Sixth Northwest Conservation & Electric Power Plan

Proposed Combined-cycle Power Plant Planning Assumptions

Jeff King

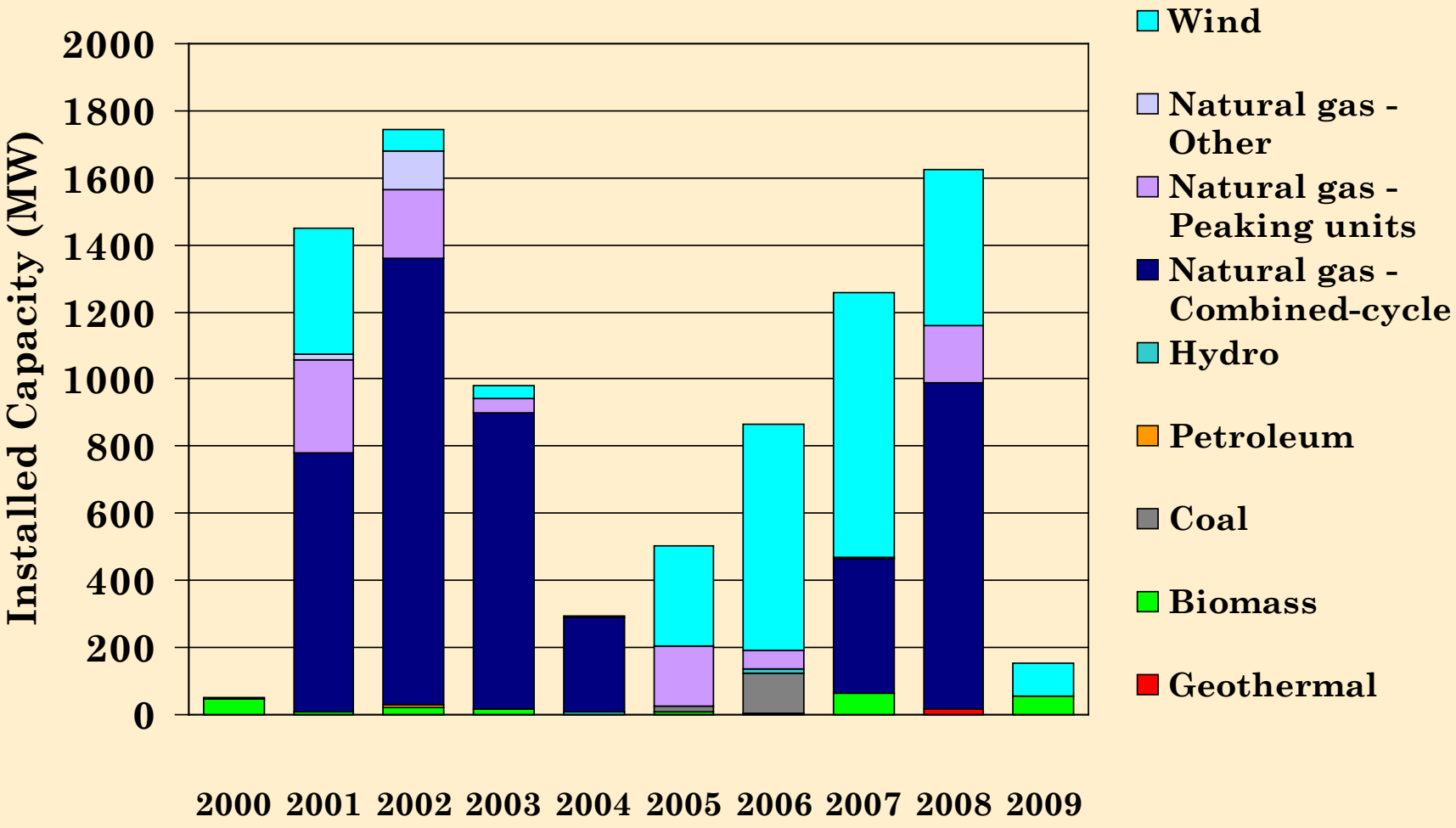
Northwest Power and Conservation Council

