Northwest Power and Conservation Council

September 4, 2008

MEMORANDUM

TO: Power Committee

FROM: Michael Schilmoeller
Power Planning Analyst

SUBJECT: Introduction to the Regional Portfolio Model

My August presentation to the Council Power Committee began an introduction to key attributes of the Regional Portfolio Model. I hope to conclude the introduction with this presentation. This presentation will not call for any Power Committee decision.

The attached PowerPoint presentation includes the full introduction. I will begin where I left off, however, with the discussion of how any given resource plan adapts to different futures. We will return to the question of the meaning and use of a plan comprised of options. We will then turn to how we propose to measure cost and risk.

I have added a couple of slides to the end of this presentation that touch on decisions the Council will face in selecting a resource plan. The Fifth Power plan provides examples of such decisions.

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Introduction to the Regional Portfolio Model
(Continued)

Michael Schilmoeller
Power Committee Presentation
Tuesday, September 16, 2008
Astoria, Oregon

Overview

- Review of decision-making under uncertainty
- Overview of the model and resource plan selection
- Response of resource plan to circumstances (slide 18)
- Cost objective and risk metric
- Picking a resource plan

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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Review

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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*

Most Elements of the Resource Plan Are Options To Construct

Additions in Megawatts

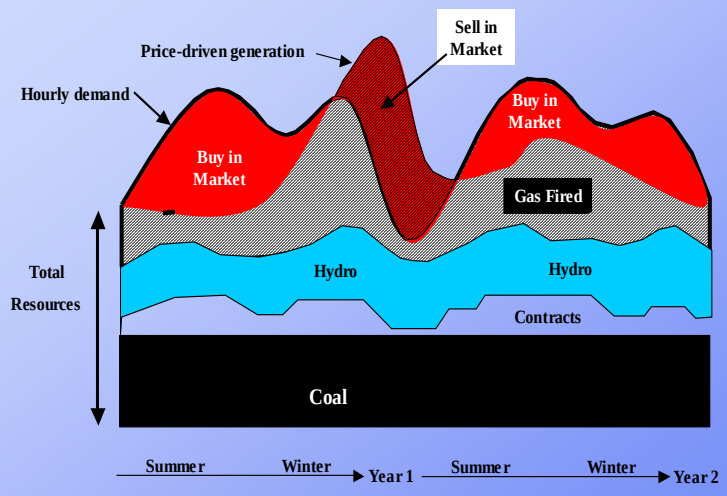
Beginning of year	2008	2010	2012	2014	2016	2018	2020
CCCT	0.00	0.00	0.00	0.00	0.00	610.00	1,220.00
SCCT	0.00	0.00	0.00	0.00	0.00	100.00	800.00
Coal	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demand Response	500.00	750.00	1,000.00	1,250.00	1,500.00	1,750.00	2,000.00
Wind_Capacity	0.00	100.00	1,500.00	2,400.00	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

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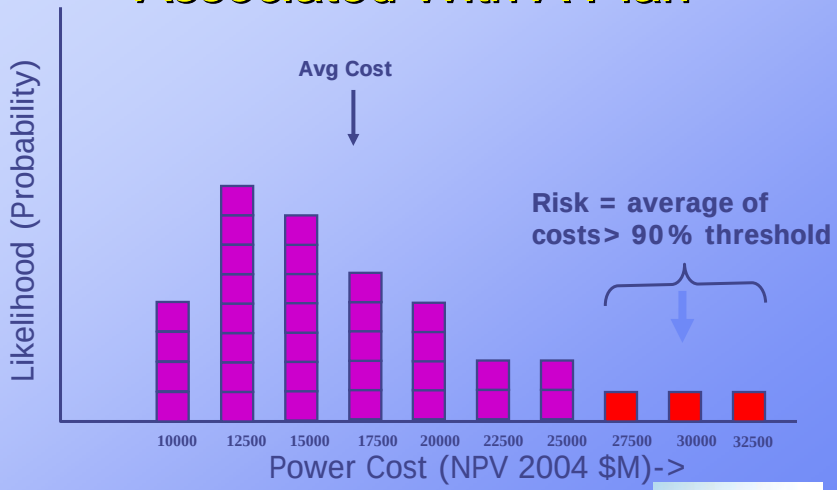
Risk and Expected Cost Associated With A Plan



