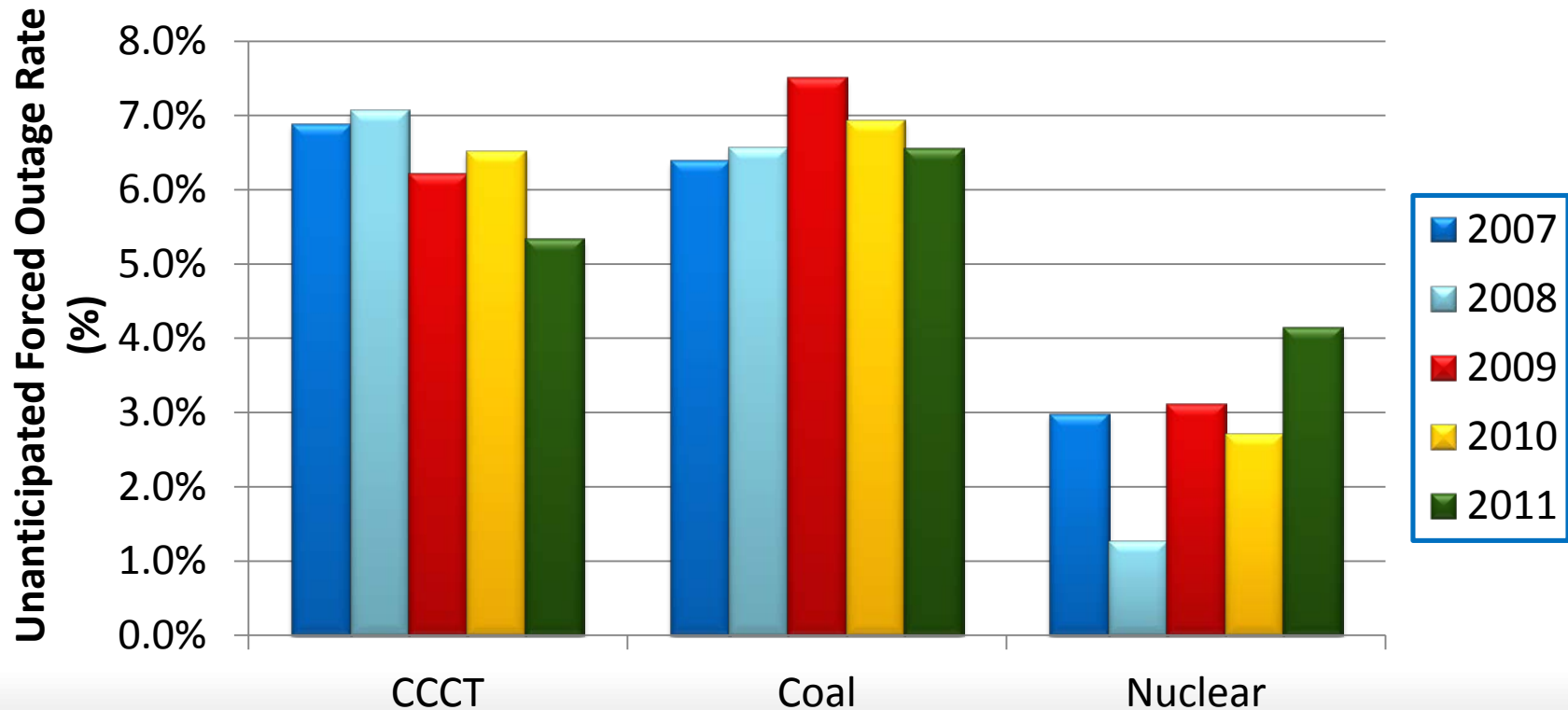
- Output
- Cost

- Construction Lead Times

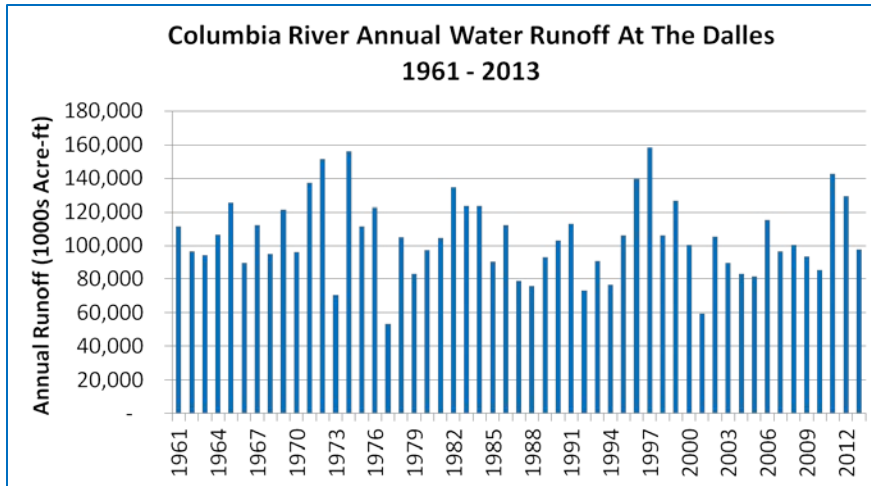
3. Wholesale Electricity Market Price Uncertainty

Generating Resources Are Subject to Unanticipated Outages (i.e., “Forced Outages”) Which Reduces Their Availability

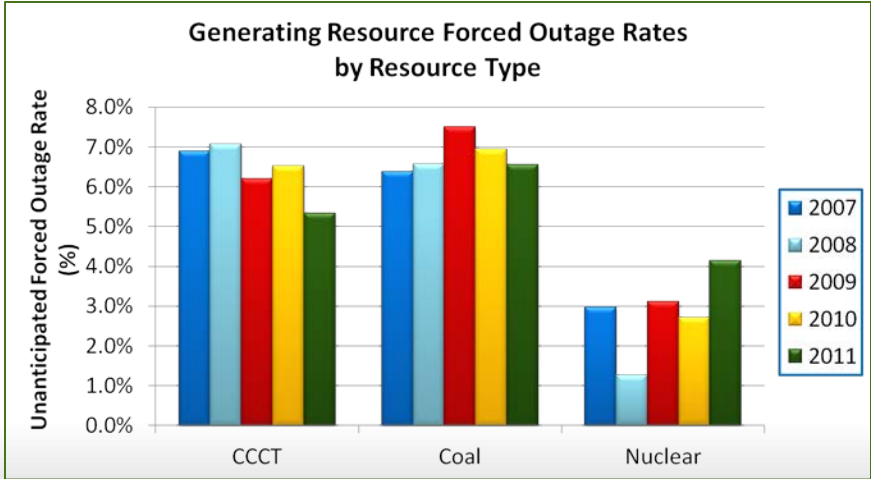
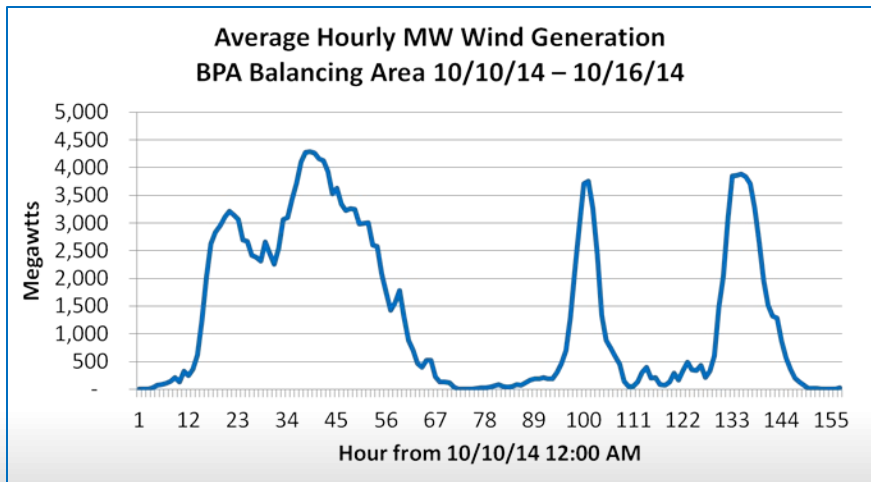
Generating Resource Forced Outage Rates by Resource Type