Power Committee

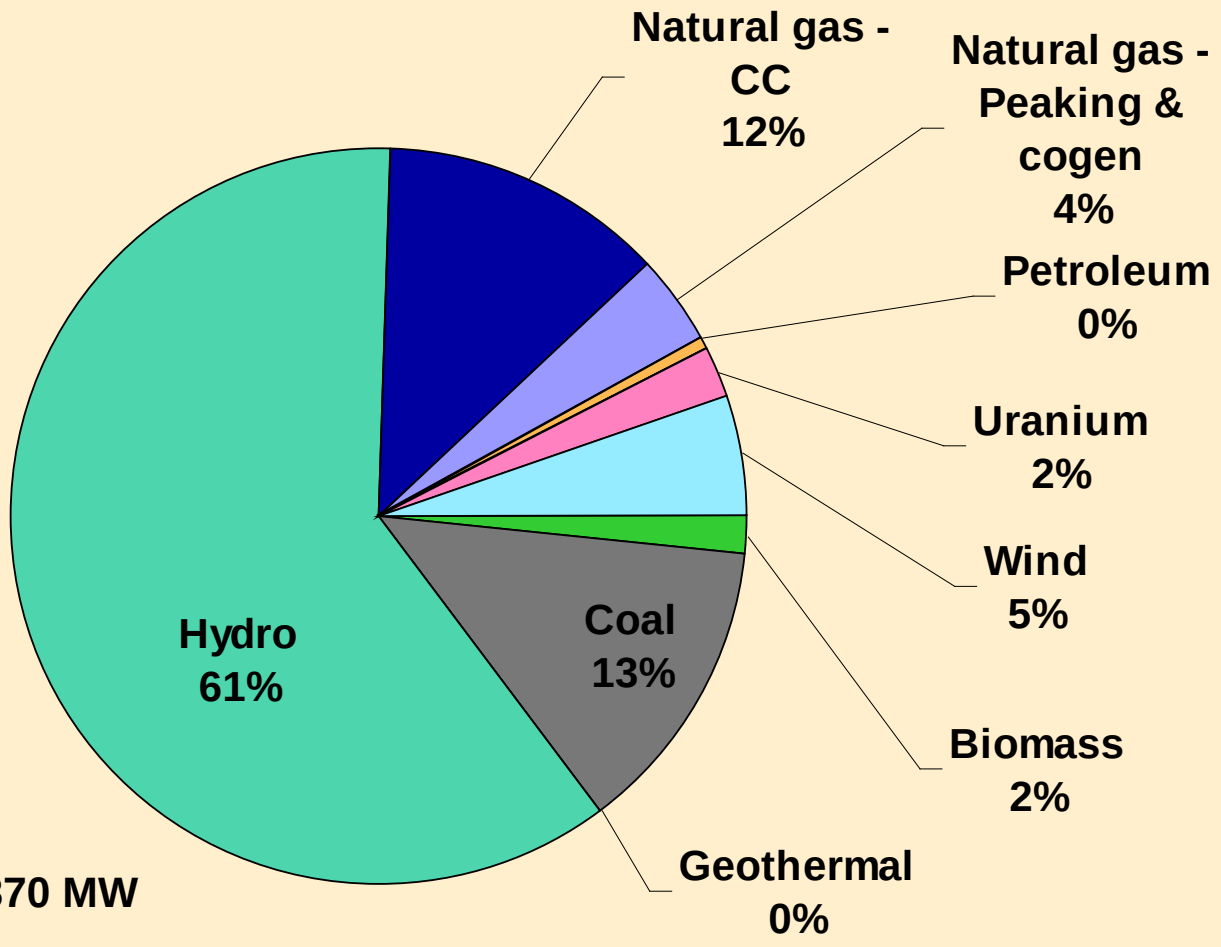
Portland, OR

October 15, 2008

Northwest generating project development



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



Total 54,870 MW

Factors affecting future role of combined-cycle plants

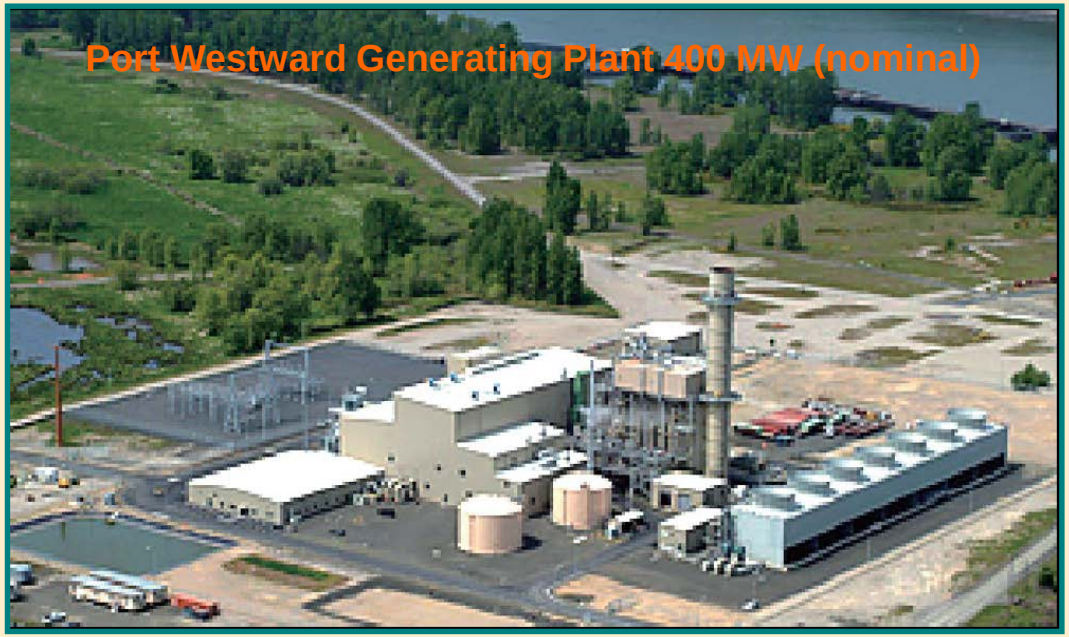
- Easily dispatchable baseload energy generation; full peaking capacity.
- Can be designed to provide load-following and supplemental peaking capacity.
- Potential, though not well-suited to providing regulating capacity
- Lowest per-MW CO2 production of the fossil resources
- Relatively short development 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

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

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.



