



Costs and Risks of Nuclear Loan Guarantees

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New Interest, But Key Challenges

- Near certain carbon controls
- Persistently high fossil fuel prices
- Growing government subsidies for non-carbon resources
 - Possible federal loan guarantees
 - Possible production tax credits
- The “China Effect” – concrete, steel, copper – up substantially since 2002
- Nuclear supply chain moribund for two decades
- Electric industry restructuring
 - Less certain cost recovery
 - Transmission bottlenecks and lead time

Capital Costs of New Plants

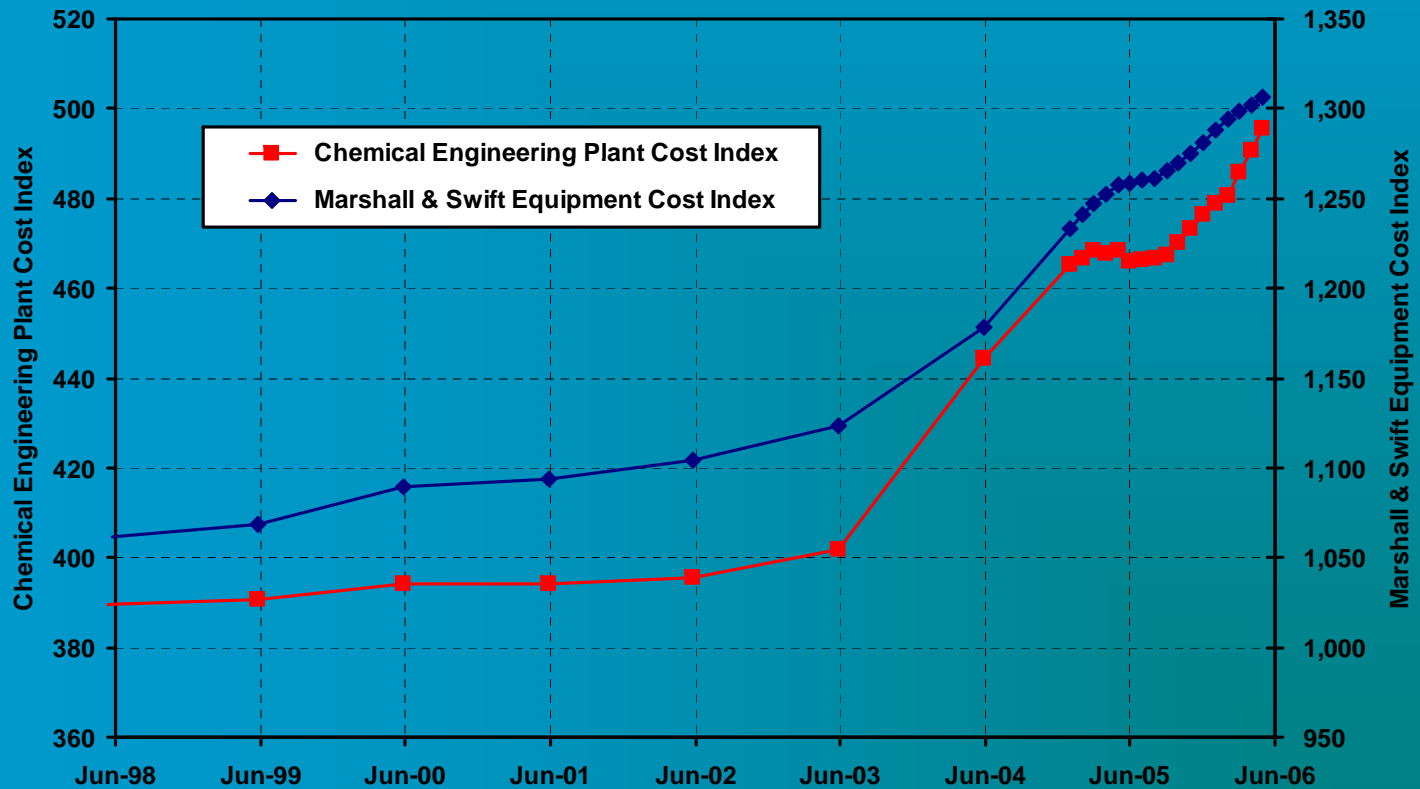
- Some studies estimate very low costs for new plants (various year dollars)
 - EIA, University of Chicago, vendors (\$1500-2100/kW)
- Others do not
 - Keystone Center, Standard & Poor's, Moody's, Florida Power & Light (\$3600-6000/kW)

Keystone Basis – Asian Experience Plus Real Escalation

Plant	MWe	COD	Yen@COD	2002\$/kW	2007\$/kW
Onagawa 3	825	Jan 2002	3.1 Billion	2409	3332
Genkai 3	1180	Feb 1994	4 Billion	2643	3656
Genkai 4	1180	Jul 1997	3.2 Billion	1960	2711
KK 3	1000	Jan 1993	3.2 Billion	2615	3617
KK 4	1000	Jan 1994	2.2 Billion	2609	3608
KK 6	1356	Jan 1996	4.2 Billion	2290	3167
KK 7	1356	Jan 1997	3.7 Billion	1957	2707
Y 5 (SK)	1000	Jan 2004		1700	2352
Y 6 (SK)	1000	Jan 2005		1656	2290
Average				2354	3257

Cost data from MIT 2003 Future of Nuclear Power study. Average does not include South Korean units.

