Northwest Power and Conservation Council

July 31, 2008

MEMORANDUM

TO: Council Power Committee

FROM: Michael Schilmoeller
Power Planning Analyst

SUBJECT: Introduction to the Regional Portfolio Model

In my presentation to the Power Committee in May, I described some of the key attributes of decision making under uncertainty. This presentation continues that discussion, introducing the Regional Portfolio Model. I will outline how the Regional Portfolio Model works and explain the similarities with decision making under uncertainty. This presentation will not call for any Power Committee decision.

The Regional Portfolio Model resembles most resource production cost models. Utilities and planning organizations use production cost models for estimating total cost and generation over a study period. The speed of the Regional Portfolio Model, however, permits the model to test many possible plans, each in a large number of scenarios. It differs from other production cost models in that resource construction and retirement are responsive to different future conditions or scenarios. Thus, it captures the risk associated with longer lead-times and higher mothball or cancellation costs. It differs from most other production cost models, also, in not relying on perfect foresight to select resource construction schedules. These attributes give the model the ability to quantify risk in a manner consistent with how decisions are actually made.

The presentation will focus on how the model uses decision criteria to modify resource construction and retirement in its simulations. The model selects least-cost resource schedules for each level of risk. We will examine the process that the model uses to make these selections. The selected schedules are, in fact, only for the completion of permitting, siting, and licensing resources. Such schedules reflect options to immediately begin construction of specific quantities of specified resources at specified dates. Our discussion will consider why and how to use such a resource plan. Finally, how we measure cost and risk are themselves important to understand. We will cover these briefly in the last portion of the presentation.

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Introduction to the Regional Portfolio Model

Michael Schilmoeller

Power Committee Presentation

Wednesday August 13, 2008

Spokane, Washington

Overview

- Review of decision-making under uncertainty
- Overview of the model and resource plan selection
- Response of resource plan to circumstances
- Cost objective and risk metric

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Significance to Resource Planning

	Buying an automobile?	Resource Planning?
Objectives	✓	✓
Reduce size and likelihood of bad outcomes	✓	✓
… but cannot eliminate risk	✓	✓
Cost – risk tradeoff	✓	✓
Imperfect Information	✓	✓

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Significance to Resource Planning

	Buying an automobile?	Resource Planning?
Use of scenarios	✓	✓
Resource allocations reflect likelihood of scenarios	✓	✓
… even if "we cannot assign probabilities"	✓	✓
Resource allocations reflect severity of scenarios	✓	✓
Decisions to use options are deferred	✓	✓

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Significance to Resource Planning

	Buying an automobile?	Resource Planning?
Choices depend on circumstances	✓	✓
No "do overs", stuck with consequences	✓	✓
Emphasis on developing options and alternatives	✓	✓
A plan may be predominantly about options	✓	✓
Issue: How much of each resource to use?	✓	✓

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Different Kind of Risk Modeling

- Imperfect foresight and use of decision criteria for capacity additions
- Adaptive plans that respond to futures
  - Primarily options to construct power plants or to take other action
  - May include policies for particular resources
- "Scenario analysis on steroids"
  - 750 futures, strategic uncertainty
  - Frequency that corresponds to likelihood

Sources of Uncertainty

- *Fifth Power Plan*
  - *Load requirements*
  - *Gas price*
  - *Hydrogeneration*
  - *Electricity price*
  - *Forced outage rates*
  - *Aluminum price*
  - *Carbon allowance cost*
  - *Production tax credits*
  - *Renewable Energy Credit (Green tag value)*
- *Sixth Power Plan*
  - *All of those to the left, except, perhaps, aluminum price*
  - *Power plant construction costs*
  - *Technology availability*
  - *Conservation costs*

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Most Elements of the Resource Plan Are Options To Construct