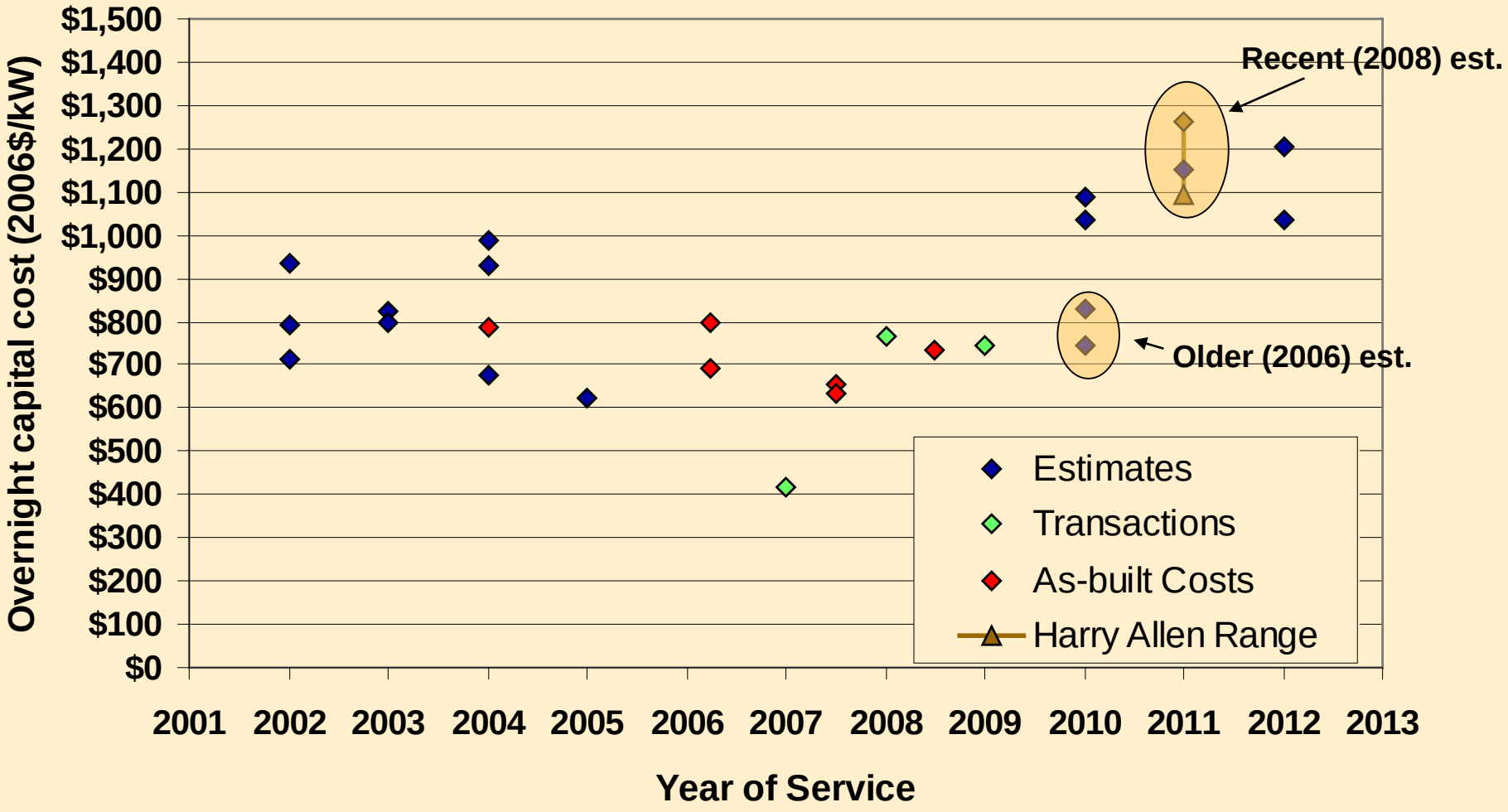
Problems re: assessing plant capital costs