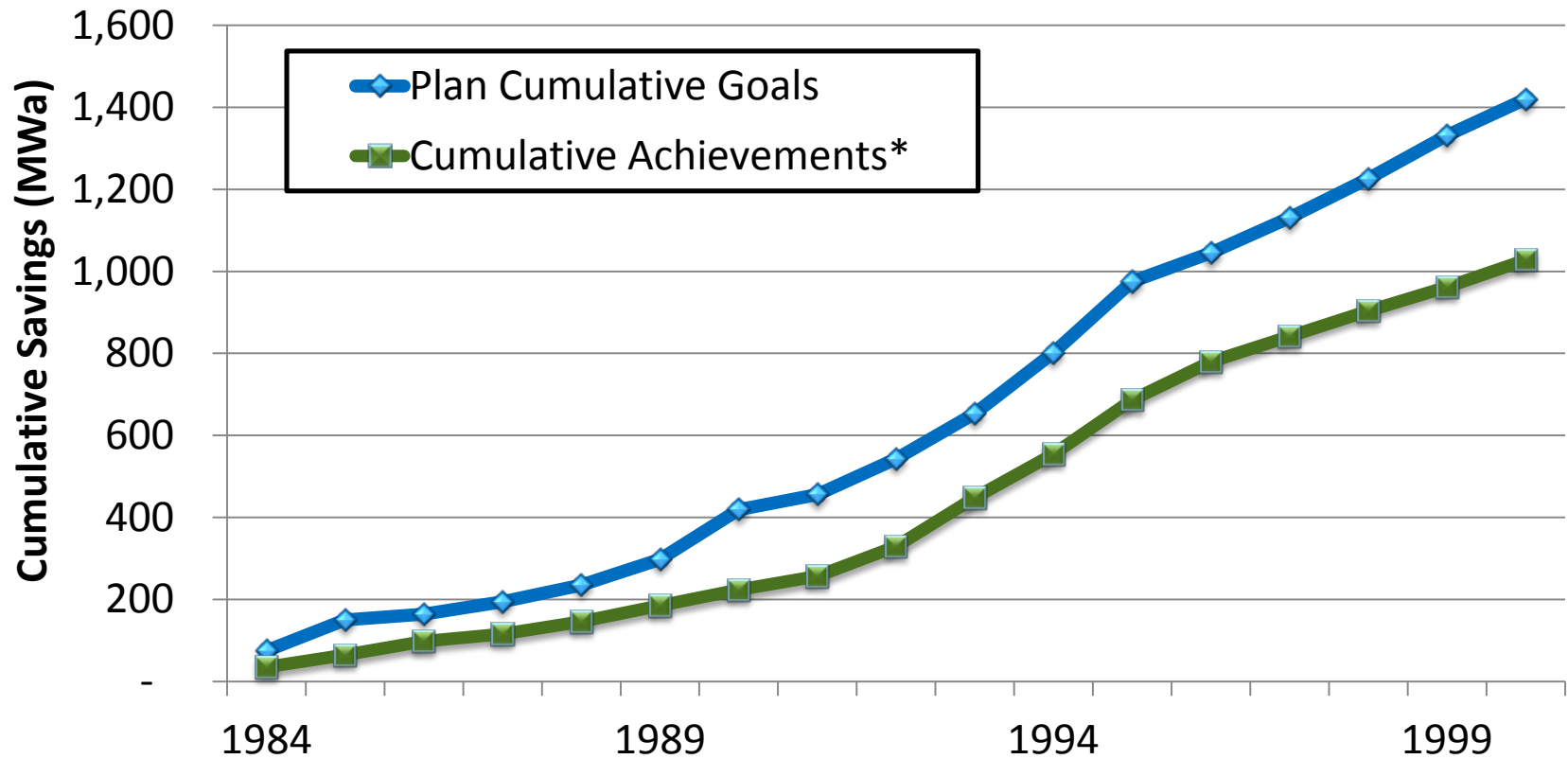
Resource *Variability* Is Different Than Resource *Uncertainty*



But Both Are Important



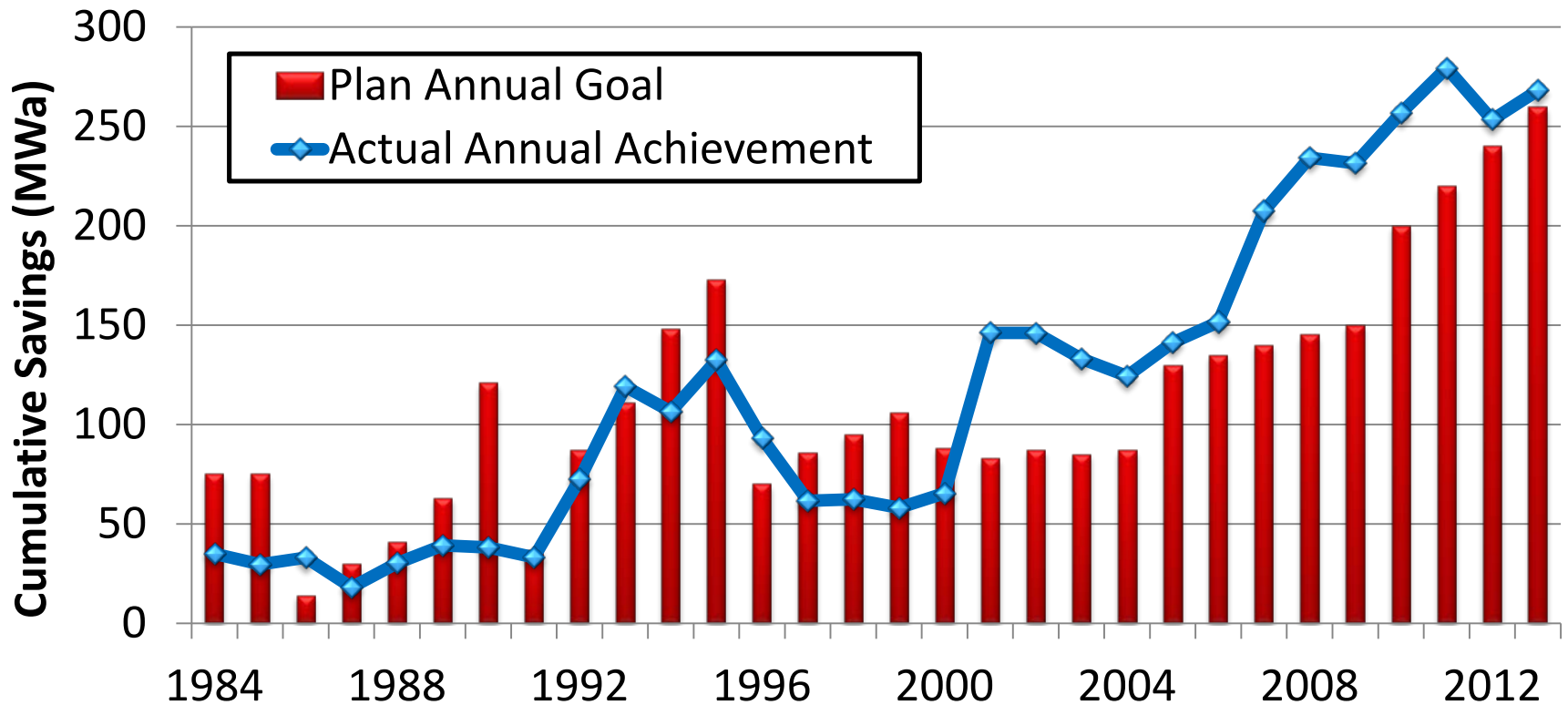
Energy Efficiency Resource Uncertainty Stems from Delays in Deployment (i.e. Construction) Schedule



