

Impact of Key Issues on Nuclear Plant Economics and Financial Risk

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Factors Favorable/Unfavorable for Nuclear

Favorable

- High Demand Growth
- High Gas Prices
- Need for Fuel Diversity
- Security of Domestic Supply
- Air Emissions Benefits

Unfavorable

- Low Demand Growth
- Low Gas Prices
- Nuclear Waste Issue
- Public/Political Opposition
- Project Lead time/Cost



Competing Alternatives for New Baseload Supply

- Combined Cycle Gas
 - Current Choice for Most New Capacity
 - Advanced Gas Turbine Technology
 - High Efficiency/Low Emissions
- Atmospheric Fluidized Bed Coal
 - Regional Choice Near Coal Supply
 - Advanced Combustion Technology
 - Reduced Air Emissions (SO_x/NO_x)



STAWBAM

Project Development Economic Model

X

- Inputs
 - Financial (Debt/Equity, Interest Rate & Term, Target IRR)
 - Project Development (Construction Cost & Schedule)
 - Plant Operation (Generation, O&M, Cap Adds, Fuel Cost)
 - Decommissioning (Cost, Plant life, Growth Rate)
- Results
 - Discounted Cash Flow (DCF)
 - Return on Investment (ROI)
 - All-in Cost (\$/MWhr)



Input assumptions (Base Case)

• HIGHER COST FOR NUC REFLECT HIGHER FINANCIAL RISK

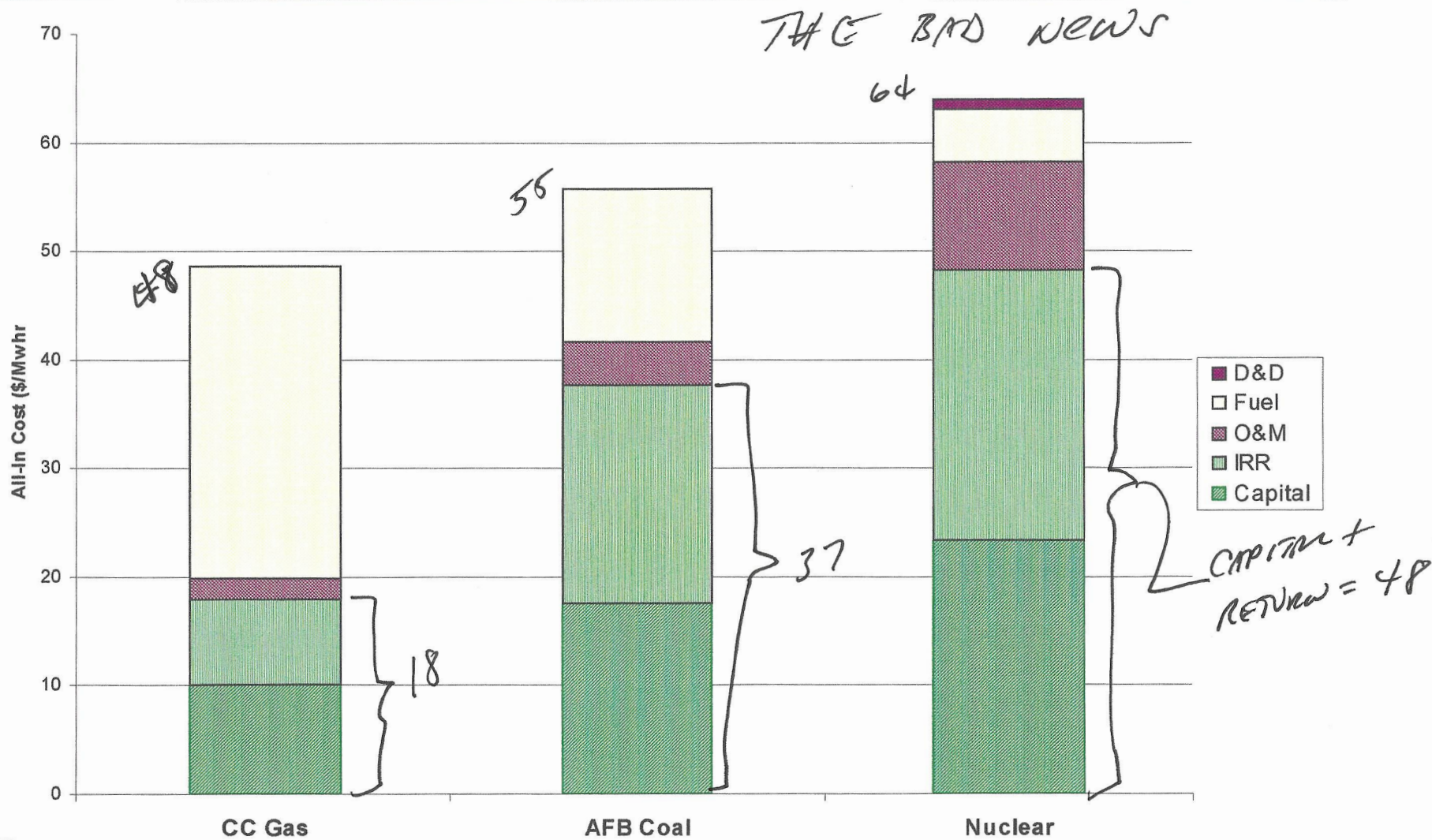
	CC Gas	AFB Coal	Nuclear
<u>Finance</u>			
• Debt/Equity	60/40	50/50	50/50
• Interest Rate	8%	10%	11%
• Target Return	15%	15%	15%
<u>Project Development</u>			
• Unit Capacity (MWe)	300	300	1000
• EPC Cost (\$/kW)	750	1200	1500
• Const. Sched. (Months)	24	36	48
<u>Plant Operation</u>			
• Capacity Factor	90%	90%	90%
• Non-Fuel O&M (\$/MWhr)	2	4	10
• Fuel Cost (\$/MMBtu)	4.0	1.8	0.5