- 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

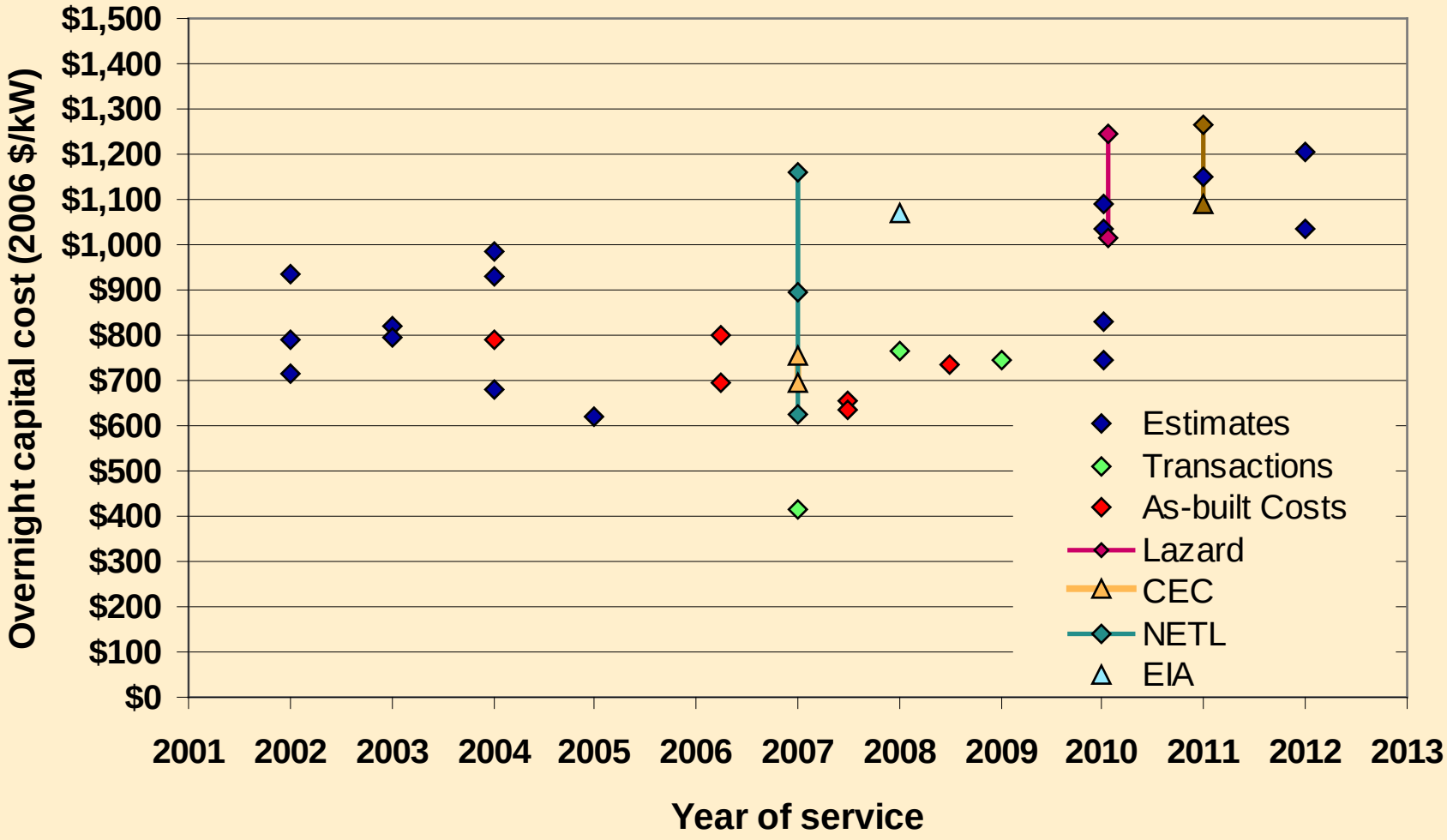
Sources of capital cost info

- 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

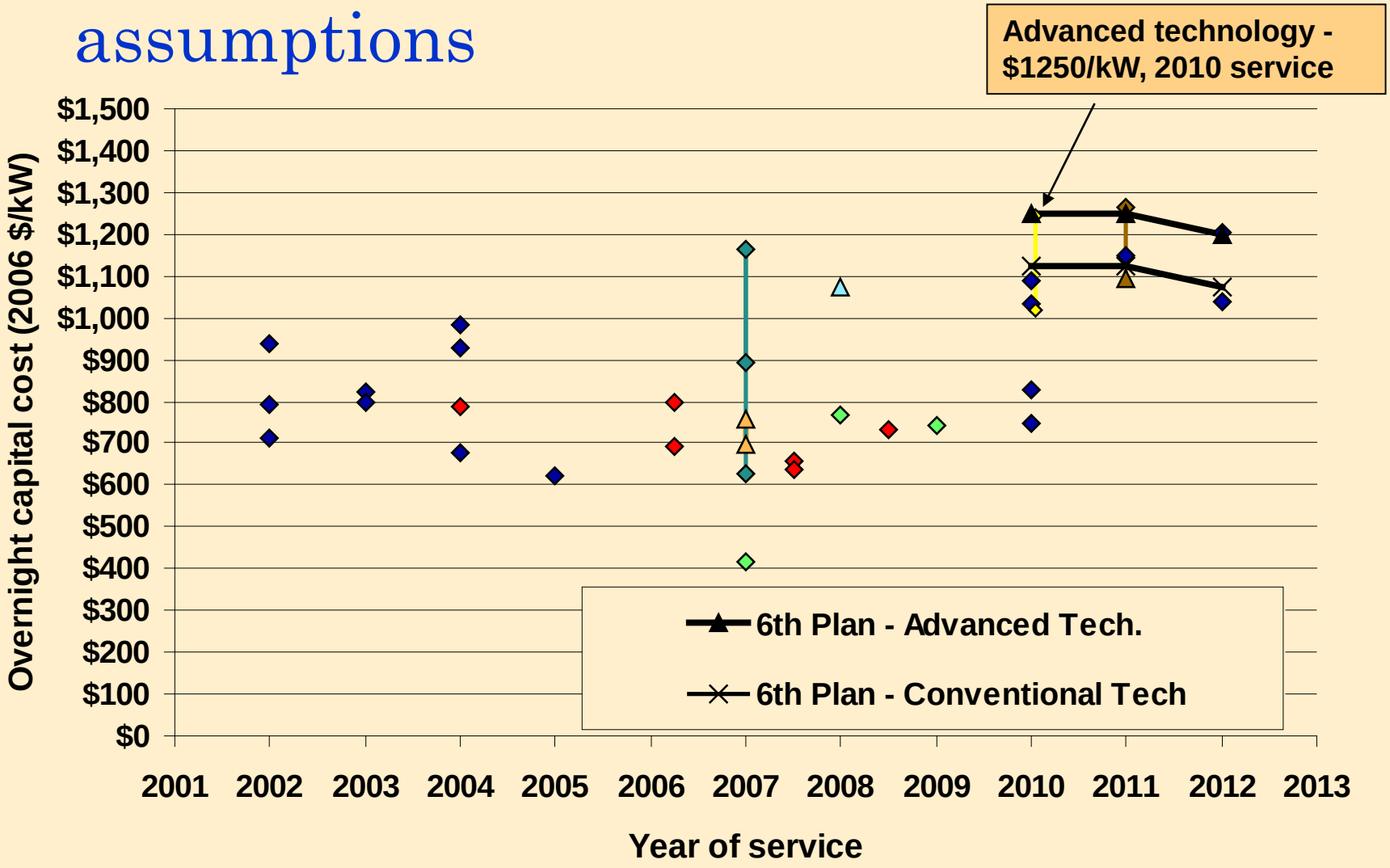
Reported combined-cycle project costs



Comparison to other surveys & estimates



Proposed combined-cycle capital cost assumptions



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