Keystone Estimated 4% Real Escalation



Four Percent Real is Probably Too Low

Commodity	Esc 86-03	Esc 03-07	Ratio vs. History
Nickel	3.8%/yr	60.3%/yr	15.9x
Copper	3.3%/yr	69.2%/yr	21x
Cement	2.7%/yr	11.6%/yr	4.3x
Iron/Steel	1.2%/yr	19.6%/yr	16.3x
Heavy construction	2.2%/yr	10.5%/yr	4.8x

Source: American Electric Power



Is “Heavy Construction” The Right Index for New Reactors?

- Much more complexity and uncertainty than bridges, runways, and refineries
- Industry moribund in Western Europe, US, and Russia since TMI and Chernobyl
- Twenty years ago: 400 suppliers, 900 N-Stamp holders; today 80 and 200 worldwide; US holders have dropped by 80 percent
- Only one forge for large parts – Japan Steel Works
- Skilled labor and contractor limits
- Uranium production well below current consumption
- Many supply chain constraints with monopoly pricing power

Escalation Hurts Nuclear More Than Coal, Gas, or Wind

Capital Cost	Keystone	Moody's	S&P	Historical
Nuclear	\$3600-4000	\$5000-6000	\$4000	\$2000-2500
Coal	NA	\$2500-2900	\$2500	\$1500
Wind	NA	NA	\$1700	\$1000
IGCC	NA	\$3300-3700	\$2800	NA
Gas CC	NA	\$700-900	\$700	\$500-750

Assume AEP is Right

- Keystone Basis (Asian Experience)
 - Escalate at 7.8% versus 4% real from 2003
 - Retain 5-6 year construction leadtime and 2007 construction start – both optimistic
 - Real discounted capital cost is \$5600/kW – much higher than Keystone and S&P, but middle of Moody's

2007 Lifecycle Costs


Cost Category	Keystone	Moody's Capital Costs
Capital Costs	6.0-7.8	7.9-10.5
Fuel	1.6	2.0
Fixed O&M	1.9	1.9
Variable O&M	0.5	0.5
Total (Levelized Cents/kWh)	9.4-11.2	12.2-14.8

Costs are in real discounted 2007 cents/kWh and include interconnection, wheeling, and decommissioning



Effect of Federal Loan Guarantees?

- Loan guarantees change price – not cost – costs and risks are shifted to taxpayers
- Constellation analysis – 8 cents/kwh drops to 3.8; this analysis – 13 cents/kwh drops to 7.5.
- Constellation analysis – reactors lose money at 8 cents/kWh in restructured markets. At 7.5 cents, return on equity is nearly zero; debt risk is large
- Cost is about \$500 million per reactor per year, if output can be sold; much larger with early retirements or shutdowns



Value and Risk of Loan Guarantees Varies Widely

- Highest value and risk for merchant generator in deregulated markets
 - Gas generally sets clearing price
 - At low gas price, nuclear at 8 cents loses money
 - Development security, deposits, operating collateral requirements
 - No cost recovery for extended outages
- Lowest value and risk for large utilities able to rate-base new investments
- Hard for DOE to develop rules for the program

Moody's View

- “The theory is that once the capital markets become more familiar with new nuclear construction, the market will be able to assess and price risk accordingly. Moody's does not fully subscribe to this philosophy.
 - *First, we believe the capital markets are capable of assessing the risk of new nuclear construction. To the extent that the capital markets price nuclear construction risk at extremely high levels, companies might consider injecting a larger component of equity into the project or find partners to share the risk.*
 - **Secondly, there are several regulated utilities that are not basing their plans on the availability of these guarantees. Instead, the decision to pursue new nuclear generation was a result of their long-term resource plans, and in some cases, was made well before the Energy Policy Act even contemplated authorizing Federal guarantees.”**