HIGHER CAPEX + LOWER CONSTRUCTION SPEED


HIGHER O&M
NUC. ADVANTAGE



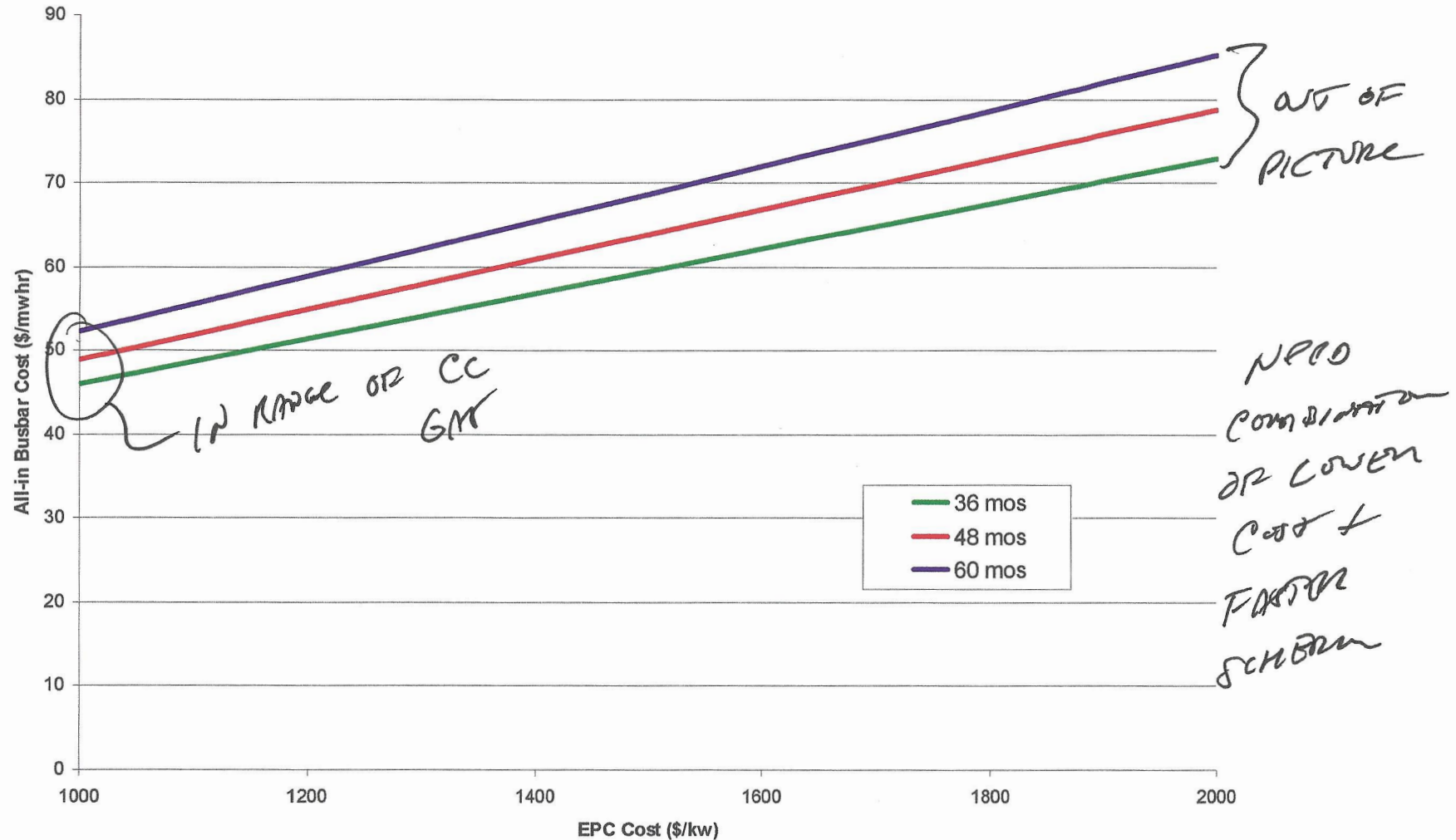
New Baseload Supply Alternatives (Base Case)