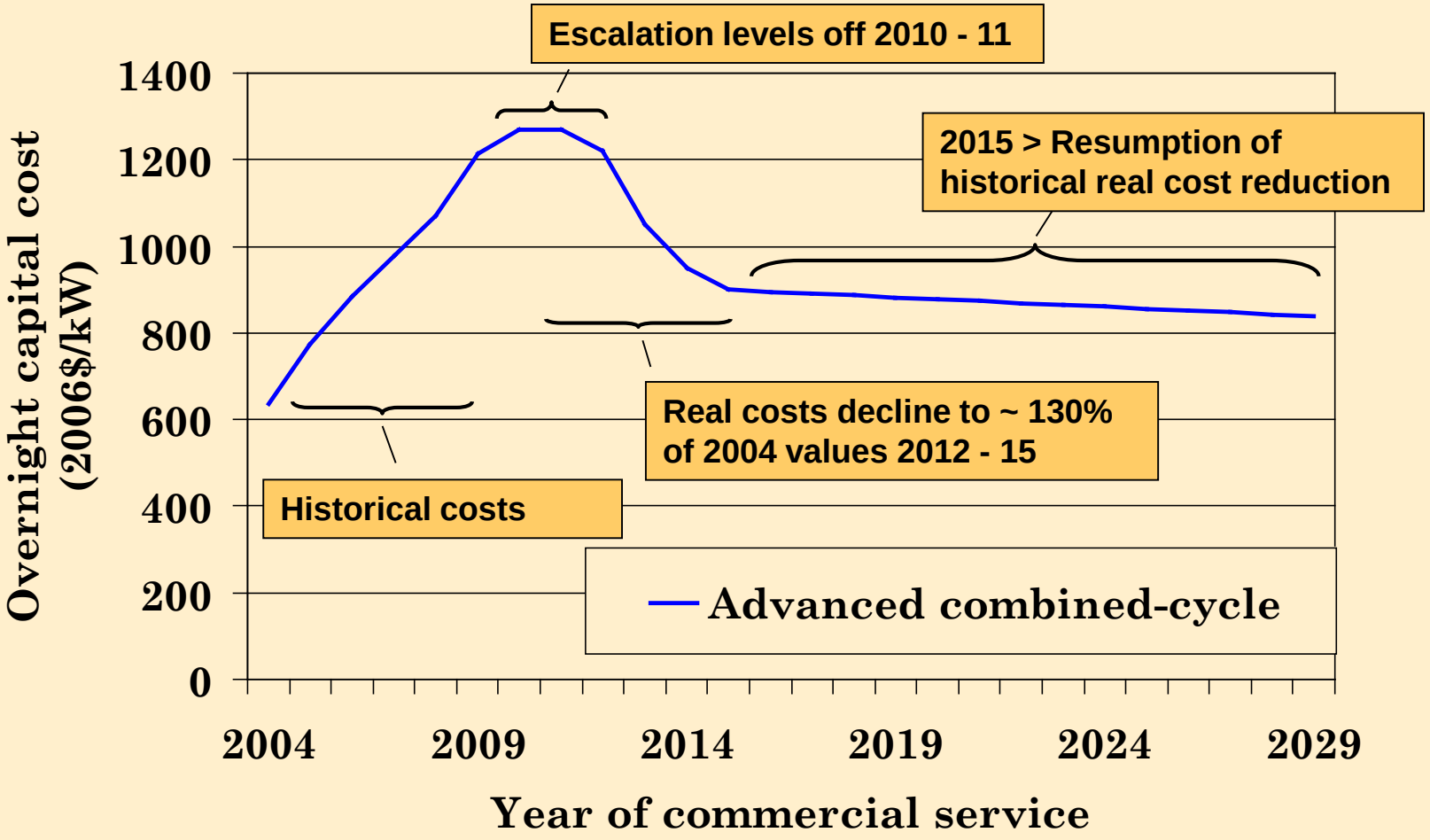
	Overnight (Baseload Capacity)	Overnight (Incl. Duct Firing Capacity)	Derate to Interconnection (0.5%)	Derate for Lifecycle (Aging Effects) (2.7%)	Total Investment (Nominal$)[c]
5th Plan: 2x1 540MW Base + 70 MW DF				**$591**	**$657**
Proposed 6th Plan: 1x1 390 MW Base + 25 MW DF	$1250	$1205[b]	$1210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

