Northwest Power and Conservation Council

October 1, 2008

MEMORANDUM

TO: Power Committee

FROM: Jeff King, Senior Resource Analyst

SUBJECT: Cost and availability of gas-fired generation

Assessment of natural gas generating resource potential is one of the most important resource assessments for the Sixth Power Plan. Gas-fired generation is among the most flexible of resources. In addition to dispatchable energy, gas-fired technologies can provide regulation and load-following for integration of wind and other intermittent renewable resources, and peaking capacity and reserves for maintaining system reliability. Among fossil sources of generation, gas-fired generation has the lowest inherent CO_2 production per megawatt. Gas-fired generation will therefore play a key role in utility responses to greenhouse gas control policies. In addition, modest local environmental impacts facilitate permitting, shorten project development lead time and broaden siting opportunities for gas-fired capacity.

Over the past several months, staff has been developing information regarding the performance, cost and availability of gas-fired combined-cycle, simple-cycle gas turbine and reciprocating engine power plants. These findings have been discussed with the Council's Generating Resources Advisory Committee (GRAC). Staff will present the findings and conclusions of this assessment at the October Power Committee meeting. Because several more days will be required to fully consider comments received following the September 27 GRAC meeting, presentation materials will be mailed to the Power Committee next week.

Staff plans to assess the potential of gas-fired fuel cell power plants and microturbines. However, these technologies will be addressed in less detail because cost, reliability, and commercialization issues make them less likely to play a significant role in the near-to-mid-term.

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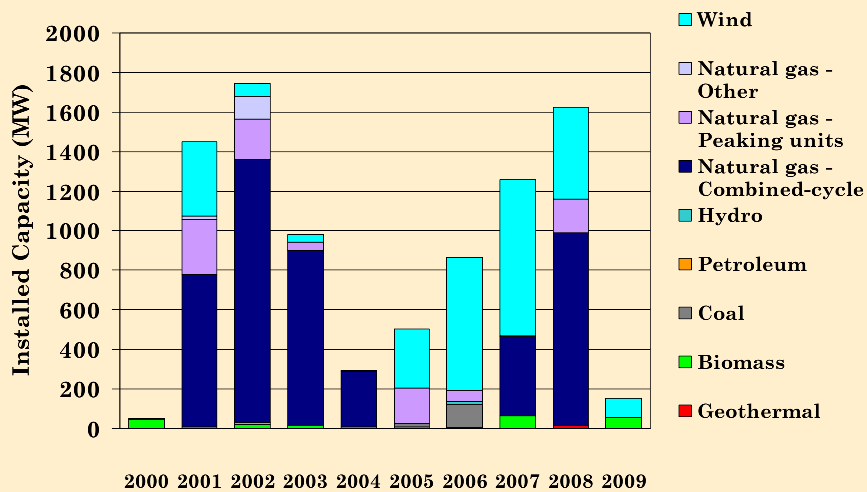
Sixth Northwest Conservation & Electric Power Plan

Proposed Combined-cycle Power Plant Planning Assumptions

Jeff King
Northwest Power and Conservation Council

Power Committee
Portland, OR
October 15, 2008

Northwest generating project development



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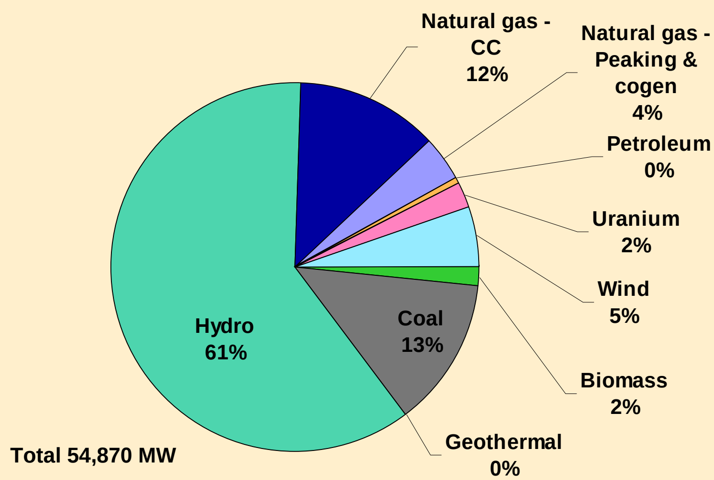
Gas combined-cycle plants now constitute 12% of Pacific Northwest generating capacity



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Factors affecting future role of combined-cycle plants

- Lowest per-MW CO2 production of the fossil resources
- Short development and construction lead time
- Non-CO2 air emissions can be controlled to very low levels
- Relatively easy to site and permit
- Low capital investment
- Thermally-efficient, but sensitive to fuel price
- Can be designed to provide load-following and supplemental peaking capacity.