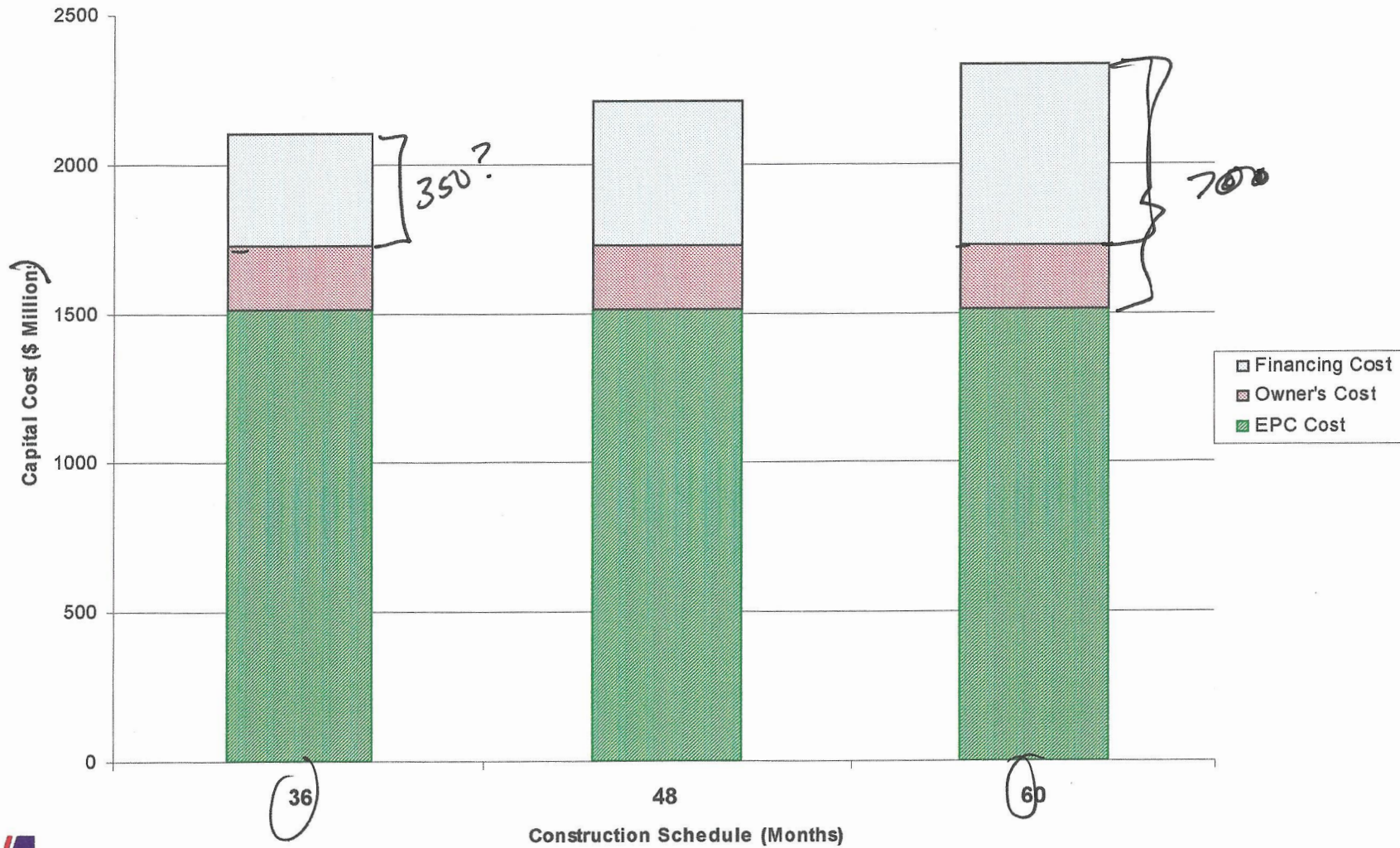
Nuclear Project Development Sensitivities