Model Overview

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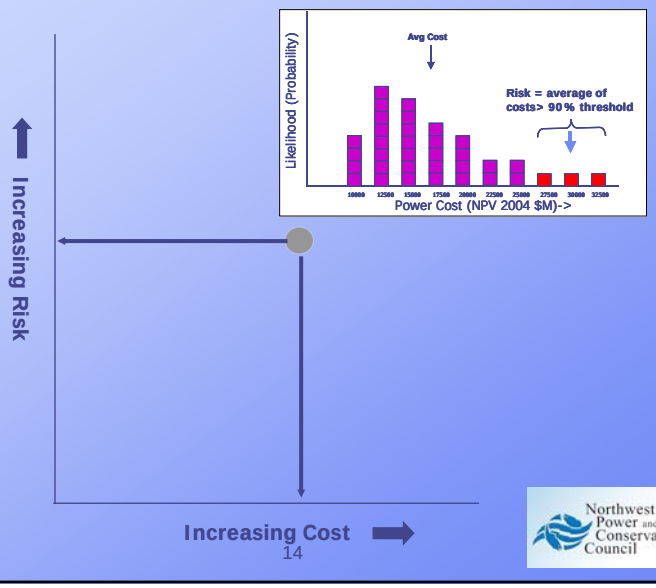
Feasibility Space