*Achievements reflect utility and NEEA savings only. Savings from codes and standards are included as baseline adjustments in each plan's baseline load forecast

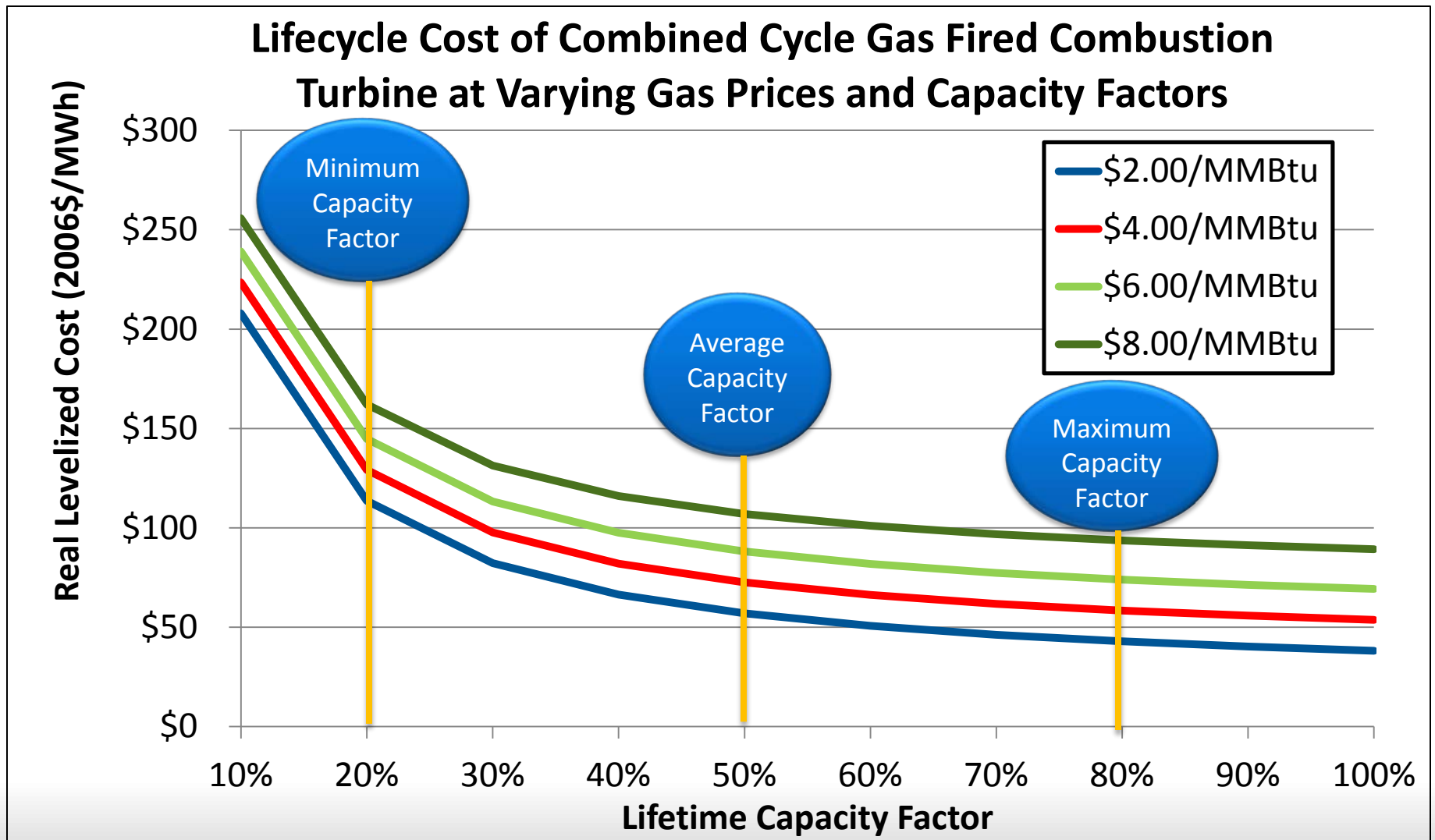
Although This Source of Uncertainty Appears to be Diminishing

Since the West Coast Energy Crisis Actual Program Achievements Have Exceed Council Plan Goals