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Combined-cycle updates for Sixth Plan

- **Plant configuration and capacity**
- **Project development and construction costs**
- **Near-term capital cost trend (2010 - 2015)**
- **Fuel costs**
- O&M costs
- Dispatch parameters
- Capital cost uncertainty
- CO2 allowance costs

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Reference plant

400 MW (nominal) natural gas-fired G-Class combined-cycle power plant. 1 GTG x 1 STG configuration w/25 MW duct firing. 390 MW baseload; 415 MW full power. Evaporative cooling, SCR for NOx control and CO oxidizing catalyst for CO and VOC control. Characteristics generally based on PGE Port Westward Generating Plant.

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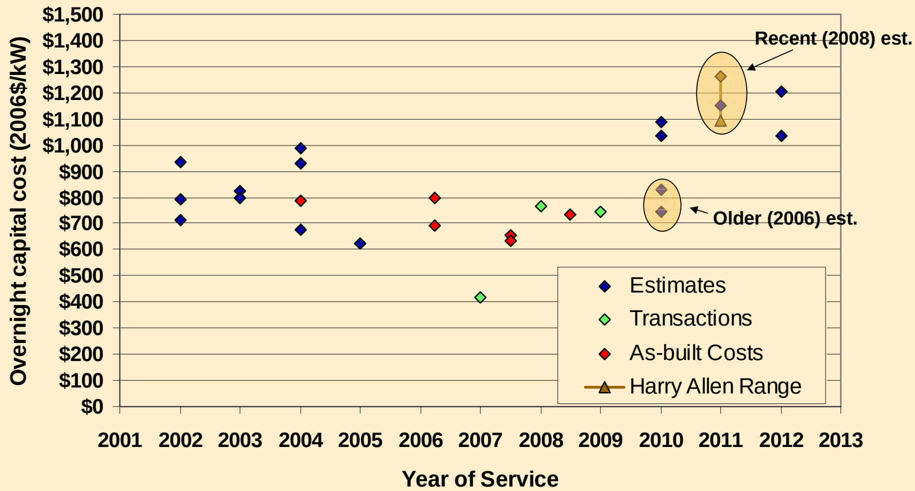
Problems re: assessing plant capital costs

- Rapid escalation of capital costs in recent years
- Variety of plant configurations, technology and features
- Sensitivity of output to elevation, ambient temperature and certain features, e.g. cooling technology
- Several recently reported costs are for completions of suspended projects
- Poor documentation of reported costs
- Technology generational turnover may be underway