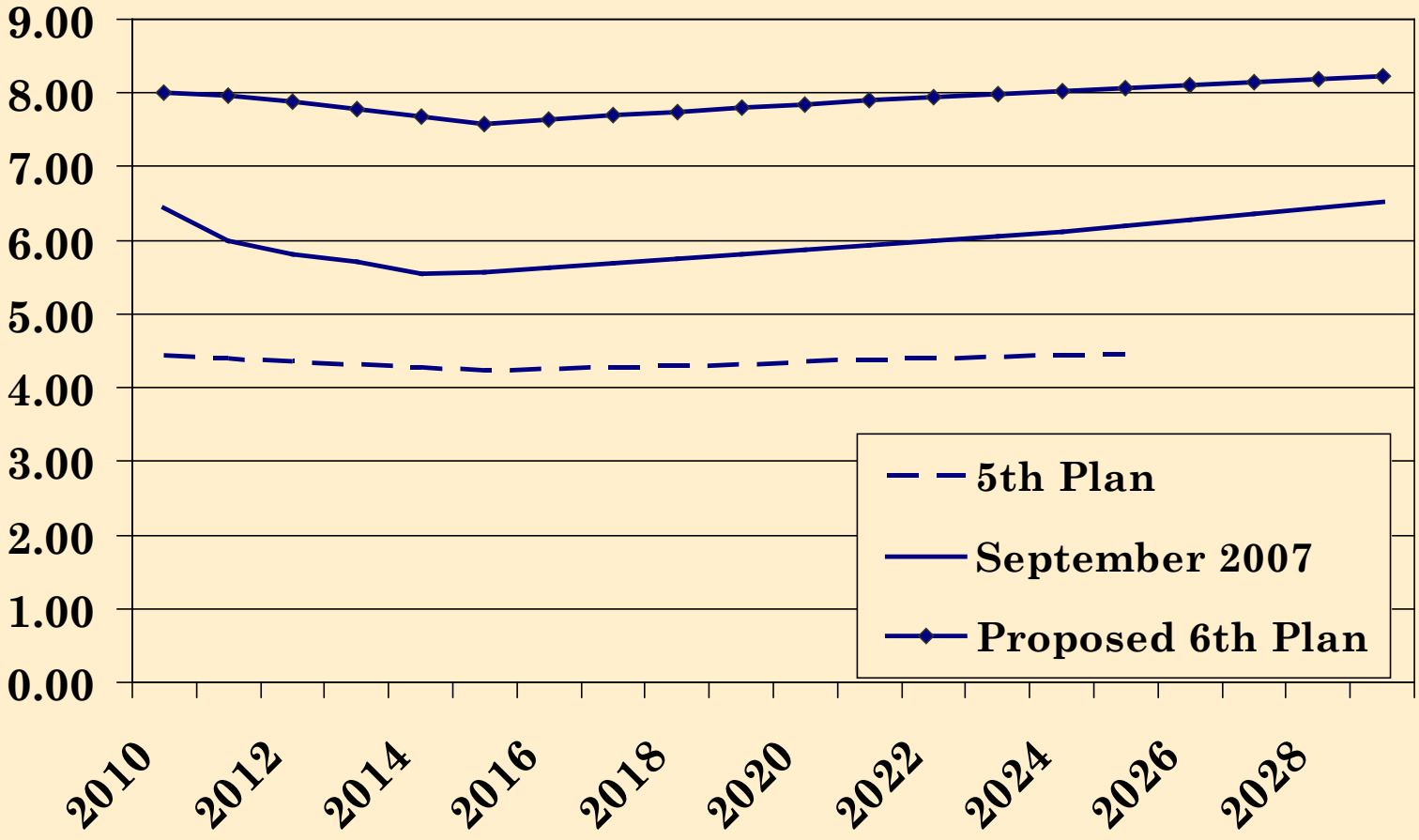


Natural gas price forecasts

Medium case

Firm Incremental (New resources)

Total cost (fixed + variable)