How Do Carbon Taxes Change Matters? S&P's View

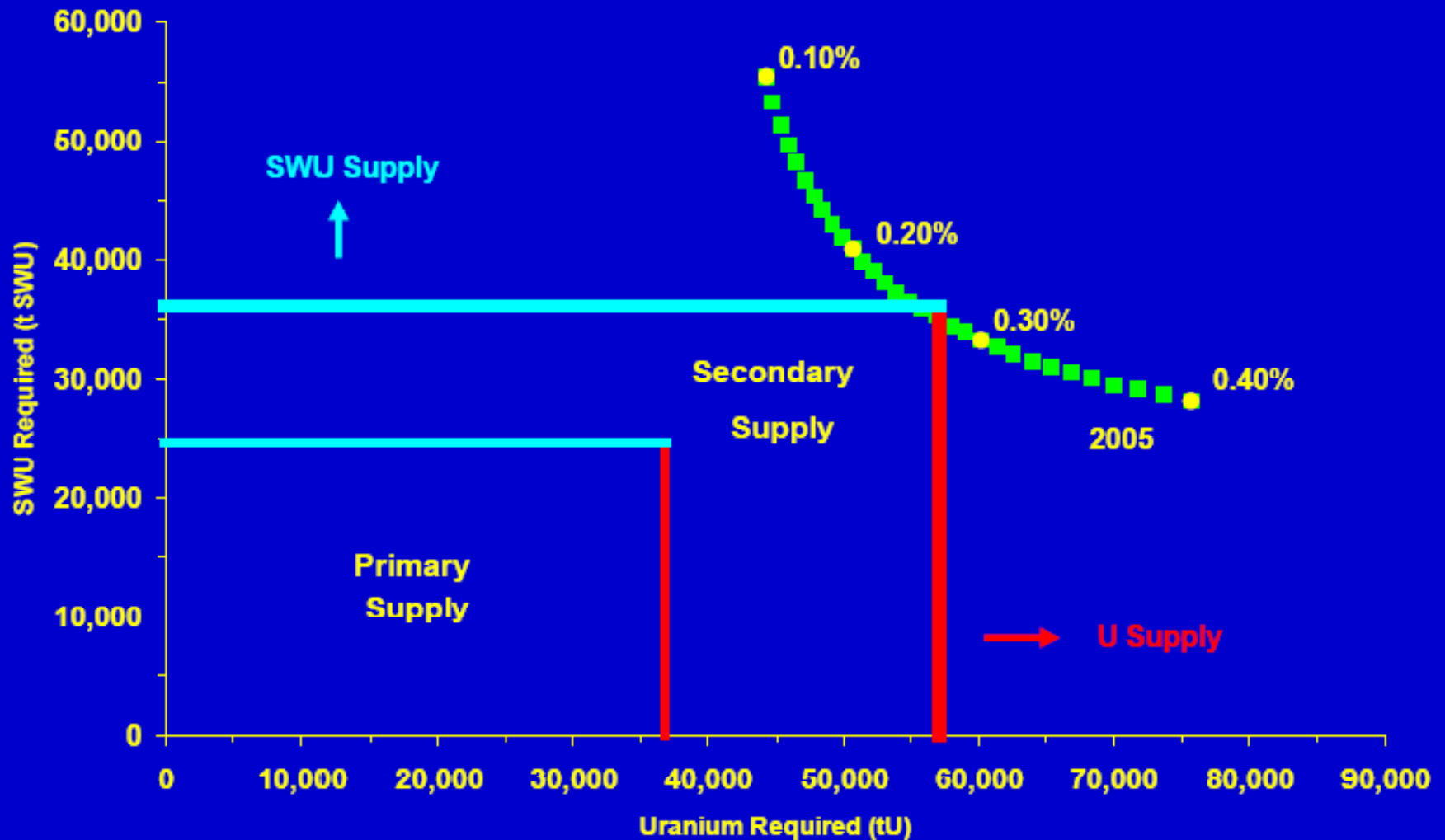
	Pulverized Coal	Gas (CCCT)	Eastern IGCC	Wind	Nuclear
Capital Cost (\$/kW)	2438	700	2795	1700	4000
<i>Total cost (cents/kWh)</i>	<i>5.8</i>	<i>6.8</i>	<i>6.8</i>	<i>7.1</i>	<i>8.9</i>
CO2 Capture Cost (\$/kW)	940	470	450	NA	NA
Cost for CCS (cents/kWh)	6.2	2.8	3.4	NA	NA
<i>Cents/kWh</i>	<i>12.0</i>	<i>9.6</i>	<i>10.2</i>	<i>7.1</i>	<i>8.9-9.8</i>
Cents/kWh (credits \$10-30)	<i>6.2-7.9</i>	<i>7-7.7</i>	<i>7.1-8.7</i>	<i>7.1</i>	<i>8.9-9.8</i>



Uranium is Also Problematic

- Production is 60% of demand
 - Supply augmented by surplus inventories that disappear by 2013
 - Lead time for new mines is 10+ years
 - Enrichment is also challenged
- Monopoly pricing potential in both uranium and enrichment

2005 SUPPLY VS REQUIREMENTS



THE SUPPLY CHALLENGE