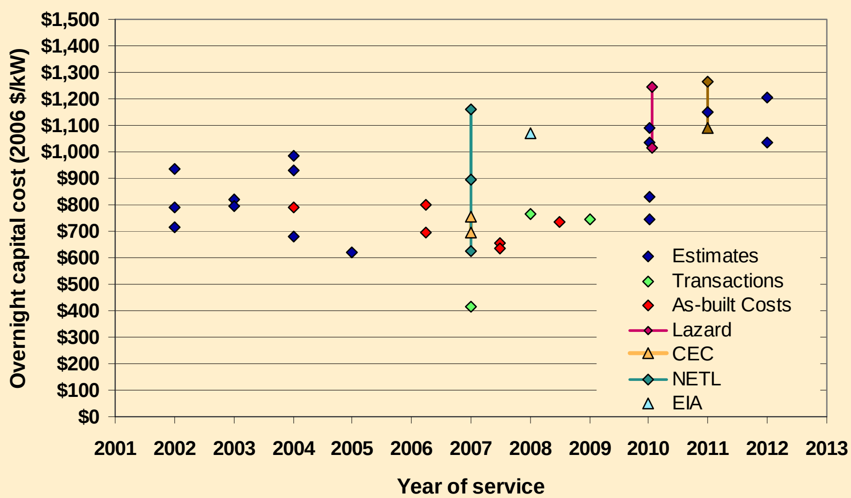
Sources of capital cost info

- Announced as-built costs for actual plants
- Announced preconstruction estimates for proposed plants
- Recent transactions
- EIA 2008 Annual Energy Outlook (June 2008)
- NETL Cost & Performance Baseline for Fossil Energy Plants (August 2007)
- CEC Comparative Costs of California Central Station Electricity Generation Technologies (2008)
- Lazard Levelized Cost of Energy Analysis (June 2008)
- CERA Capital Cost Forum (proprietary)
- Consultation w/representatives on Council's Generating Resources Advisory Committee

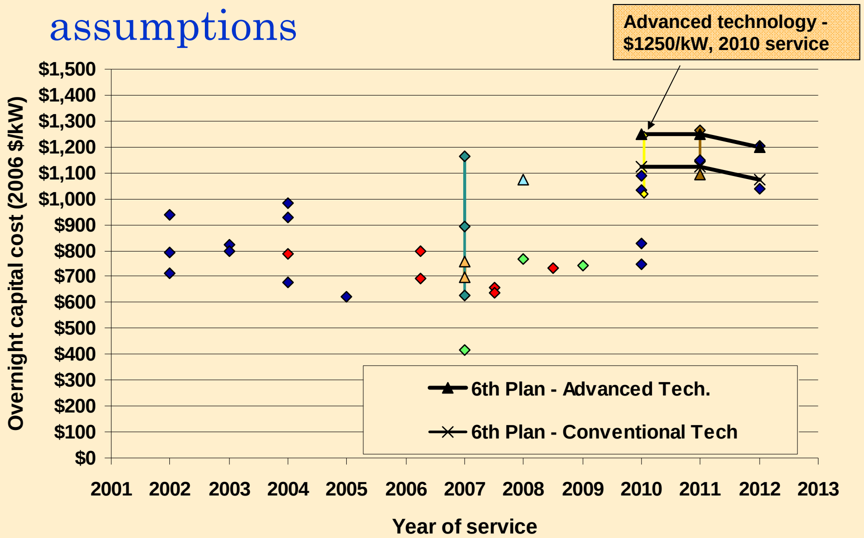
Reported combined-cycle project costs



Comparison to other surveys & estimates



Proposed combined-cycle capital cost assumptions

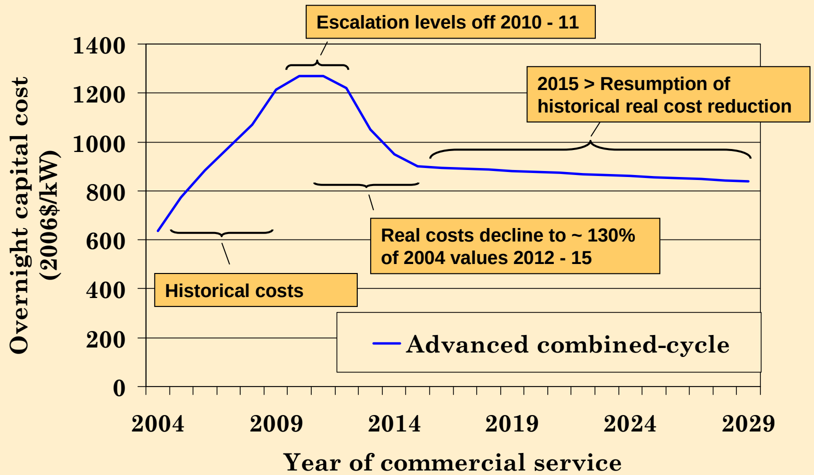


Adjustments to arrive at model input values (2006 $/kW[a], 2010 service)

	Overnight (Baseload Capacity)	Overnight (Incl. Duct Firing Capacity)	Derate to Interconnection (0.5%)	Derate for Lifecycle (Aging Effects) (2.7%)	Total Investment (Nominal$)[c]
5th Plan: 2x1 540MW Base + 70 MW DF				**$591**	**$657**
Proposed 6th Plan: 1x1 390 MW Base + 25 MW DF	$1250	$1205[b]	$1210	**$1245**	**$1420**

a) Except nominal (as-spent $) in Total Investment column
b) 390 MW @ $1250/kW + 25 MW @ $510/kW
c) IOU financing