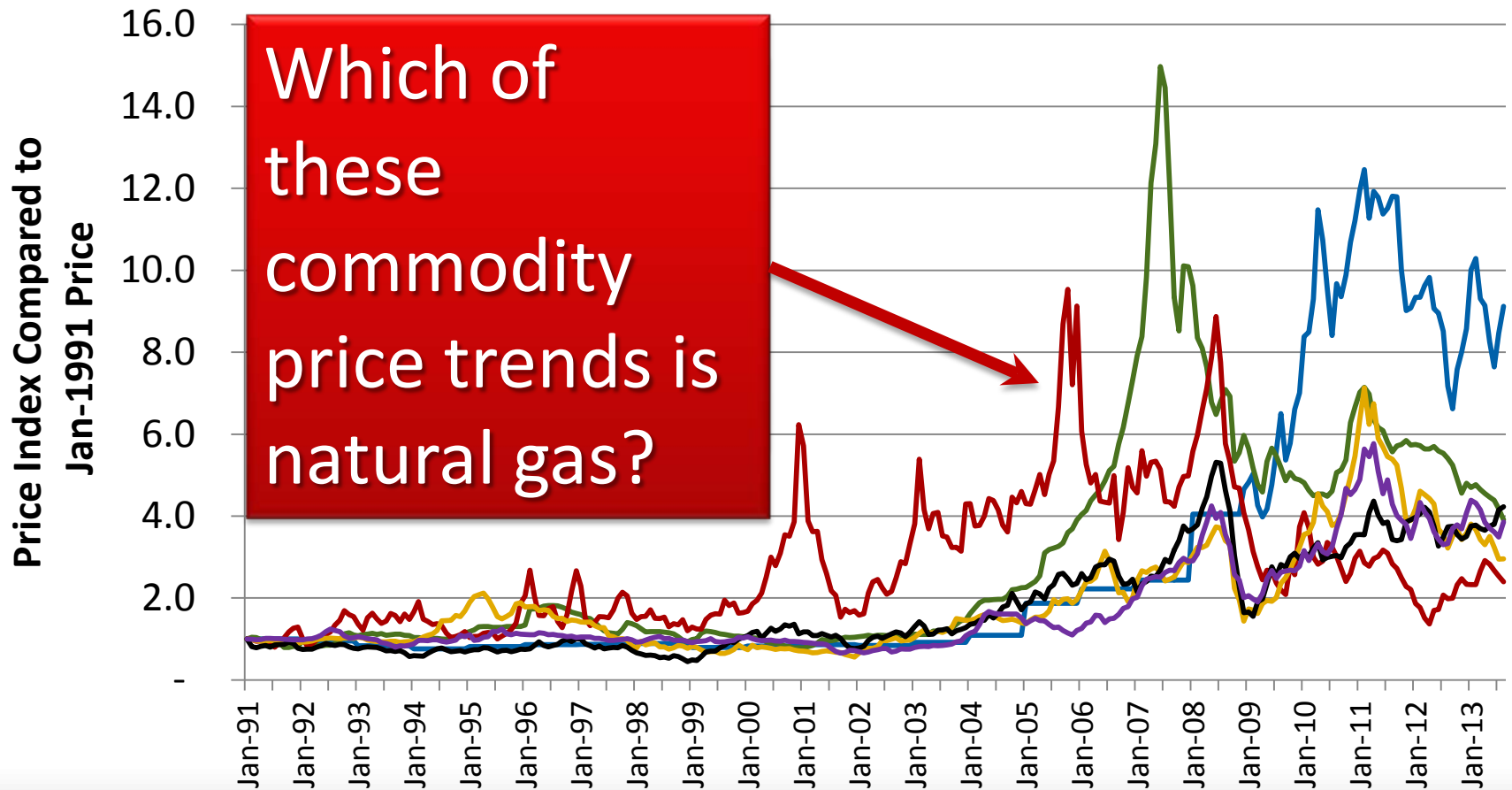


*Achievements reflect utility and NEEA savings only. Savings from codes and standards are included as baseline adjustments in each plan's baseline load forecast

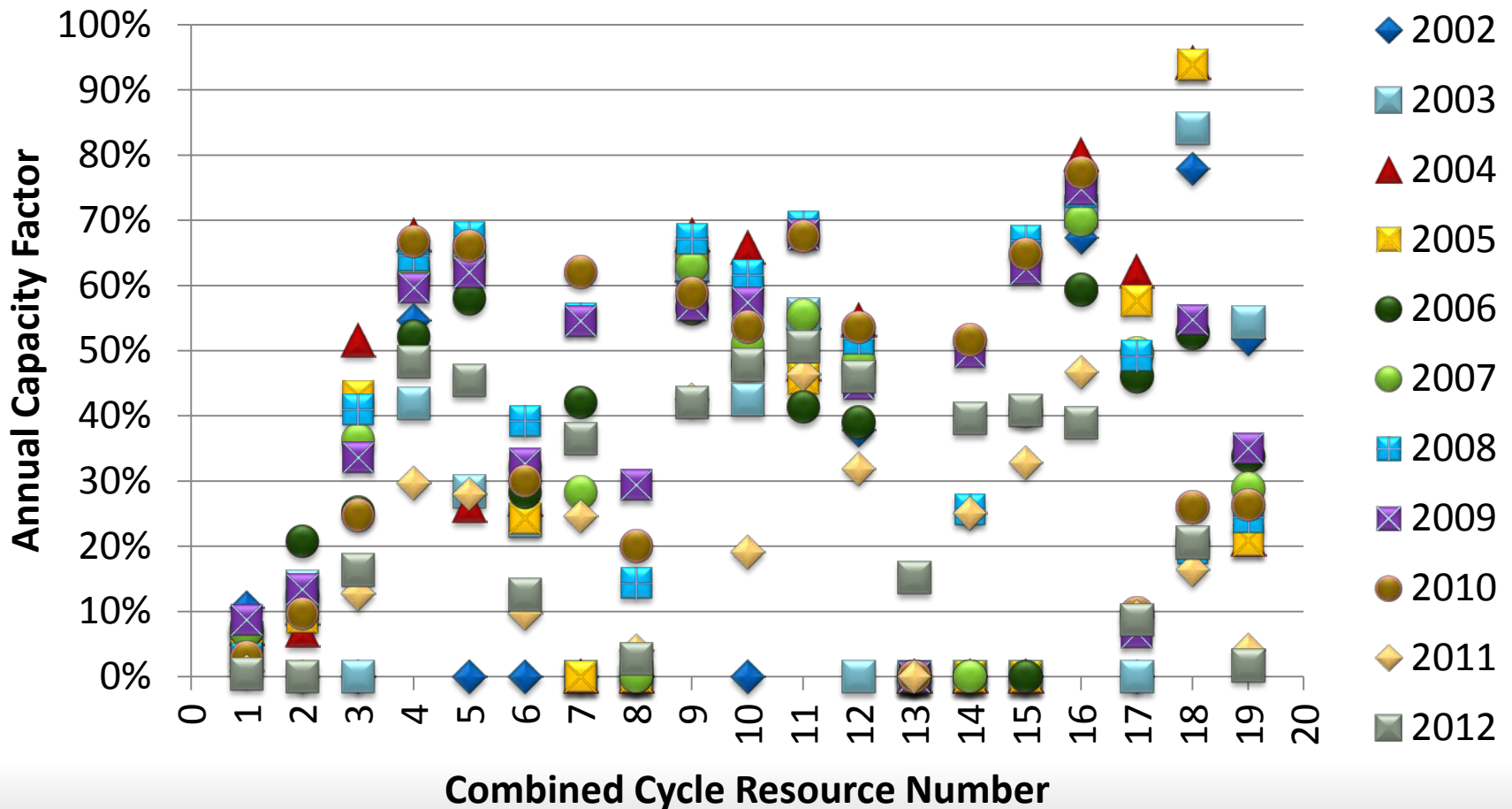
Resource Cost Uncertainty Is Driven by Input Fuel Prices and Utilization (i.e., "Capacity Factors")