	<u>Low</u>	 <u>Base</u>	<u>High</u>
• EPC Cost (\$/kW)	<u>1000</u>	<u>1500</u>	<u>2000</u>
• Const. Sched. (Mos)	<u>36</u>	<u>48</u>	<u>60</u>

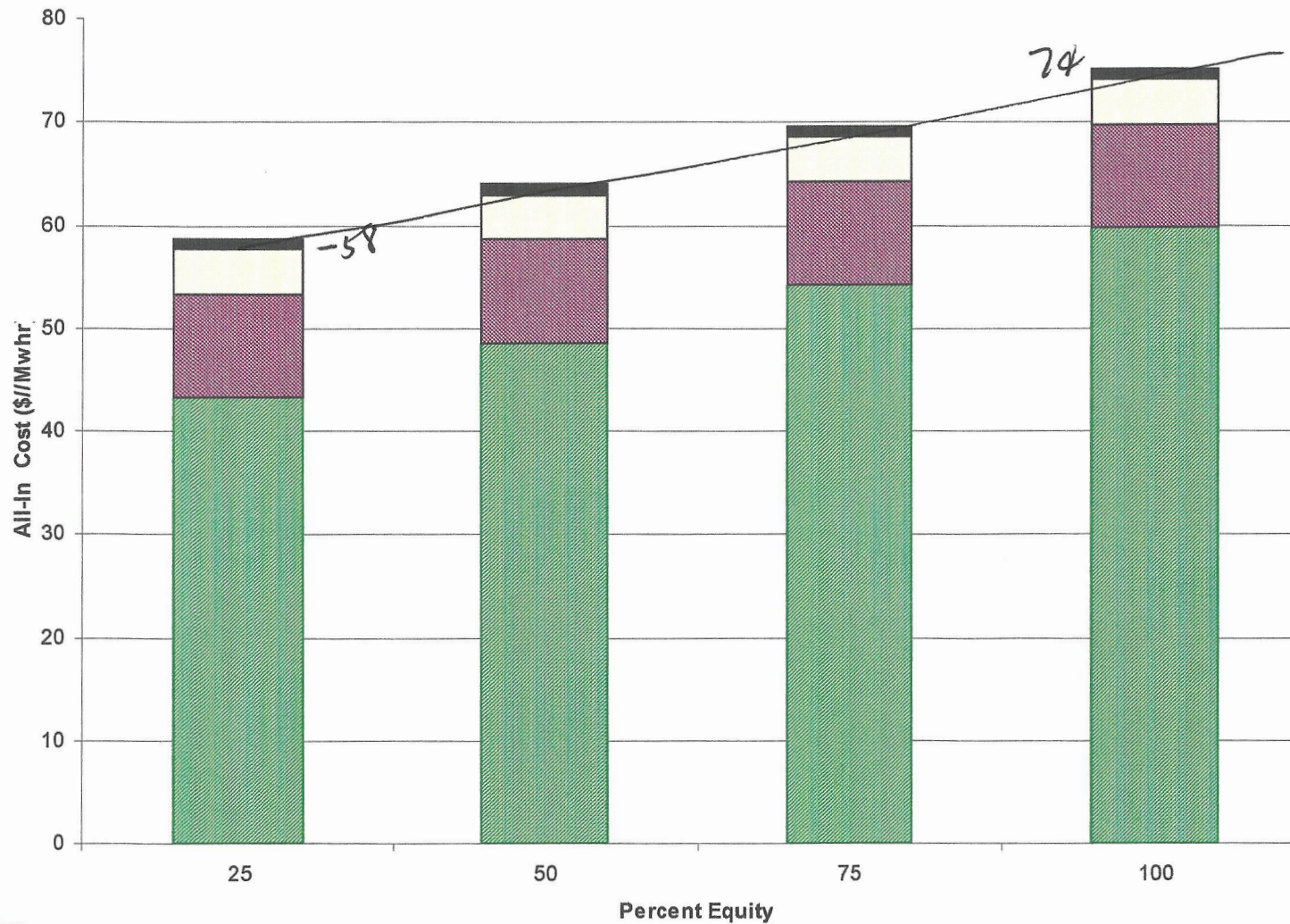
Nuclear Busbar Cost vs Construction Cost/Schedule