Additions in Megawatts

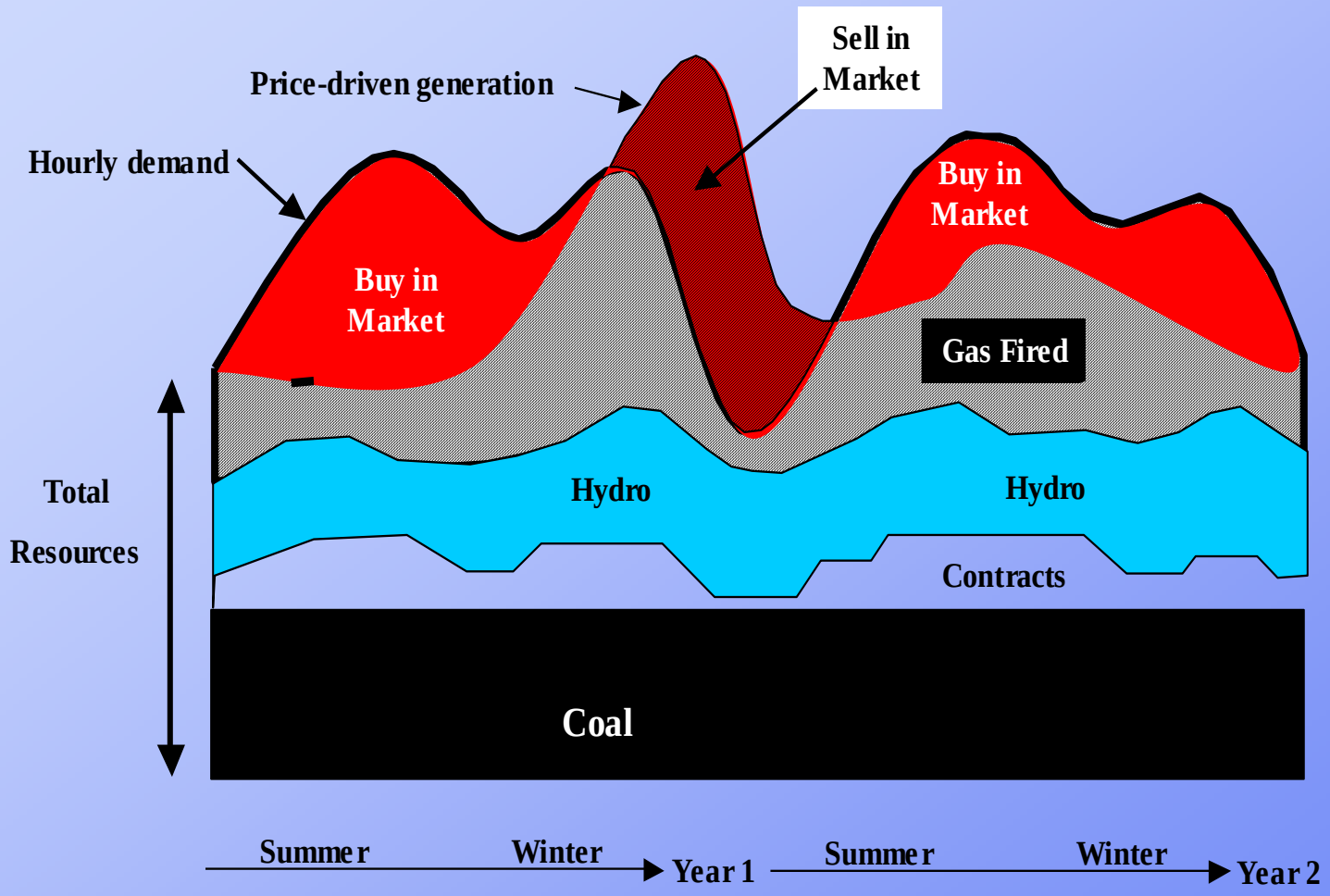
Beginning of year	2008	2010	2012	2014	2016	2018	2020
CCCT	0.00	0.00	0.00	0.00	0.00	610.00	1,220.00
SCCT	0.00	0.00	0.00	0.00	0.00	100.00	800.00
Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demand Response	500.00	750.00	1,000.00	1,250.00	1,500.00	1,750.00	2,000.00
Wind_Capacity	0.00	100.00	1,500.00	2,400.00	4,400.00	5,000.00	5,000.00
IGCC	0.00	0.00	425.00	425.00	425.00	425.00	425.00
Conservation cost-effectiveness premium over market	10.00	5.00					
avg New Conservation	443	746	1071	1416	1774	2020	2198

Power Resource Risks

Costs and Considerations

- Construction Risk
  - Responding fast enough to capture value
  - Sunk siting and permitting costs
  - Construction materials cost
  - Mothball and cancellation costs
- Operation Risk
  - Fuel, maintenance, and labor costs
- Retirement Risk
  - Carrying the forward-going fixed cost of an unused plant
  - Undervaluing and retiring a plant that may have value in the future

Operating Costs



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Spinner Graphs

- Illustrates "scenario analysis on steroids," one plan, across all futures
- Link to Excel Spinner Graph Model (11mb ZIP file)