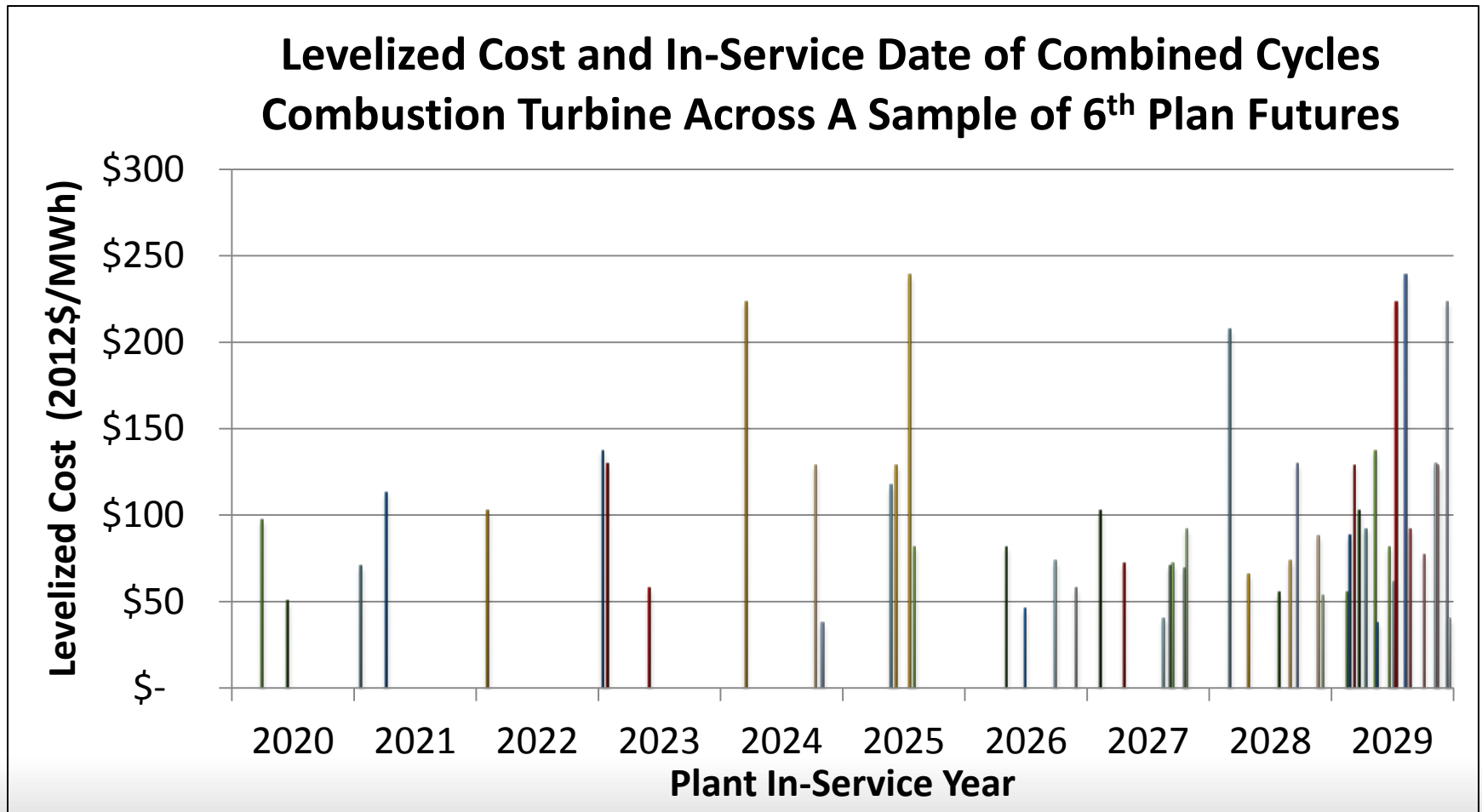
Forecasting Natural Gas Prices Is Equivalent to Engaging in Commodity Trading



Combined Cycle Generation Resource Capacity Factors Vary Significantly From Year-to-Year