Effect of Construction Schedule on Capital Cost



Cost vs Investment Equity



ABILITY TO
LEVERAGE
CAPITAL COST
WILL DEPEND
ON ABILITY TO
CONTROL RISK
(CAPITAL
STOCKING)



Nuclear Project Size Sensitivities

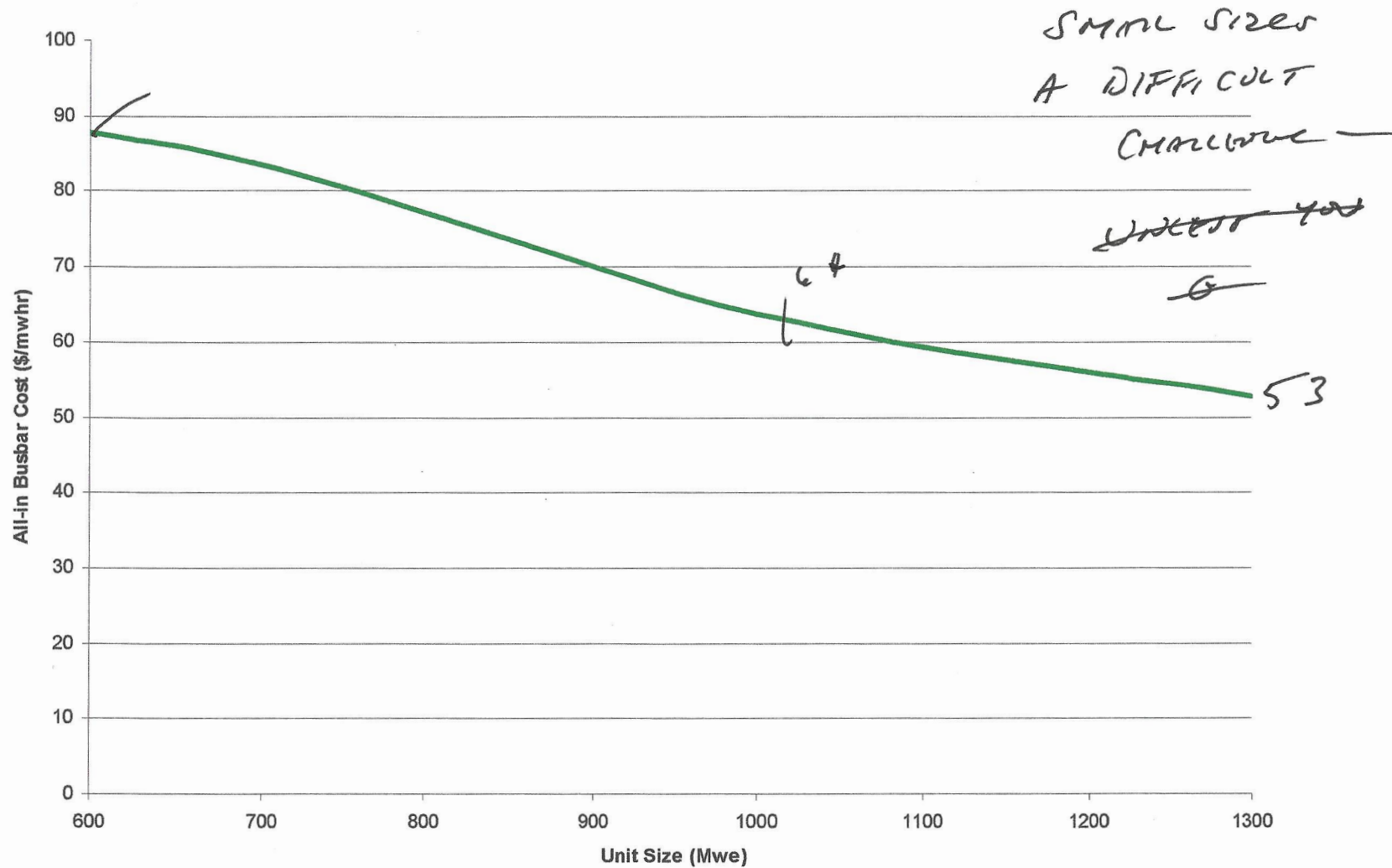
	<u>Unit Capacity (MWe)</u>		
	<u>600</u>	<u>1000</u>	<u>1300</u>
<u>Project Development</u>			
• EPC Cost (\$/kW)	2000	1500	1200
• Const. Sched. (Mos)	42	48	52
←—————→			
<u>Plant Operation</u>			
• Capacity Factor	90%	90%	90%
• Non-Fuel O&M(\$/MWhr)	15	10	8
• Fuel Cost (\$/MWhr)	5	5	5