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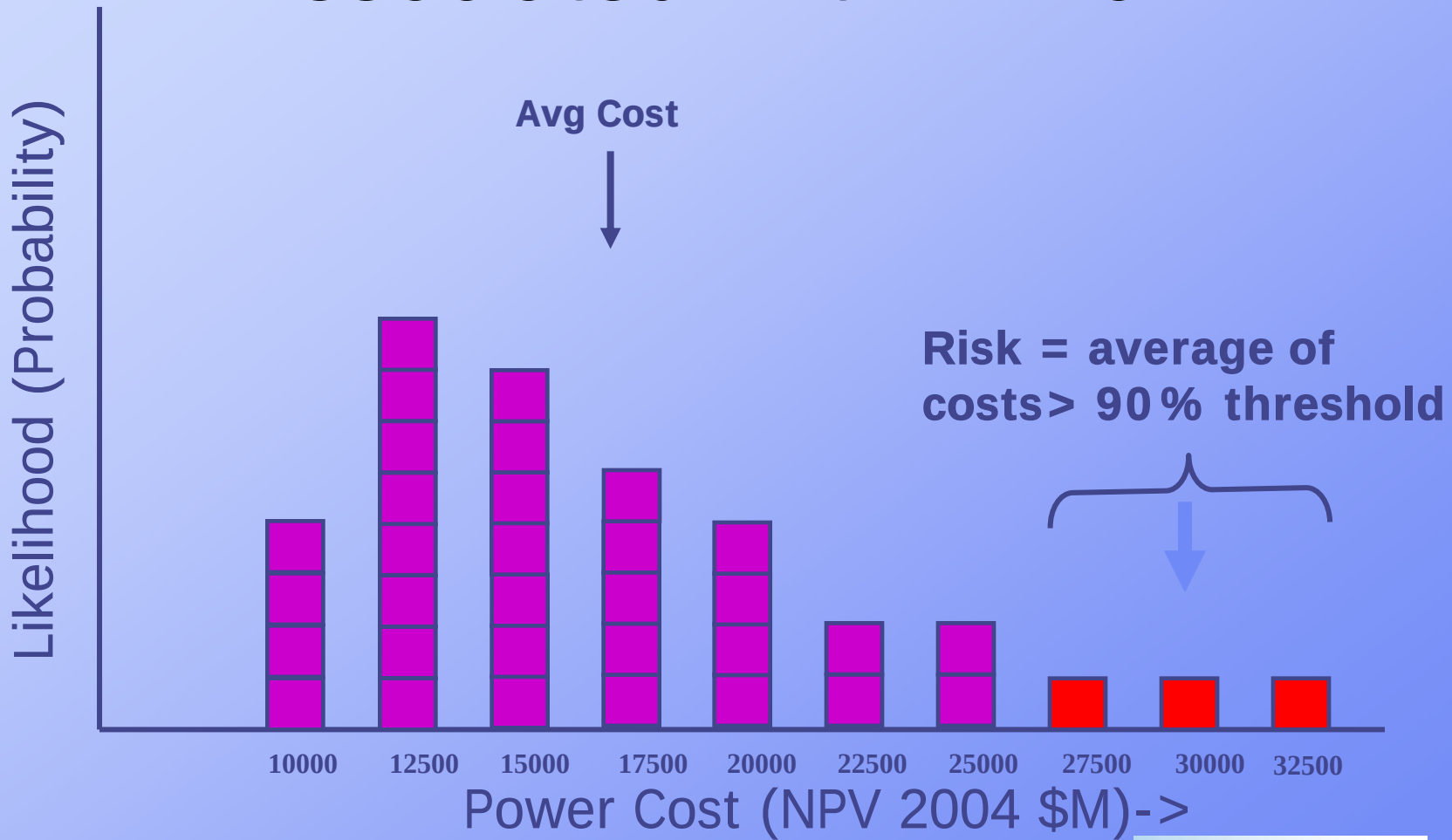
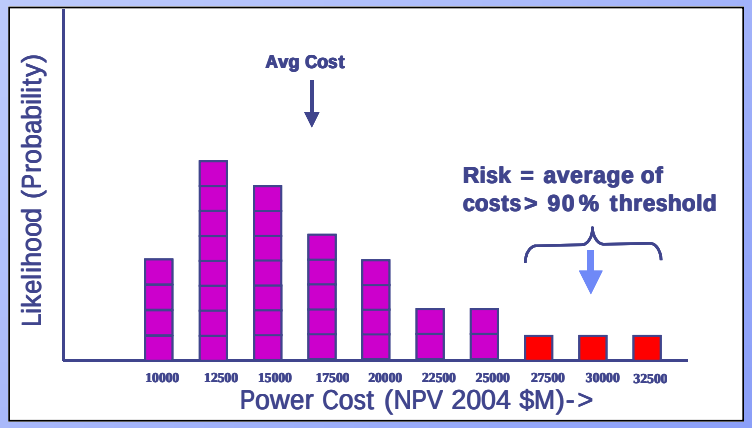
Risk and Expected Cost Associated With A Plan