Model Overview

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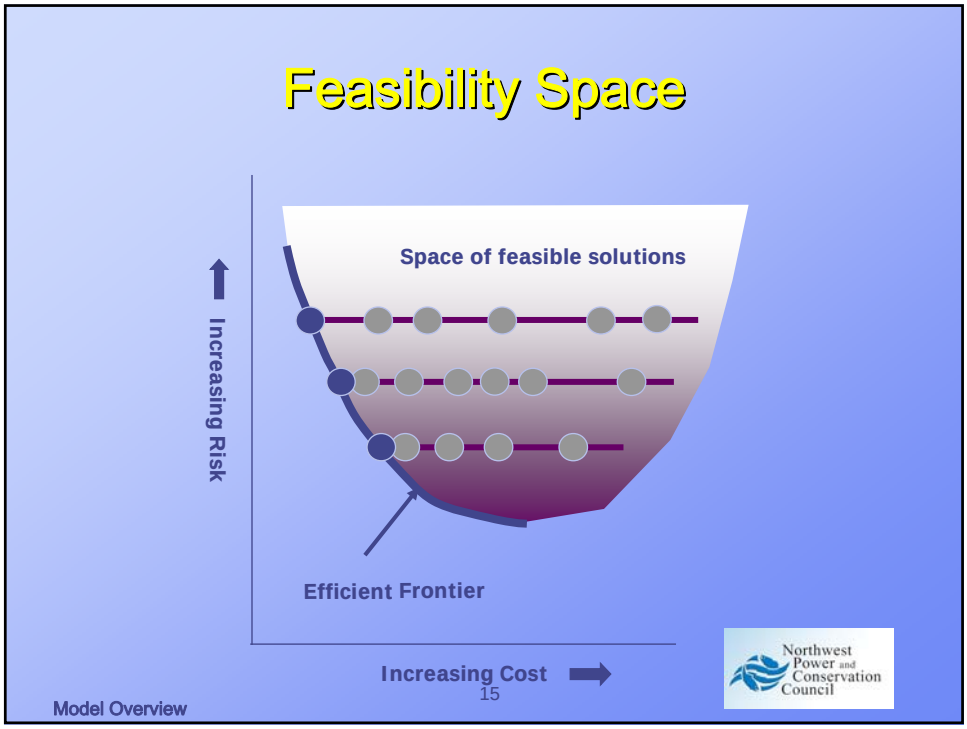
Feasibility Space
Space of feasible solutions
Increasing Risk
Efficient Frontier
Increasing Cost
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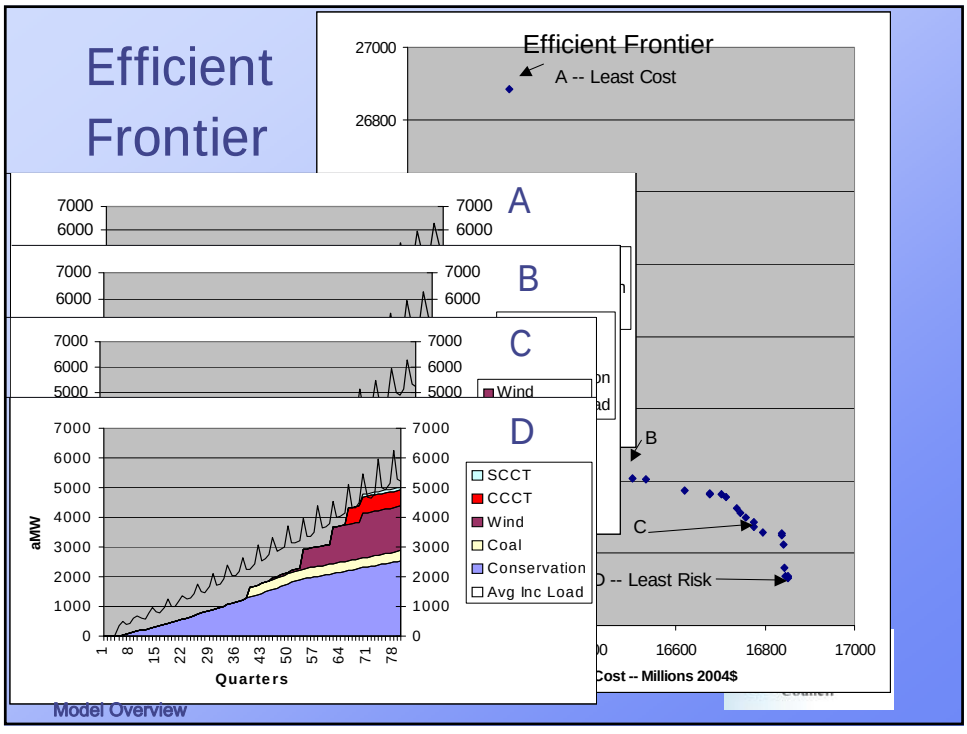
Model Overview


Efficient Frontier
Efficient Frontier
A -- Least Cost
B
C
D -- Least Risk
27000
26800
16600
16800
17000
Cost -- Millions 2004$
A
B
C
D
Wind
aMW
Quarters
SCCT
CCCT
Wind
Coal
Conservation
Avg Inc Load
Model Overview