Typical

Size (2000m) on O&M



Nuclear Unit Costs - Size Matters



Benefits of Nuclear Fleet Development

BUILDING MORE
OF SAME UNITS
NOT PROPORTION

TO REDUCE
UNIT COST

- Reduced EPC Cost

- Spread Engineering Costs over Multiple Units - ONE TIME DESIGN + LIC. FEE
- Reduced Equipment Procurement Costs ~ VOLUME DISCOUNT
- Reduced Construction Cost & Schedule ~ LEARNING CURVE

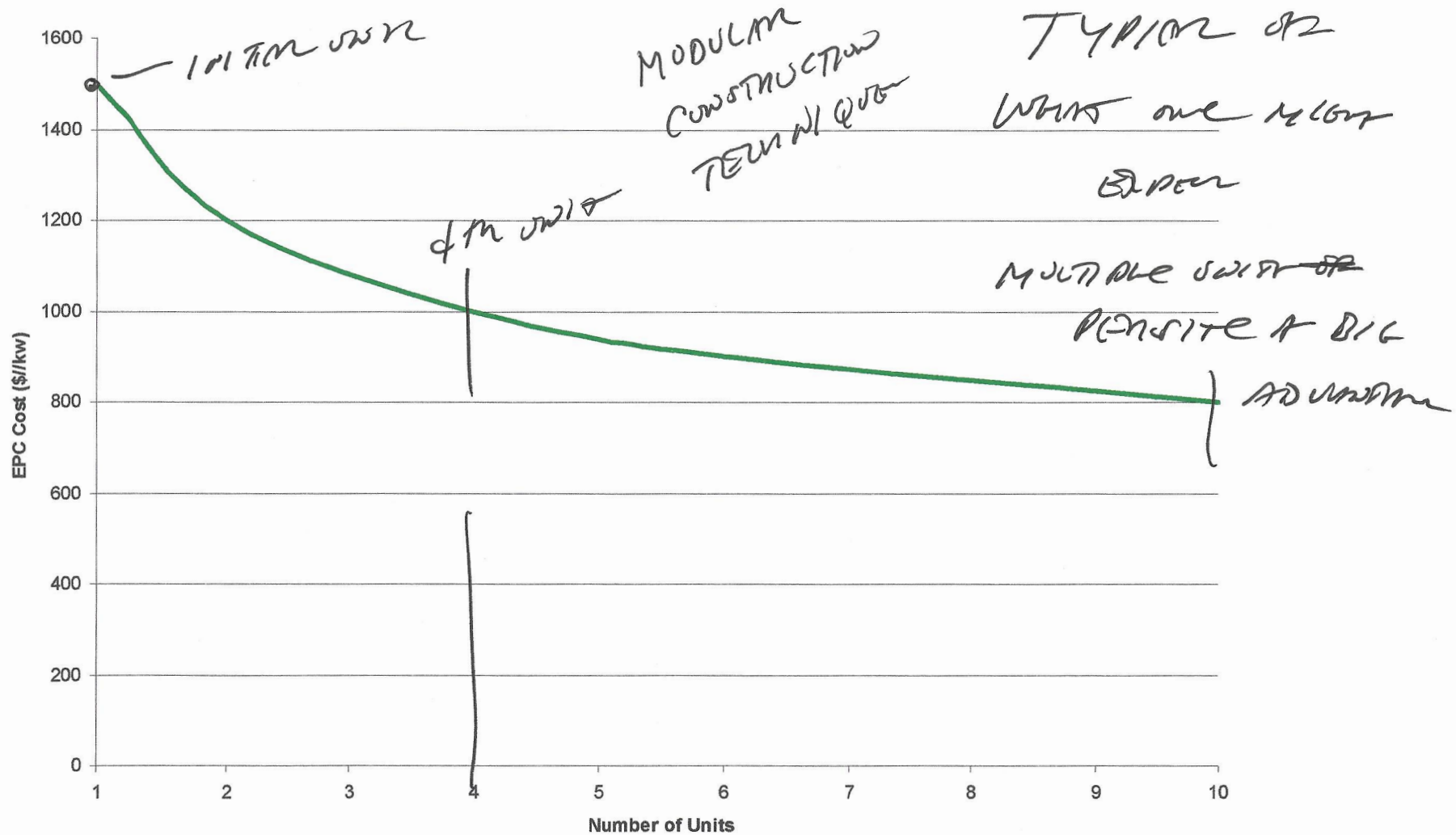
MODULARIZATION

- Operational Economies of Scale

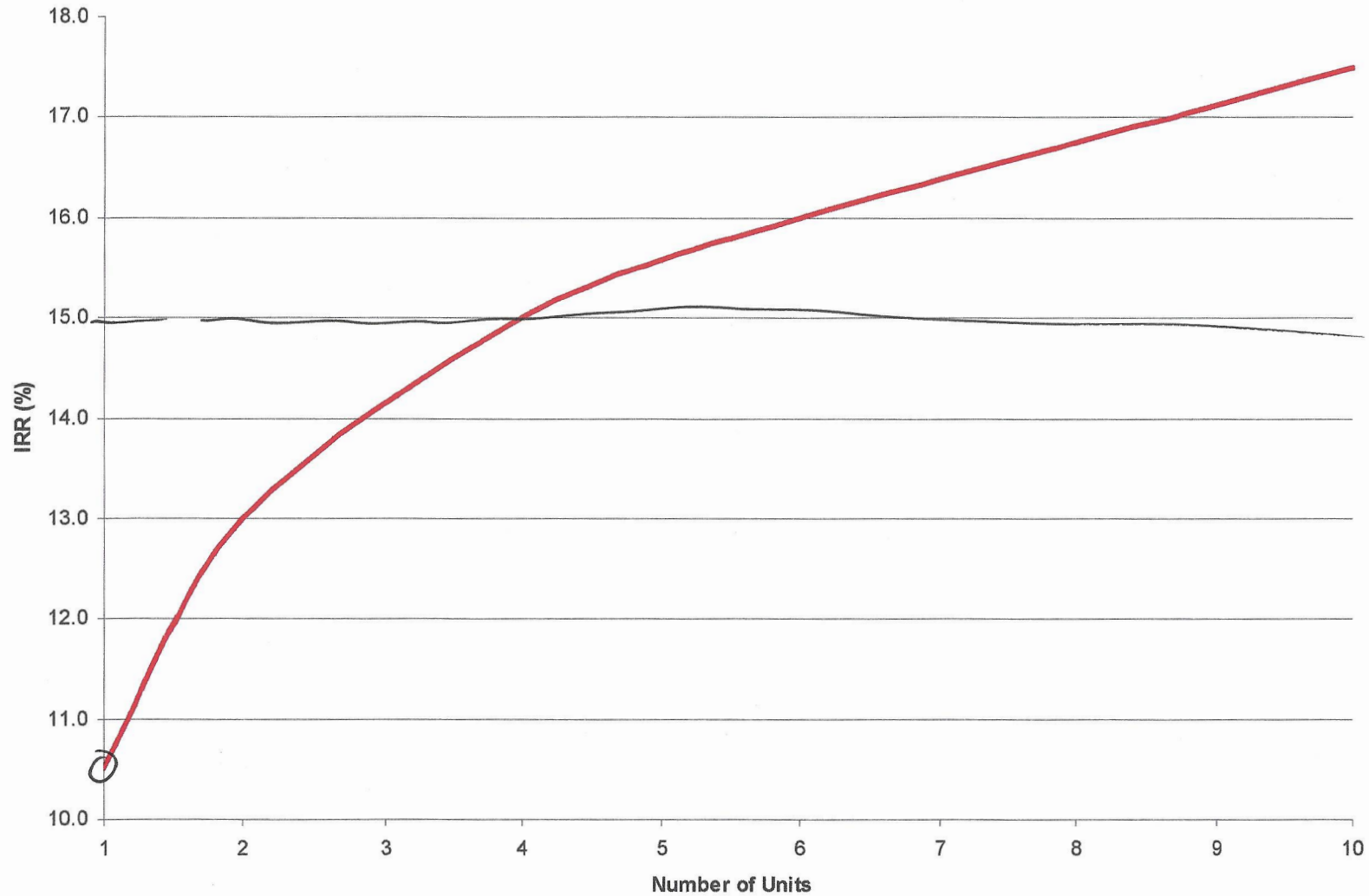
- Procurement Leverage (Fuel, Equipment) - VOL. DISCOUNT
- Reduced Software Costs (Engineering, Procedures, etc) - ONE TIME
- Improved Plant Performance (Outage Optimization, etc) - LEARNING CURVE