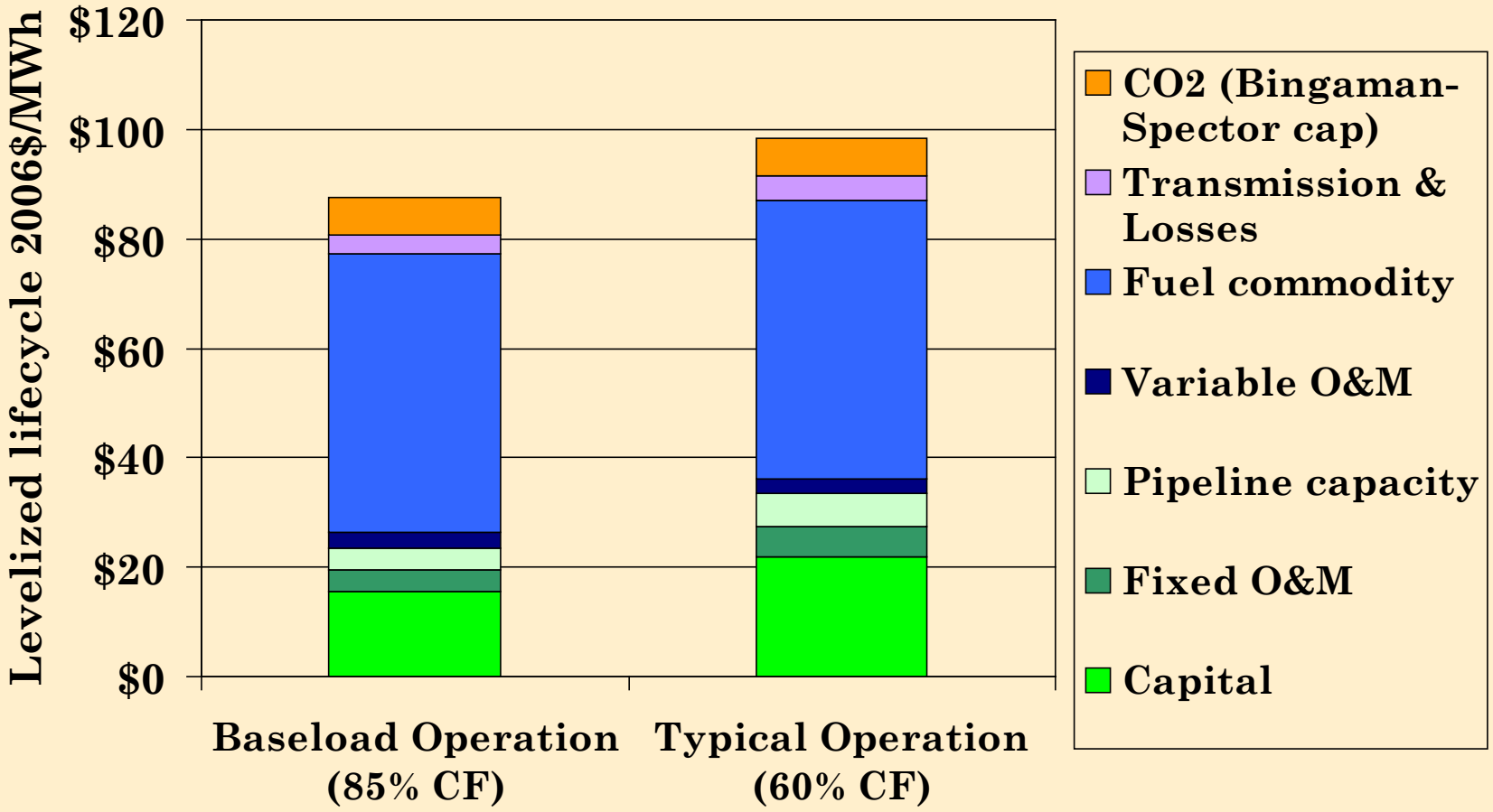


Cost of energy

IOU financing

2010 service

Westside NG - Proposed 6th Plan



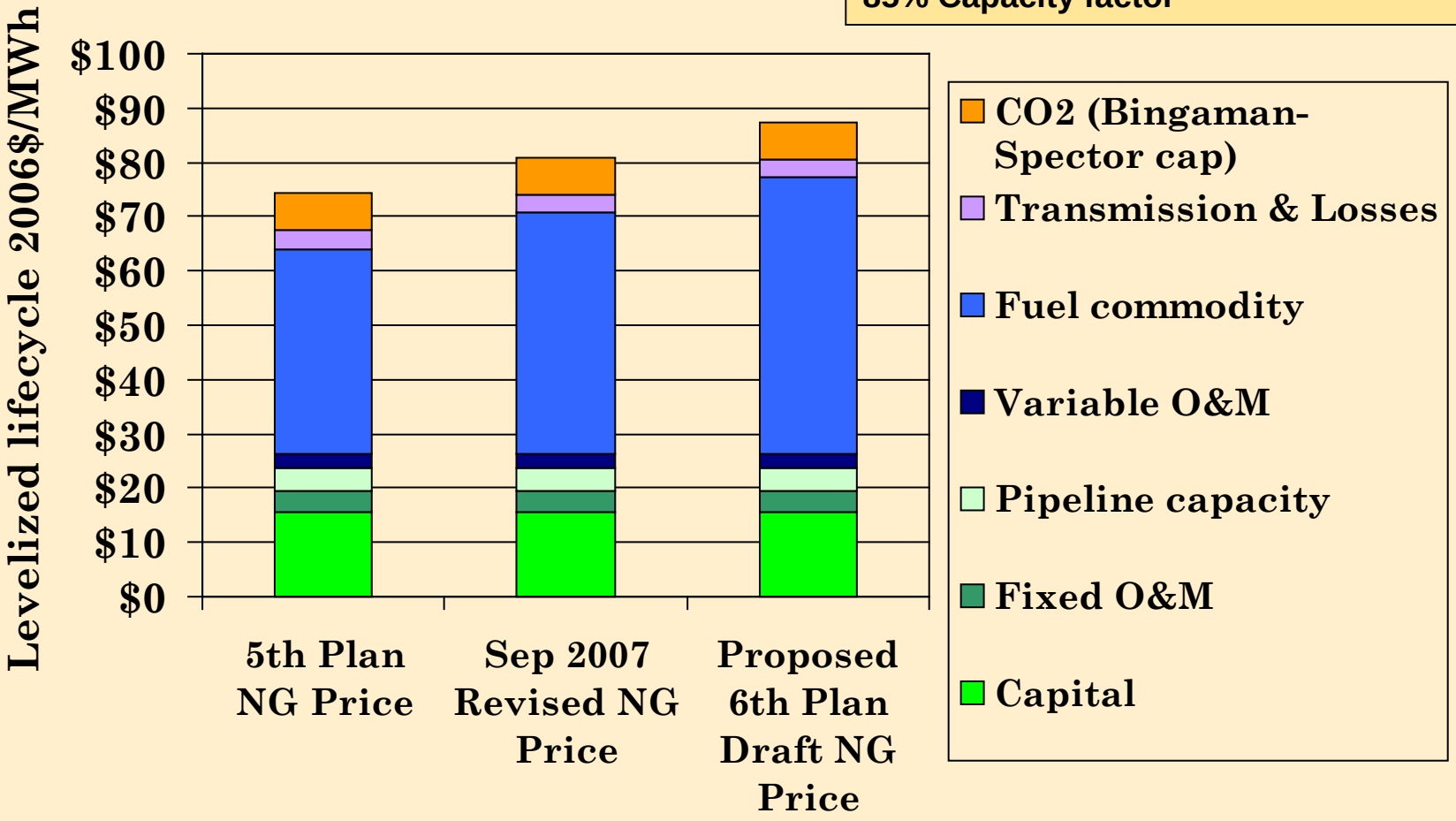
Sensitivity to fuel price

IOU financing

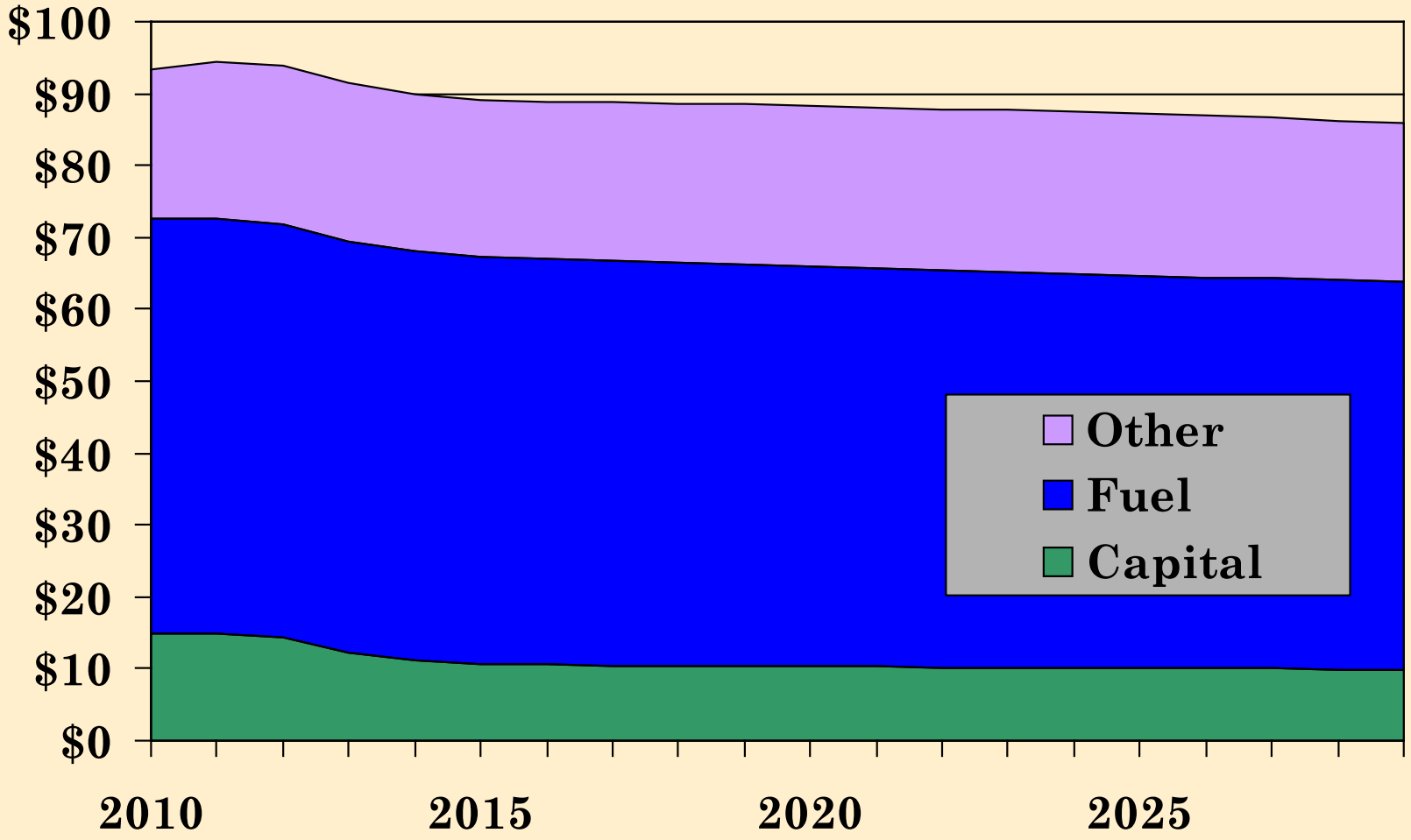
2010 service

Westside NG

85% Capacity factor