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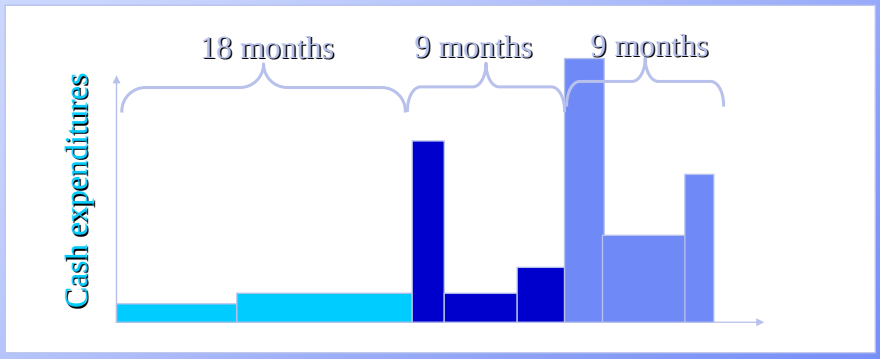
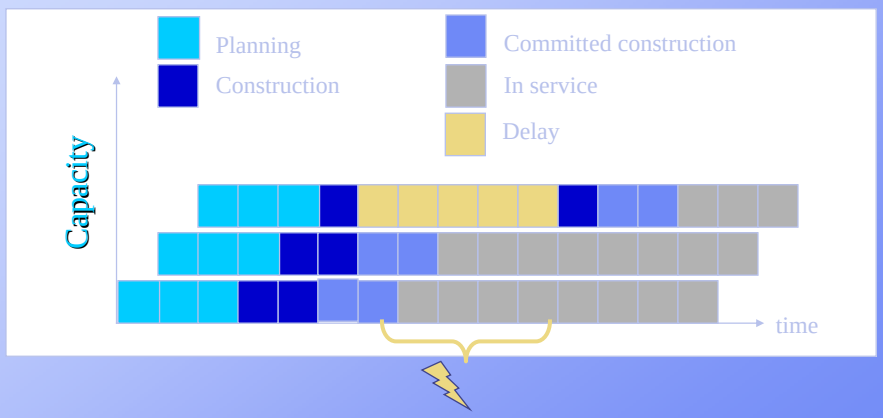
The Construction Cycle



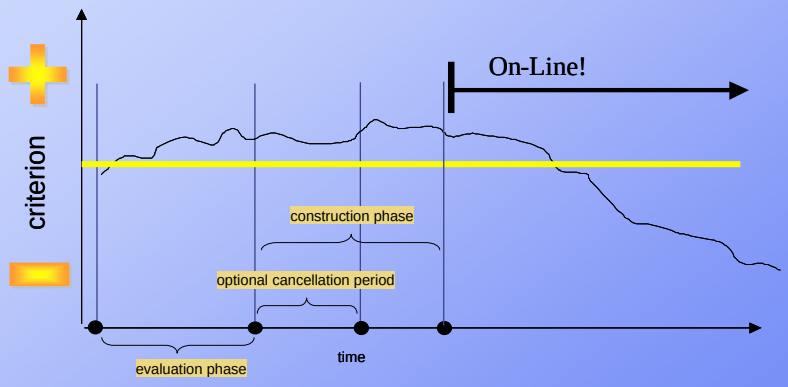
Construction Optionality



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 Construction



Decision Flexibility

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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

Decision Flexibility

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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 decile
- 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

$TailVaR_{90}$

Average of the ten percent worst outcomes (highest NPV costs)

- Measures the likelihood and severity of *bad* outcomes
  - Plans with better outcomes not punished
  - Consistent with the Act's objective
- Captures portfolio diversification

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Study Considerations

- Are the assumptions reasonable? Examples from the Fifth Plan:
  - Deployment rate for discretionary conservation
  - Availability of affordable IGCC
  - Impact of IPP generation on wholesale market prices
  - Likelihood of price caps on wholesale market prices
  - Potential for demand response (DR)
  - Transmission concerns and consequences
- Have we considered all the resource planning alternatives?
- Have we considered all the contingencies?

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Resource Plan Selection

- Trade-off between economic cost and risk
- Rate impacts and volatility
- Exposure to market prices
- Non-economic costs and risks, including associated carbon emissions
- Meeting reliability standards
- Difficulties with changing the resource plan

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Review

- Overview of the model and resource plan selection
- Response of resource plan to circumstances
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- Remember most of this by recalling the general principles of decision-making under uncertainty

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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

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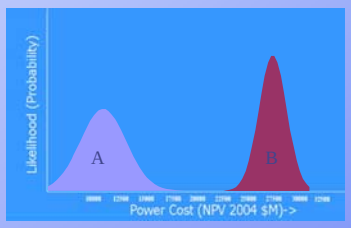
Problems with Risk Metrics

- 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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