Feasibility Space



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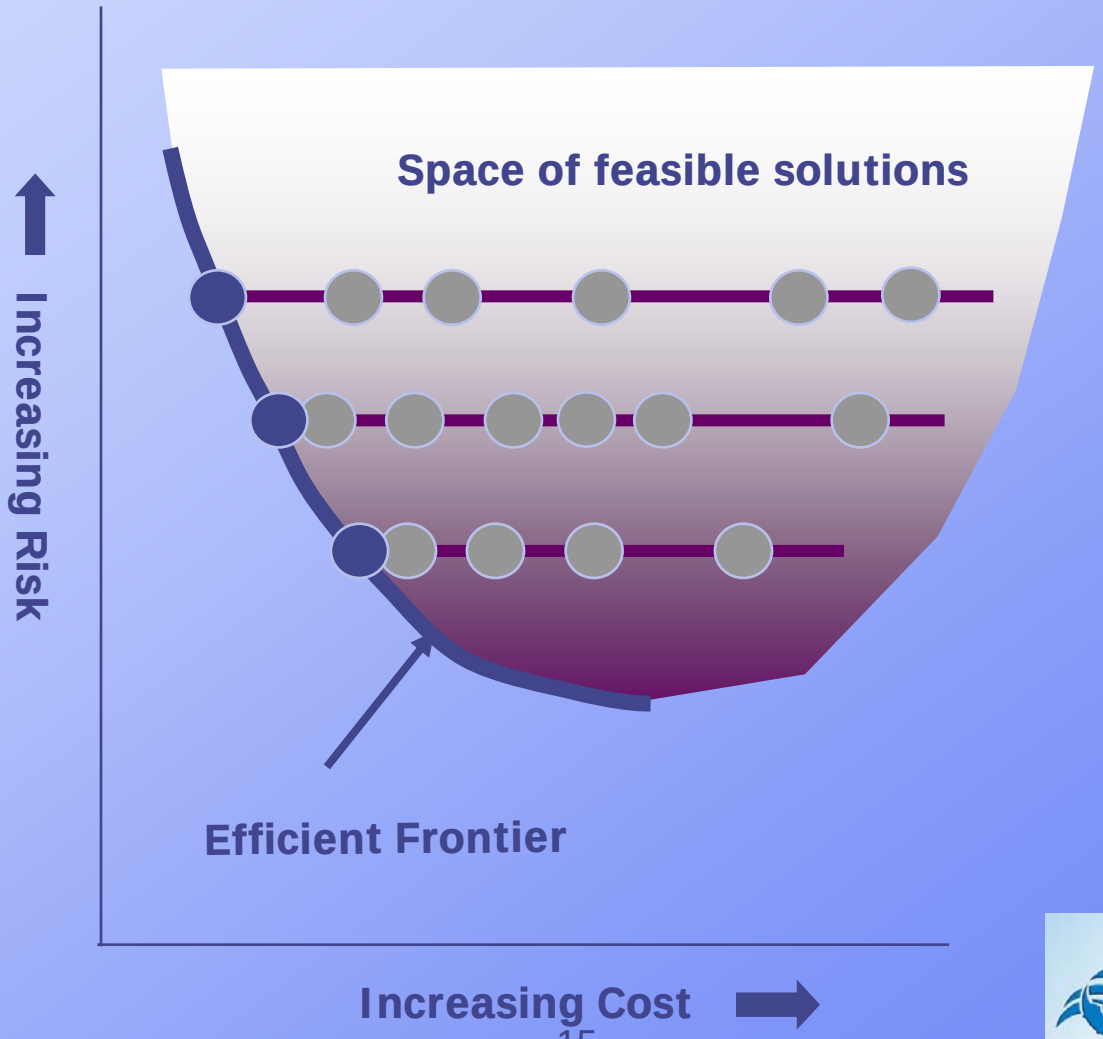
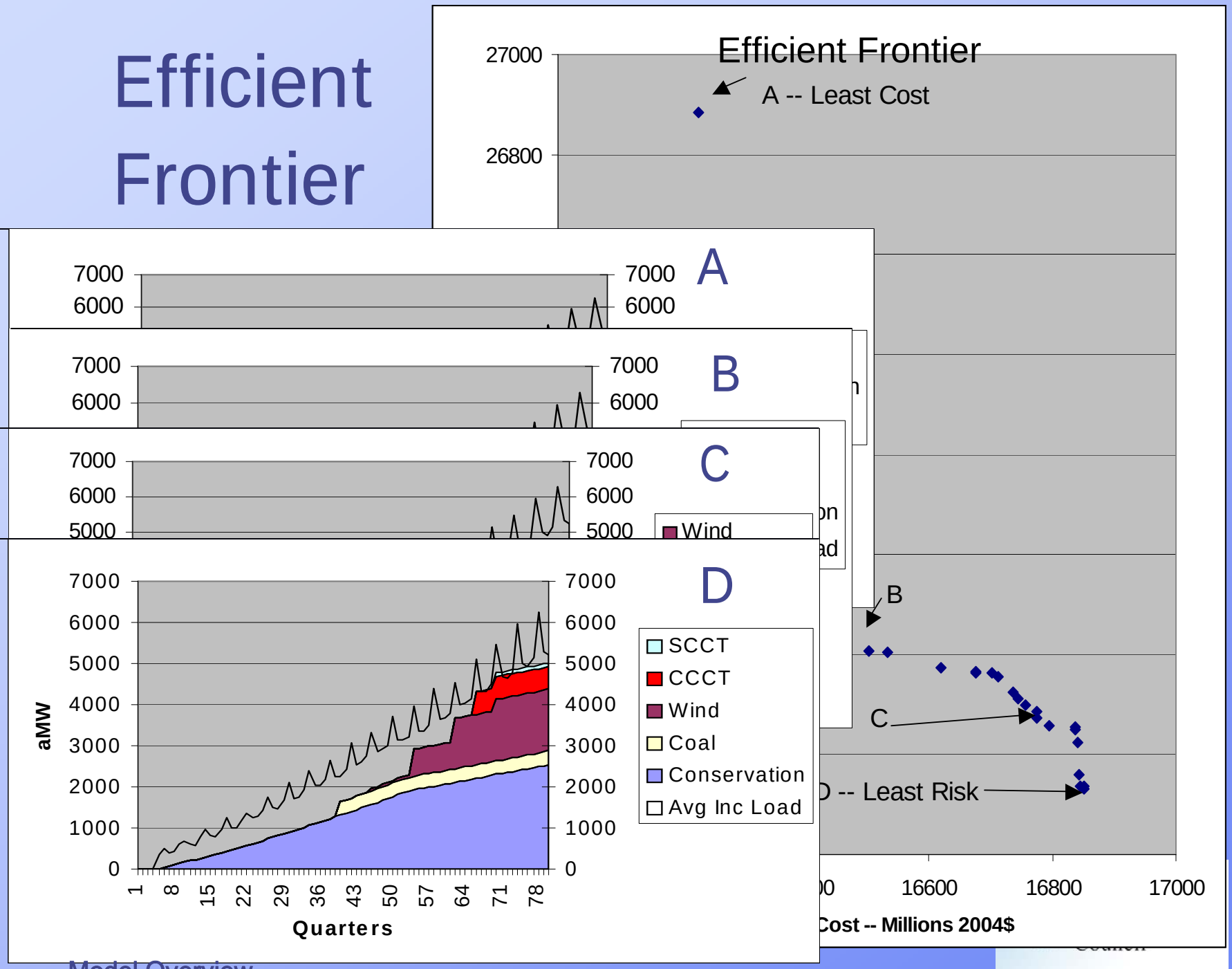