Whither capital costs? (for discussion)



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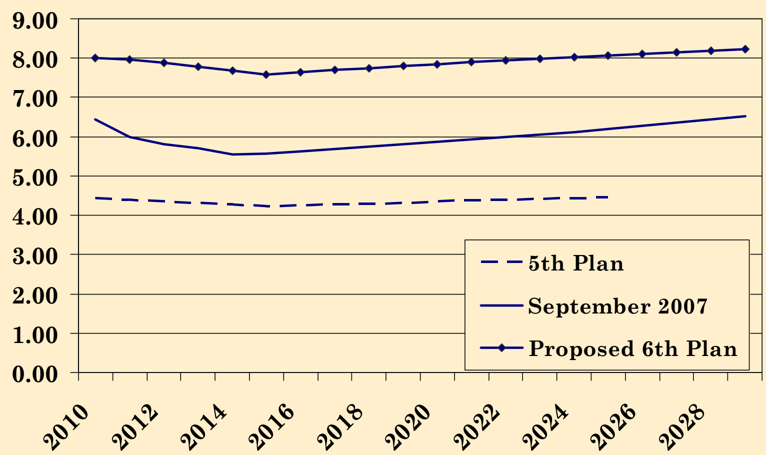
Natural gas price forecasts

Medium case
Firm Incremental (New resources)
Total cost (fixed + variable)



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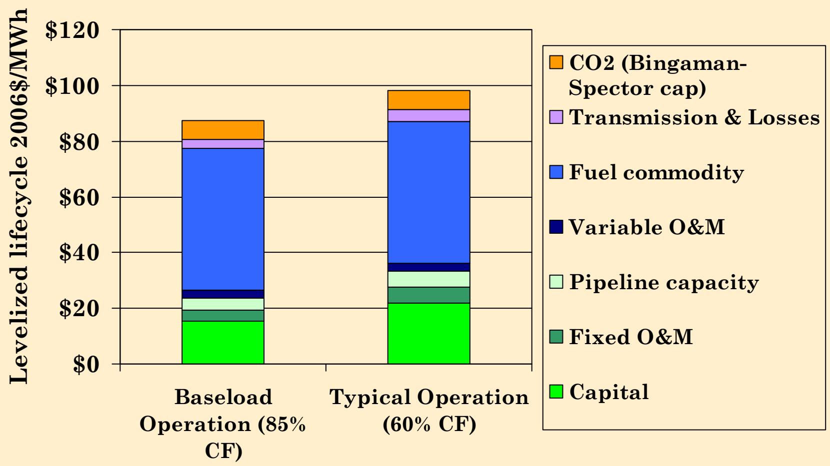
Cost of energy

IOU financing
2010 service
Westside NG - Proposed 6th Plan



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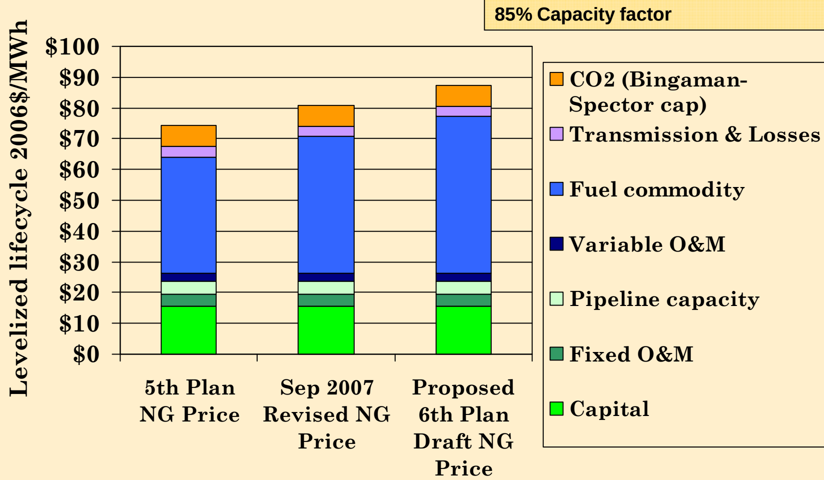
Sensitivity to fuel price