These Uncertainties Mean There's No Single "Avoided Cost" for New Resources



Plan Must Address Three Major Sources of Uncertainty

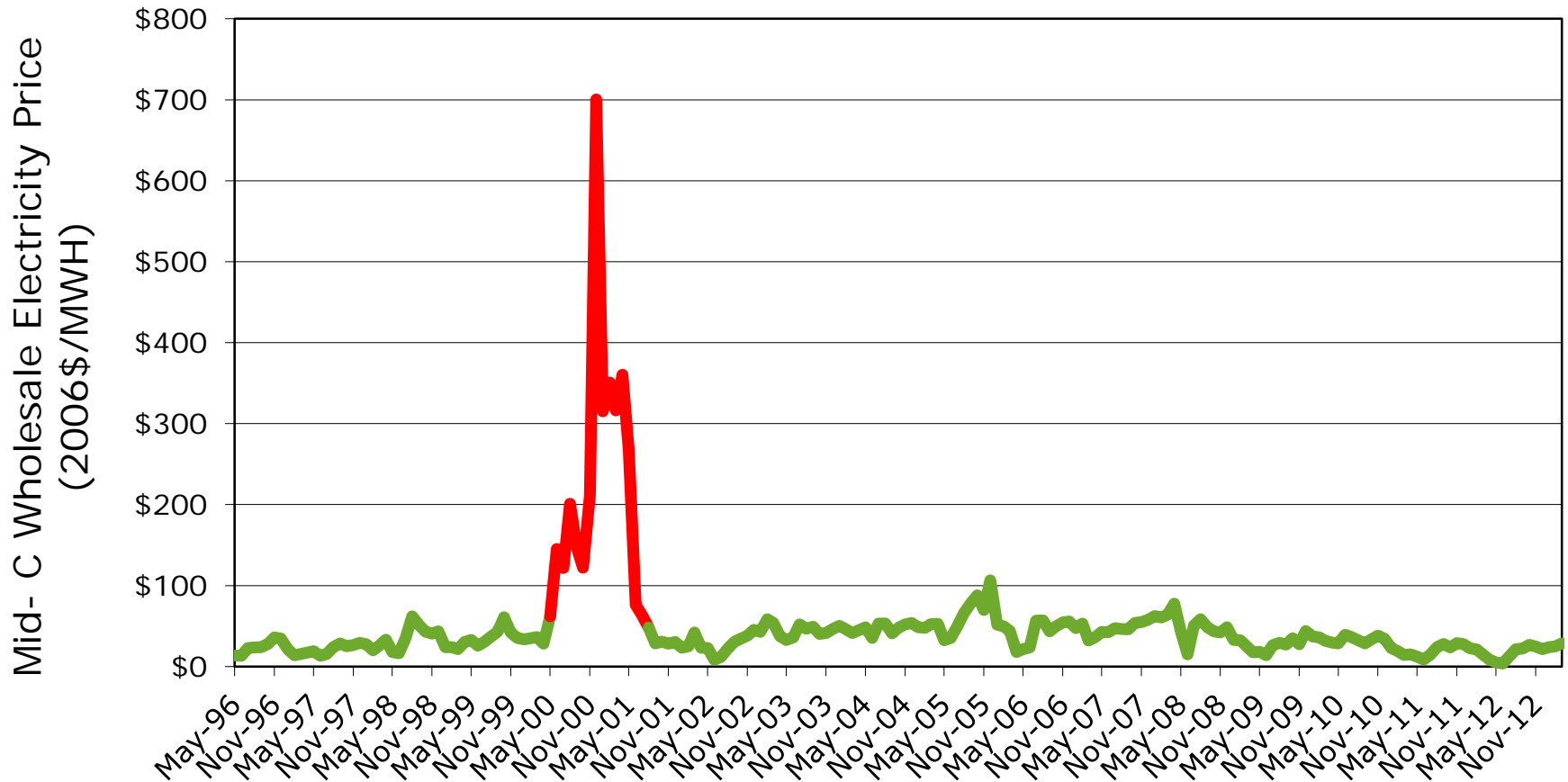
1. Load Uncertainty

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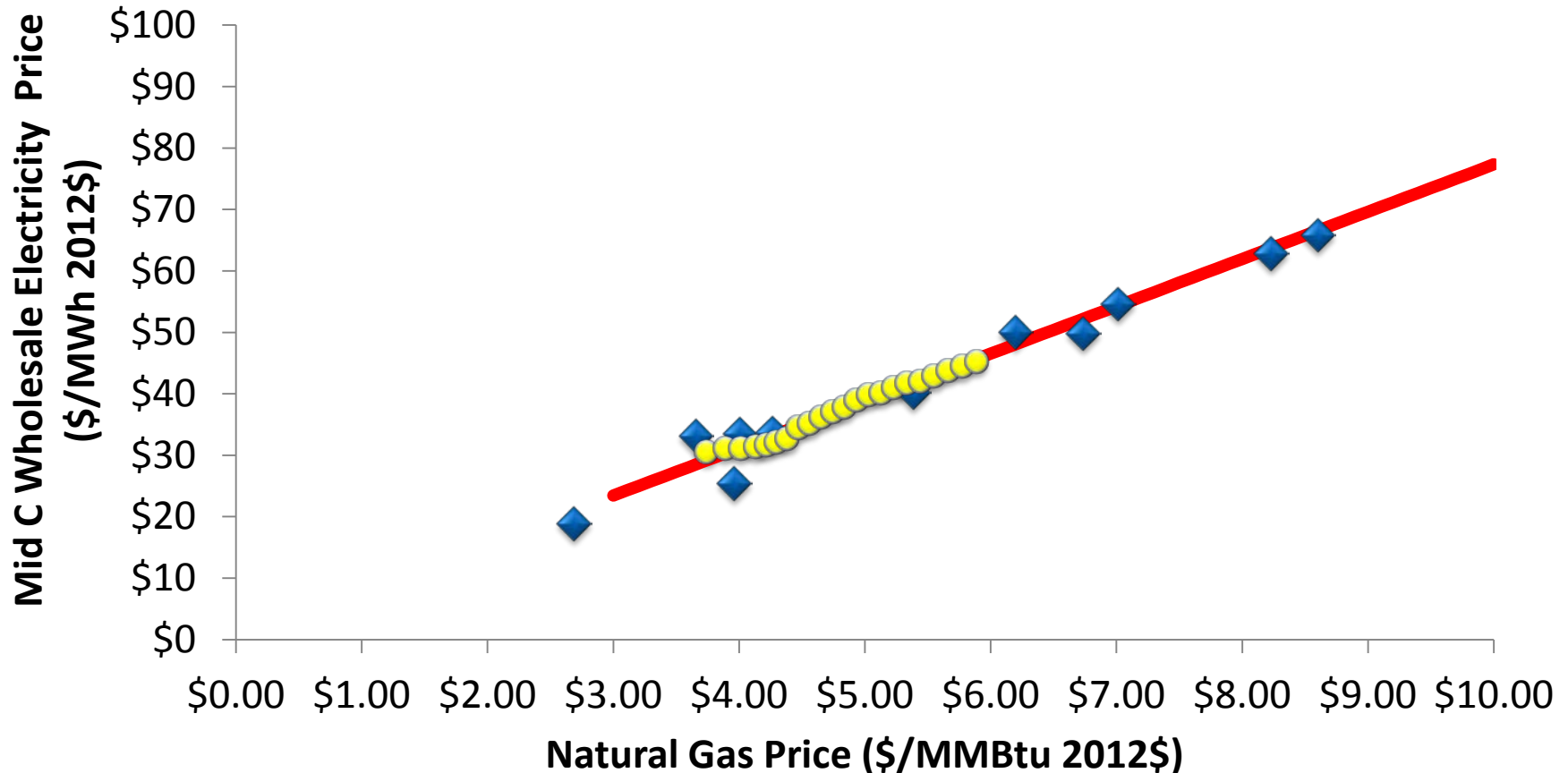
- Output
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3. Wholesale Electricity Market Price Uncertainty

Market Price Surprises – Electricity

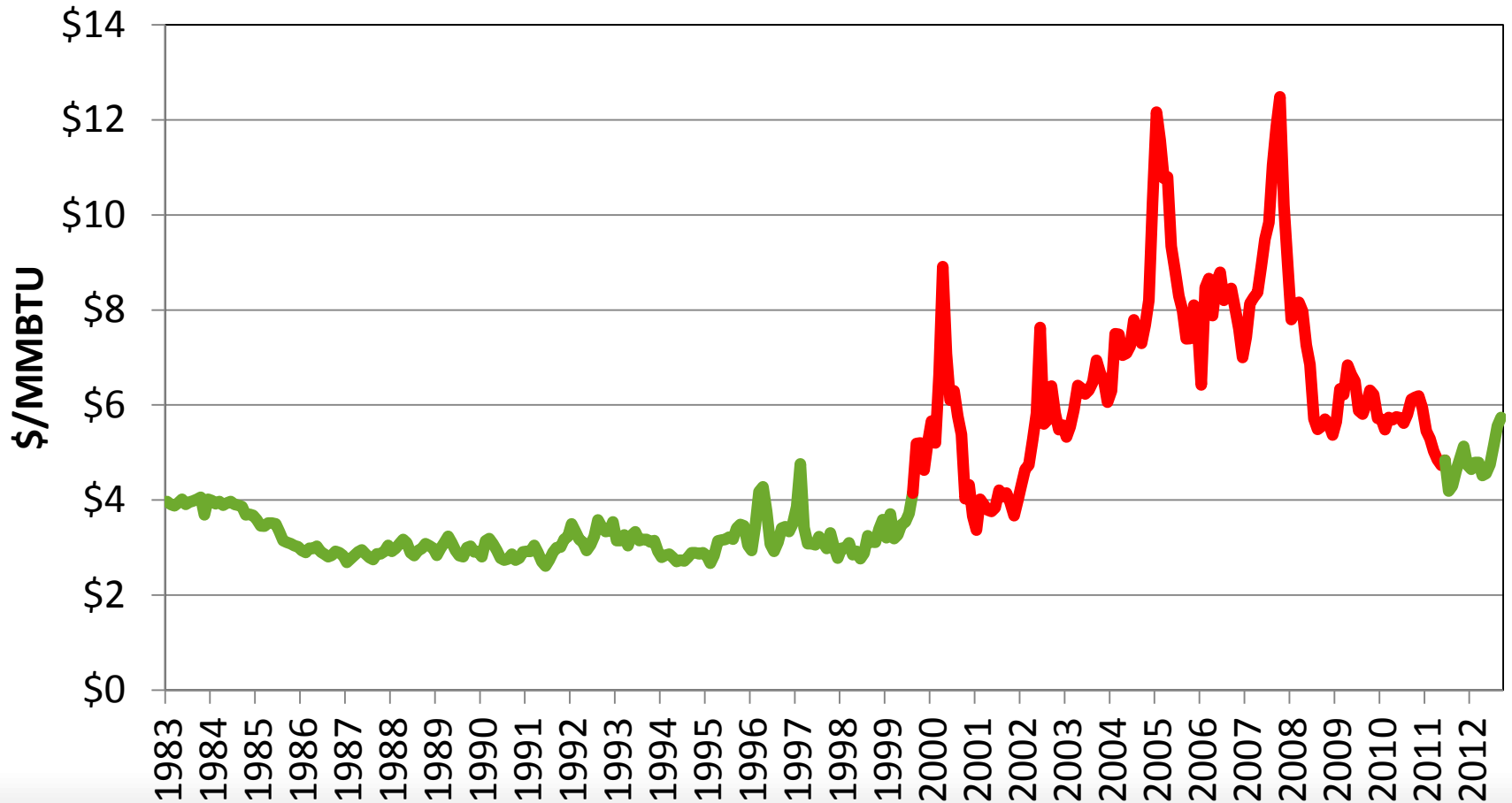


Wholesale Electricity Market Prices Are Strongly Correlated to Natural Gas Prices



◆ Historic Wgt Ave Mid C Price ● Forecast Mid Case — Lin. Fit to Forecast data

So Natural Gas Market Price *Surprises* Also Affect Wholesale Electricity Prices



With All These Uncertainties, How Does the Council Answer Those Simple Questions?