Efficient Frontier



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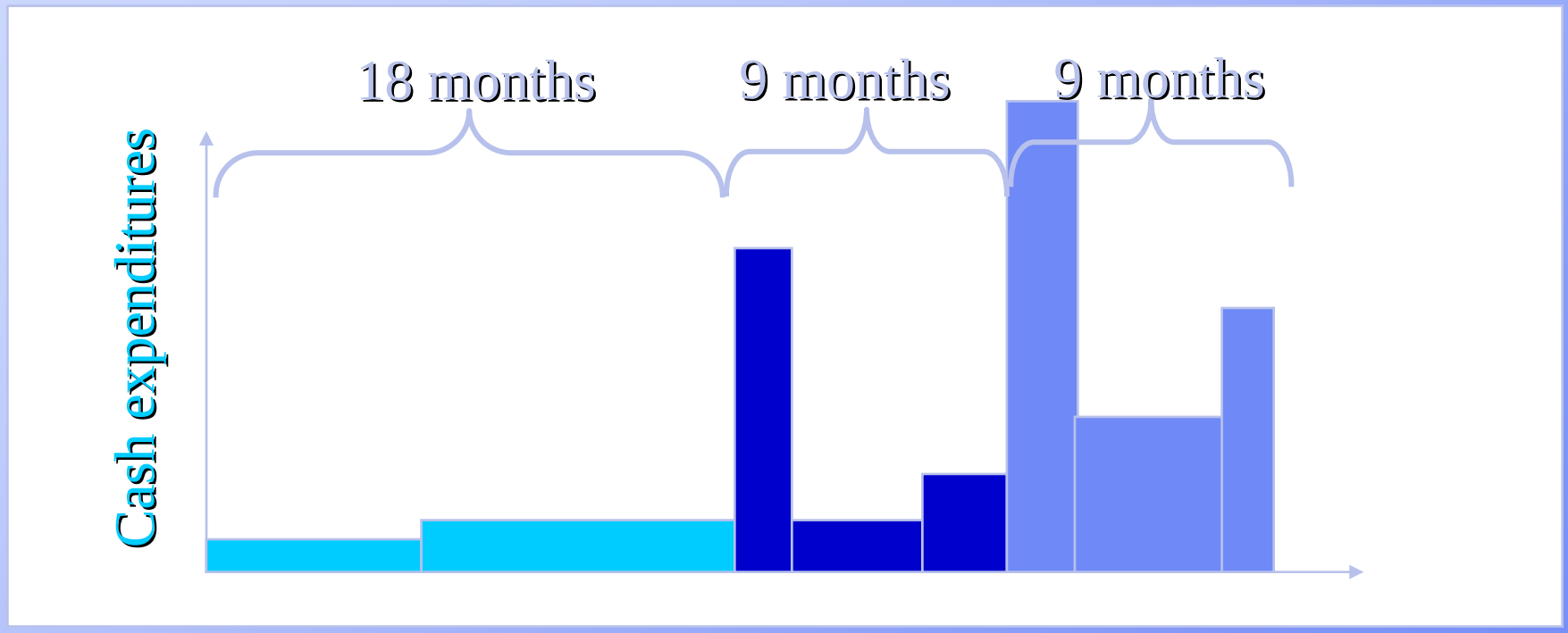
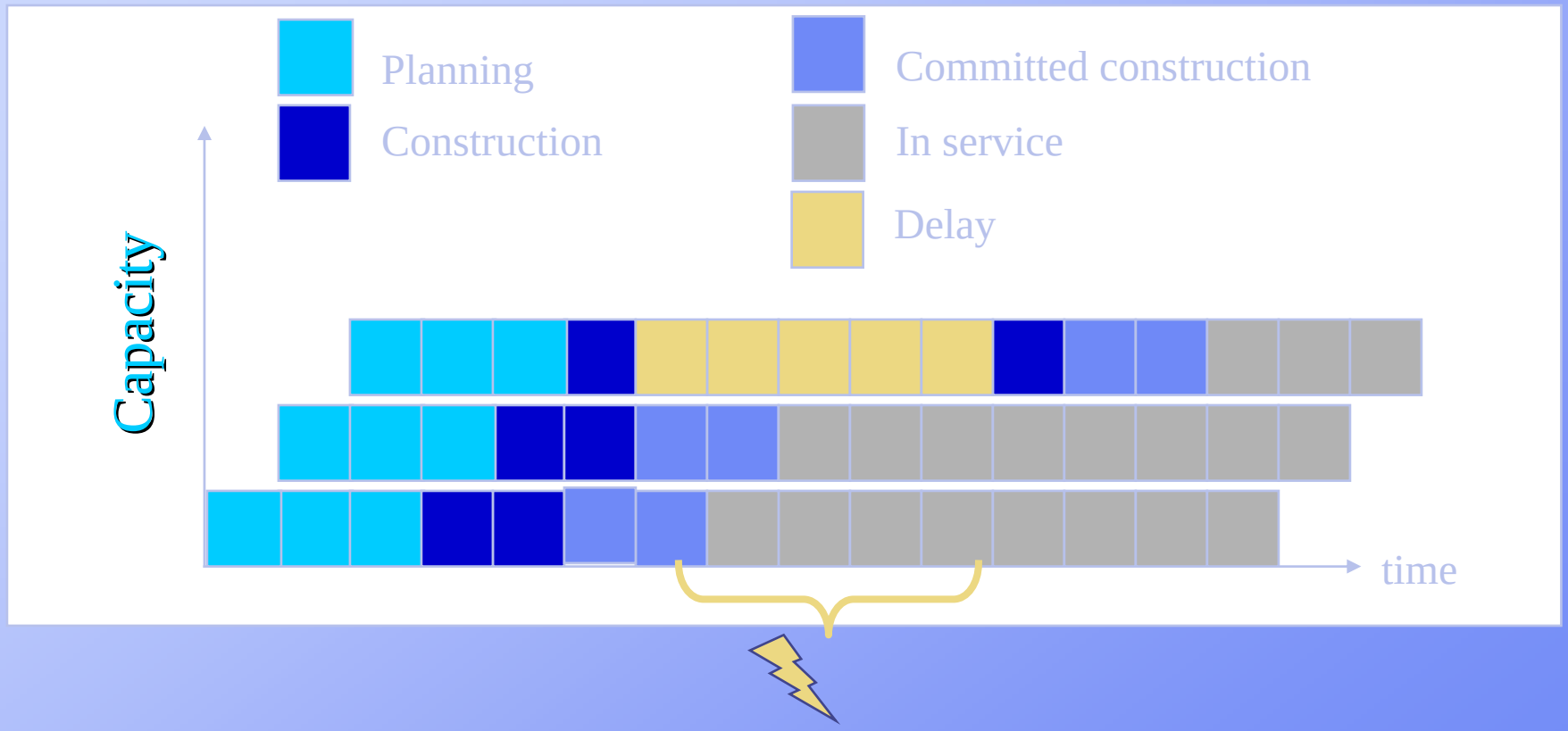
The Construction Cycle