IOU financing
2010 service
Westside NG
85% Capacity factor



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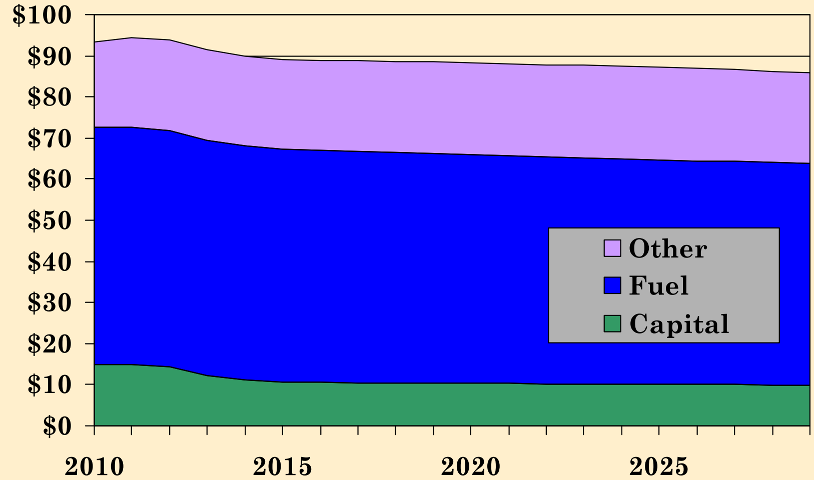
Sensitivity to service date



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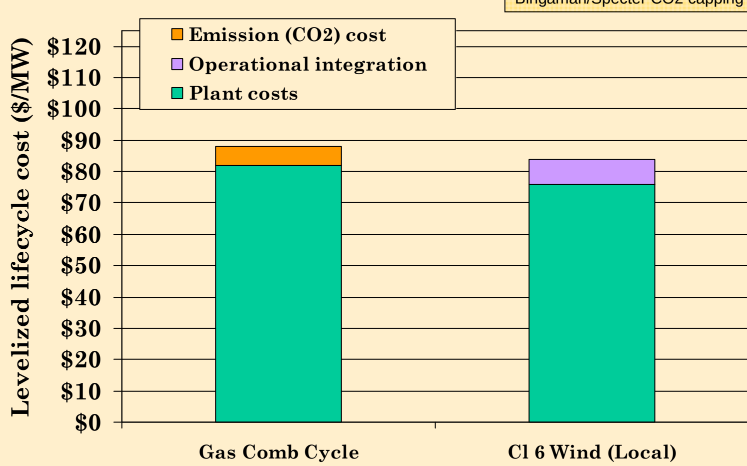
Resource comparison

2010 service
Point of interconnection (wind incl. R & LF)
Federal production tax credits for wind
Baseload operation
Bingaman/Specter CO2 capping cost



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Combined-cycle power plant: summary of planning assumptions

- Advanced (G-class) combustion turbine technology
- 1 GTG x 1 STG configuration w/25 MW duct firing
- 400 MW (nominal): 390 MW (baseload), 415 MW (peak).
- 65 MW load-following capability
- 7110 Btu/kWh (baseload, lifecycle), 53% efficient
- $1245/kW overnight development and construction cost
- 24 mo project development, 9 mo preconstruction, 30 mo construction (63 mo overall)
- Earliest service for new project ~ 2014

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Next steps

- Review O&M assumptions
- Define capital cost uncertainty
- Settle on dispatch parameters
- GHG control scenarios & related allowance costs

➢ **No action required by the Council at this time**

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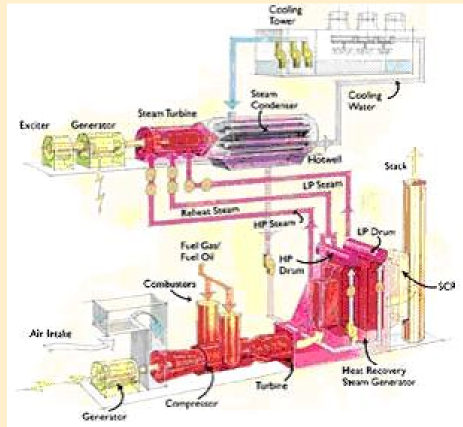
Combined-cycle technology



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