- 1. When Will We Need Resources?*
- 2. How Much Will We Need?*
- 3. What Should We Build/Buy?*
- 4. How Much Will It Cost?*
- 5. What's the Risk?*

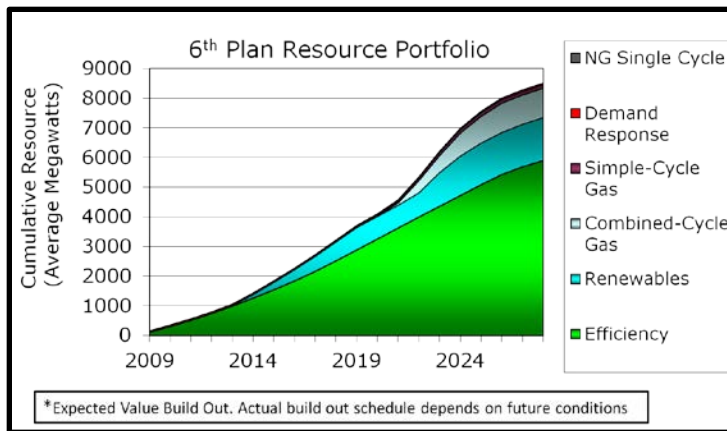


The lowest cost, lowest risks resources first.

The Answers to Those Questions Requires Planning for Uncertainty

Resource Strategies – actions and policies over which the decision maker *has control* that will affect the outcome of decisions

Futures – circumstances over which the decision maker *has no control* that will affect the outcome of decisions

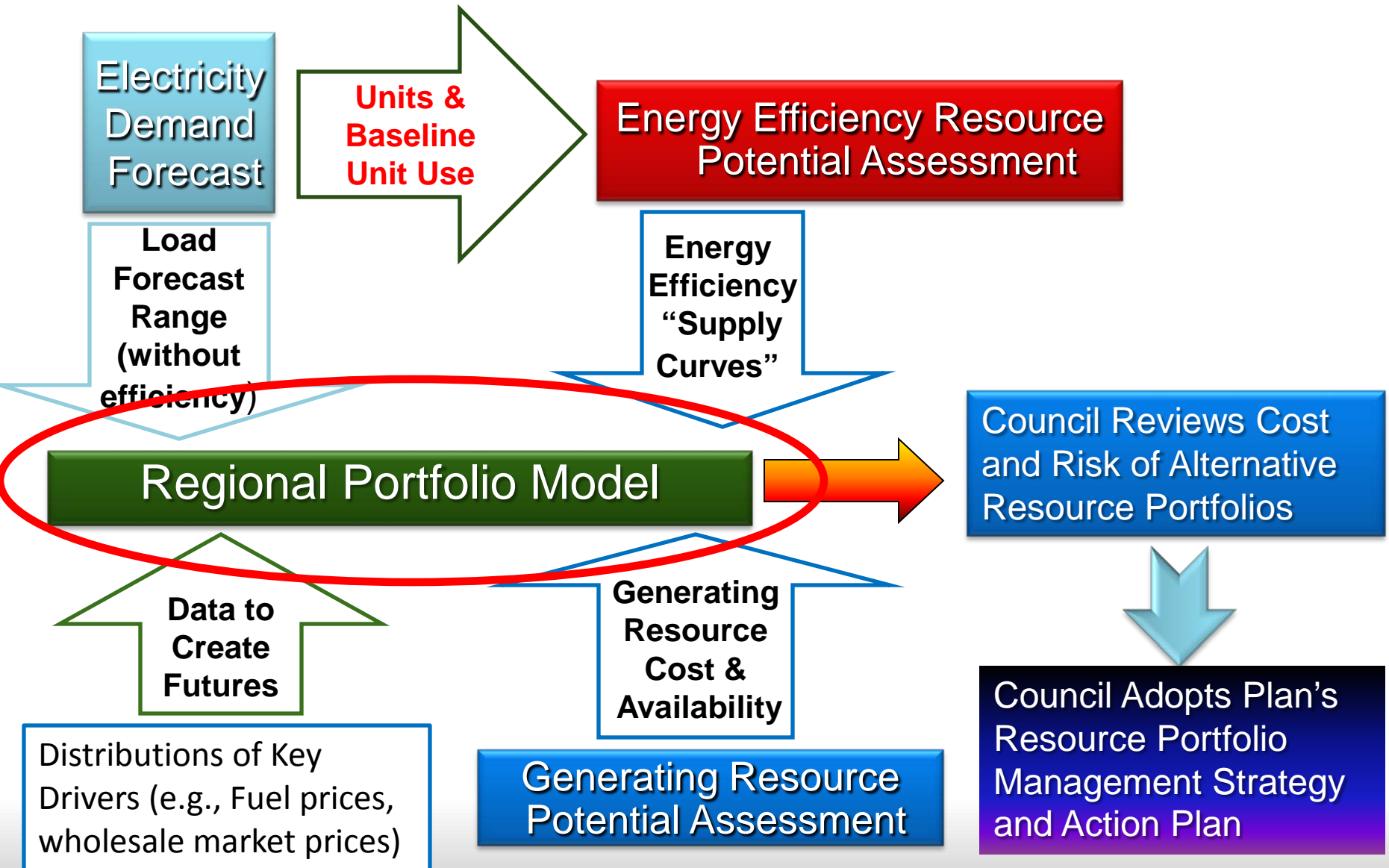


- Load Uncertainty
- Resource Uncertainty
 - Output
 - Cost
 - Construction Lead Times
- Wholesale Electricity Market Price Uncertainty



Scenarios – Combinations of *Resource Strategies* and *Futures* used to “stress test” how well what we control performs in a world we don’t control

This Is What the Regional Portfolio Model Does



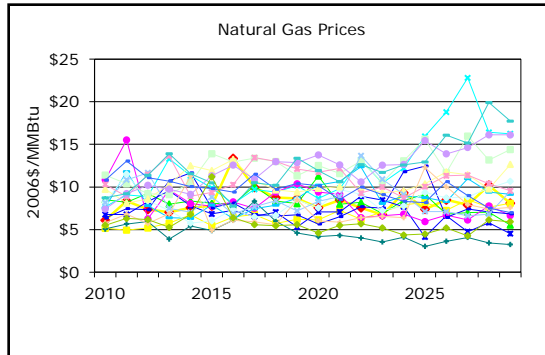
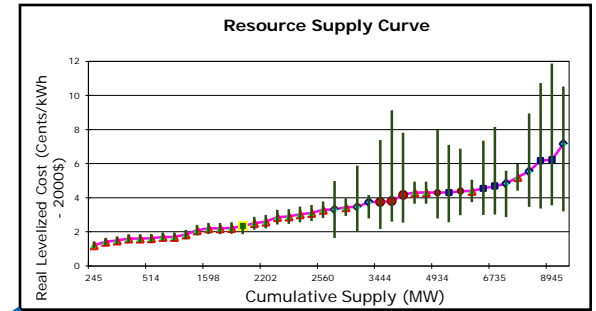
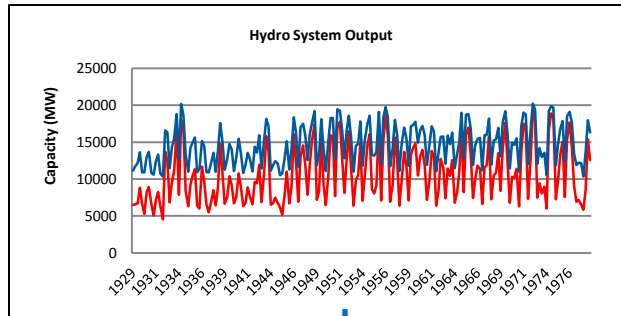
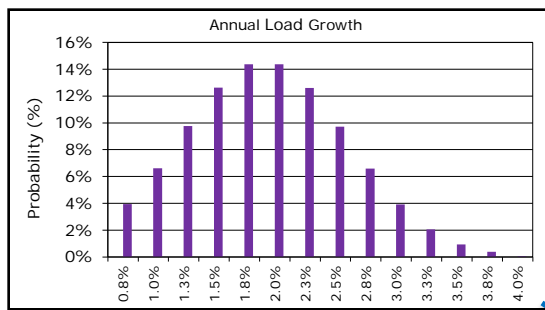
Council Follows the “Gump” Resource Strategy Testing Model