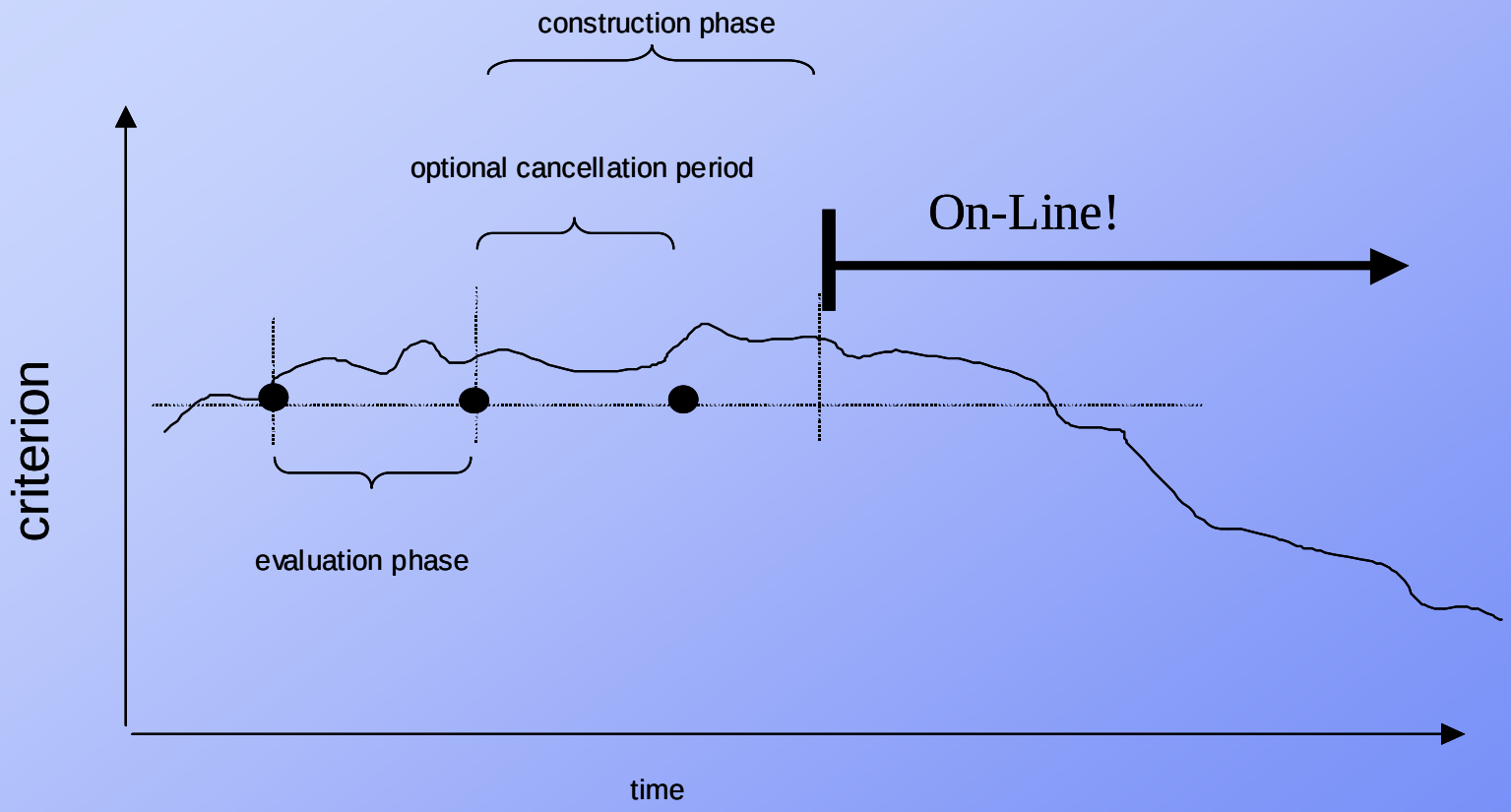
Construction Optionality



Example of Decision Criterion for Construction: CCCT and SCCT

- Projected economic value, from the construction, fixed, and variable costs and values from simulated forward curves:
  - the electricity forward price is an average of flat electricity prices over the preceding 18-months
  - the natural gas forward price is also such an 18-month average
- Project the energy adequacy at the end of the construction cycle. If the system would otherwise be inadequate, build this unit if it is the least cost among the options available.

Decision Criteria For Each Resource



Example of Decision Criterion for Retirement

- Forecast the value of the unit using the forward-going fixed cost only (fixed fuel transportation and salaries)
- Mothball (de-staff, sell fixed fuel contracts) after pre-specified number of periods
- Permanently decommission (convert the site to other purposes) if the plant remains in mothball status for some period

Why Use a Schedule of Construction Options for a Resource Plan?

- More realistic
- Consistent with statutory requirement for 20-year resource plan
- Necessary for capturing construction cost risk
- Consistent with earlier Council Plans

How Do We Interpret and Use a Schedule of Construction Options?

- As a ceiling for what should be sited and licensed
- To develop signposts for re-evaluation

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Objective: Mean NPV

- Central tendency gives the decision maker a sense of where the more likely outcomes lie
- Relationship to the goal of efficiency identified in the Act

Risk: Importance of Multiple Perspectives

- Standard Deviation