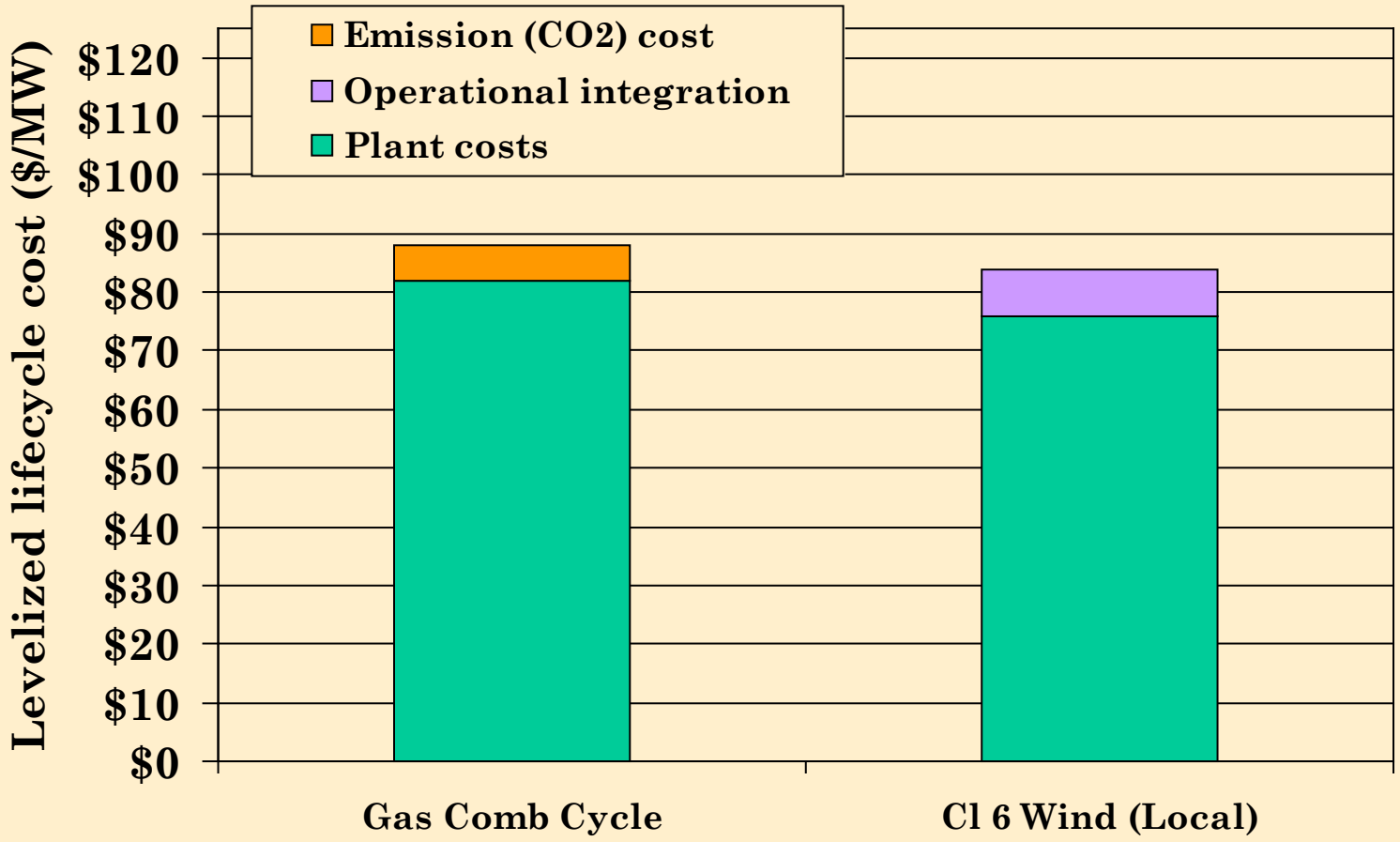


Sensitivity to service date



Resource comparison

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



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

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**

Combined-cycle technology