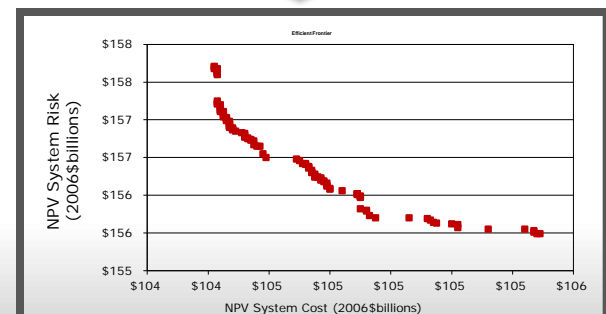
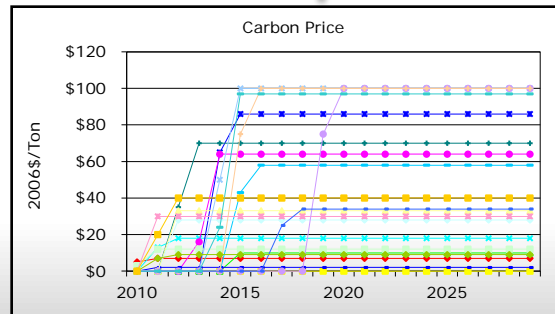
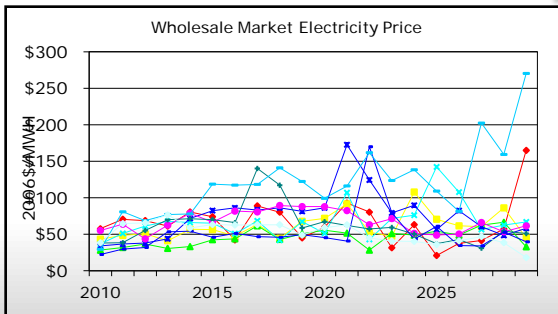
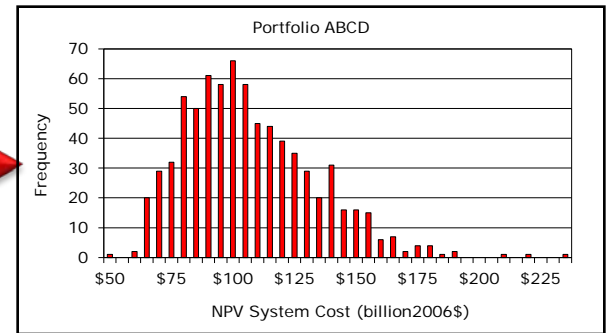
*The Future's
Like A Box of
Chocolates.*

*You Never
Know What
You're Gonna
Get.*

Council Portfolio Analysis Process “Test A Lot of Chocolates”



**Regional
Portfolio
Model**



The RPM Finds the Lowest Cost "Insurance" for the Same Risk Coverage

	LOW DEDUCTIBLE	MIDRANGE DEDUCTIBLE	HIGHER DEDUCTIBLE
Policy year claim is filed	\$250 deductible \$1,000 premium	\$500 deductible \$900 premium	\$1,000 deductible \$800 premium
1	\$1,250	\$1,400	\$1,800

Auto Insurance

INSURER	PRICE	RATING
Liberty Mutual	300.00	A++
State Farm	395.00	B

Buttons: CHOOSE

	My Car Insurance Quotes			
2	My Car Insurance			
3	My Insurance Provider			
4	Springfield, CA	Insurance Provider 1 Springfield, CA	Insurance Provider 2 Cupertino, CA	Insurance Provider 3 Modesto, CA
5	Current Auto Insurance Payment:			
6	\$154/ mo.	\$132/ mo.	\$154/ mo.	\$180/ mo.
7	Insurance Type: <i>Full Coverage</i>	Insurance Type: <input checked="" type="checkbox"/> <i>Full Coverage</i>	Insurance Type: <input checked="" type="checkbox"/> <i>Full Coverage</i>	Insurance Type: <input checked="" type="checkbox"/> <i>Full Coverage</i>
8	Coverage Type: <i>Standard</i> \$100K/\$300K Injury, \$50K Property	Coverage Type: <input checked="" type="checkbox"/> <i>Standard</i> \$100K/\$300K Injury, \$50K Property	Coverage Type: <input checked="" type="checkbox"/> <i>Basic</i> \$50K/\$150K Injury, \$30K Property	Coverage Type: <input checked="" type="checkbox"/> <i>Liability</i> \$50K/\$150K Injury, \$30K Property
	Preferred Deductible: \$500.00	Comprehensive Deductible: <input checked="" type="checkbox"/> \$500.00	Comprehensive Deductible: <input checked="" type="checkbox"/> \$1,000.00	Comprehensive Deductible: <input checked="" type="checkbox"/> \$1,000.00
	Preferred Collision Deductible: \$500.00	Collision Deductible: <input checked="" type="checkbox"/> \$500.00	Collision Deductible: <input checked="" type="checkbox"/> \$500.00	Collision Deductible: <input checked="" type="checkbox"/> \$500.00
	Preferred Medical Coverage: \$10,000.00	Medical Coverage: <input checked="" type="checkbox"/> \$10,000.00	Medical Coverage: <input checked="" type="checkbox"/> \$10,000.00	Medical Coverage: <input checked="" type="checkbox"/> \$5,000.00
	Emergency Roadside Assistance: Yes	Emergency Roadside Assistance: <input checked="" type="checkbox"/> Yes	Emergency Roadside Assistance: <input checked="" type="checkbox"/> Yes	Emergency Roadside Assistance: <input checked="" type="checkbox"/> Yes
	Safe Driver Discount: Yes	Safe Driver Discount: <input checked="" type="checkbox"/> Yes	Safe Driver Discount: <input checked="" type="checkbox"/> Yes	Safe Driver Discount: <input checked="" type="checkbox"/> Yes

Source: CR Money Lab, Premi

This image is for illustration purposes only, and do not necessarily represent the exact products, services, or ideas in the context they are found in.



What We Learn From “Stress Testing” Alternative Resource Strategies Forms the Basis of “The Plan”

- Does the amount and pace of energy efficiency development change across “low cost” and “low risk” futures?
- How sensitive are resource strategies to assumptions regarding future carbon risk/prices?
- What resource strategies provide the greatest “hedge” against electricity and gas price uncertainty?

Insights From Prior Plans

Preferred Resource Characteristics

Resource Type	Low Cost	Short Lead Time	Small Increment	No or Low Fuel Price Risk	Low Carbon Policy Risk
Energy Efficiency	★	★	★	★	★
Wind		★	★	★	★
Solar PV		★	★	★	★
Gas SCCT/CCCT	★	★	★		
Coal				★	
Nuclear					★

 = Resource exhibits desired characteristic
 = Resource partially exhibits desired characteristics

Your Task Is to Ensure that the 7th Plan's Resource Strategy's Benefits Outweigh Its Risks





Any Questions?