- VaR90
- 90th Quintile
- Loss of Load Probability (LOLP)
- Resource - Load Balance
- Incremental Cost Variation
- Average Power Cost Variation (Rate Impact)
- Maximum Incremental Cost Increase
- Exposure to Wholesale Market Prices
- Imports and Exports

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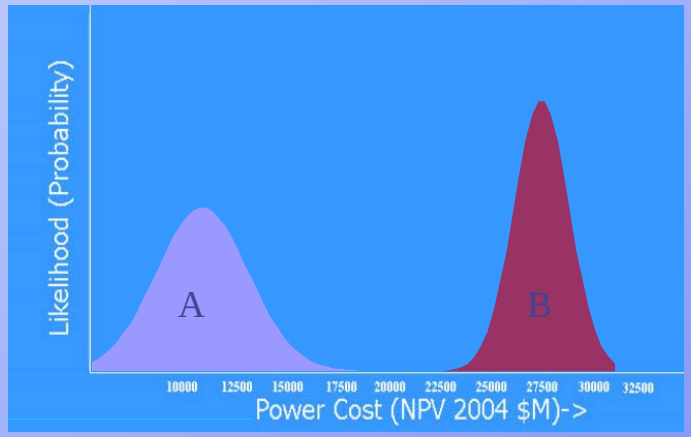
Problems with Risk Metrics

- Standard Deviation does not isolate bad outcome
- Loss of Load Probability (LOLP) does not capture diversity, because it does not measure the size of bad outcomes



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The Rationale for TailVaR$_{90}$

- Measure of likelihood and severity of bad outcomes
  - TailVaR$_{90}$ does not penalize a plan because the plan produces less predictable, but strictly better outcomes
  - TailVaR$_{90}$ recognizes actions and resources that reduce the severity and likelihood of bad outcomes
  - TailVaR$_{90}$ captures portfolio diversification
- The objective of economic efficiency
  - Relationship to the Act
  - TailVaR$_{90}$ is denominated in same units as the objective, i.e., net present value dollars

Review

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end

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Example of Decision Criterion for Construction: Conservation

- Discretionary
  - Annual, energy-weighted average of year before last's flat electricity price (lagged for budgeting)
  - Optional premium over market
- Lost Opportunity
  - Energy-weighted average of last five year's electricity prices
  - Ratchets upward to reflect represents such things as market transformation and the implementation of codes and standards
  - Optional premium over market