Potential for Fleet Construction Economies



Potential Effect of Fleet Economies on Investment Return

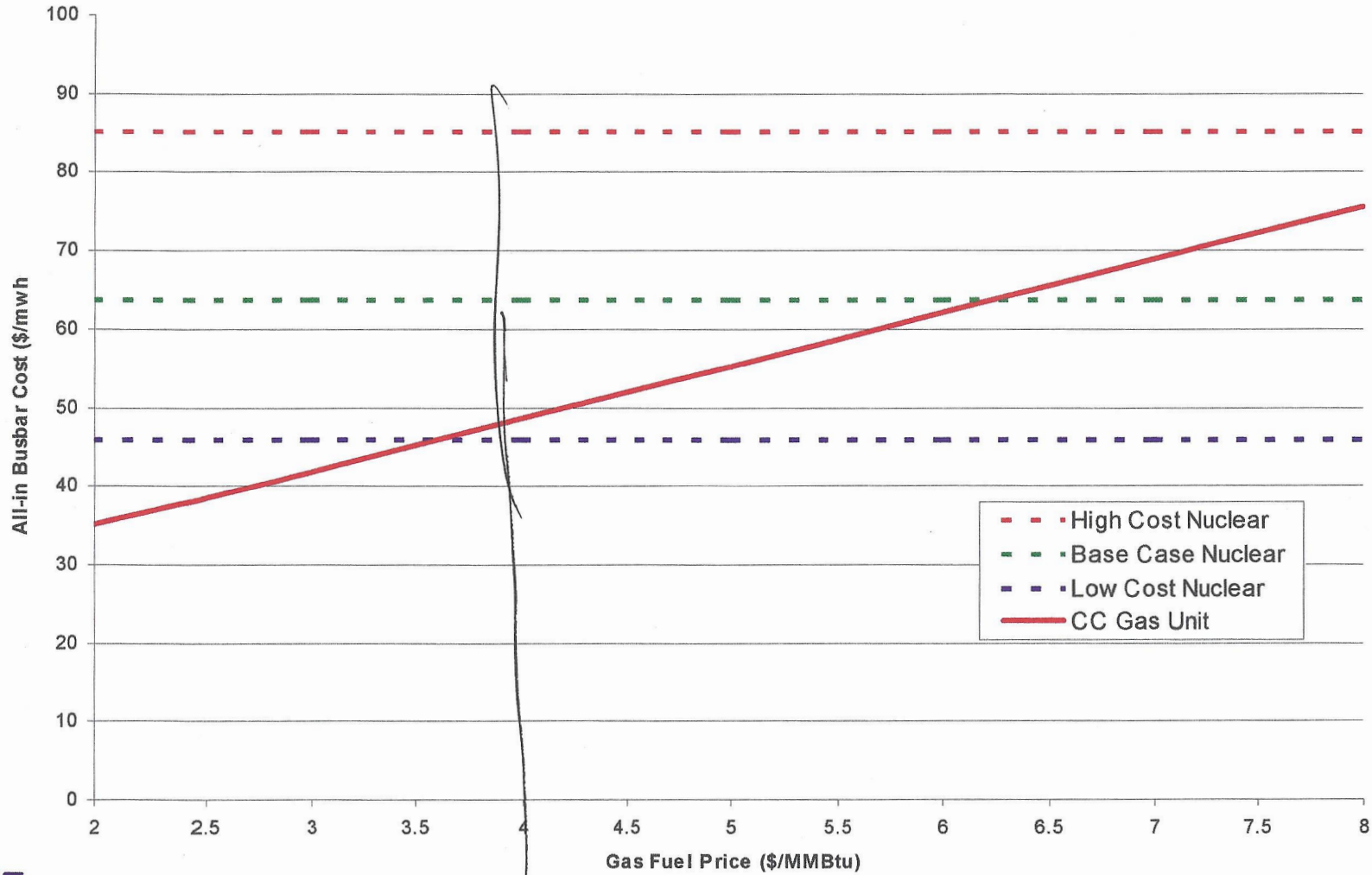


Vulnerabilities of Competing Supply Alternatives

- Combined Cycle Gas
 - Fuel Supply Shortages — ORDER HIGH DEMAND
 - High Gas Prices — HIGH DEMAND
- Advanced Fluidized Bed Coal
 - Environmental Requirements — TRANSPORT, STORAGE, WASTE
 - Air Emissions Costs 2 CO₂



Nuclear vs Combined Cycle Gas Unit Cost



X

Cost/Value of Air Emission Credits

	<u>NOx</u>	<u>SOx</u>	<u>CO2</u>
<u>New Plant Emission Rates</u>			
• CC Gas (Tons/Gwhr)	0.1	0	400
• AFB Coal (Tons/Gwhr)	1.0	0.05	900
•			
<u>Assumed Value/Cost (\$/Ton)</u>	2000	200	10

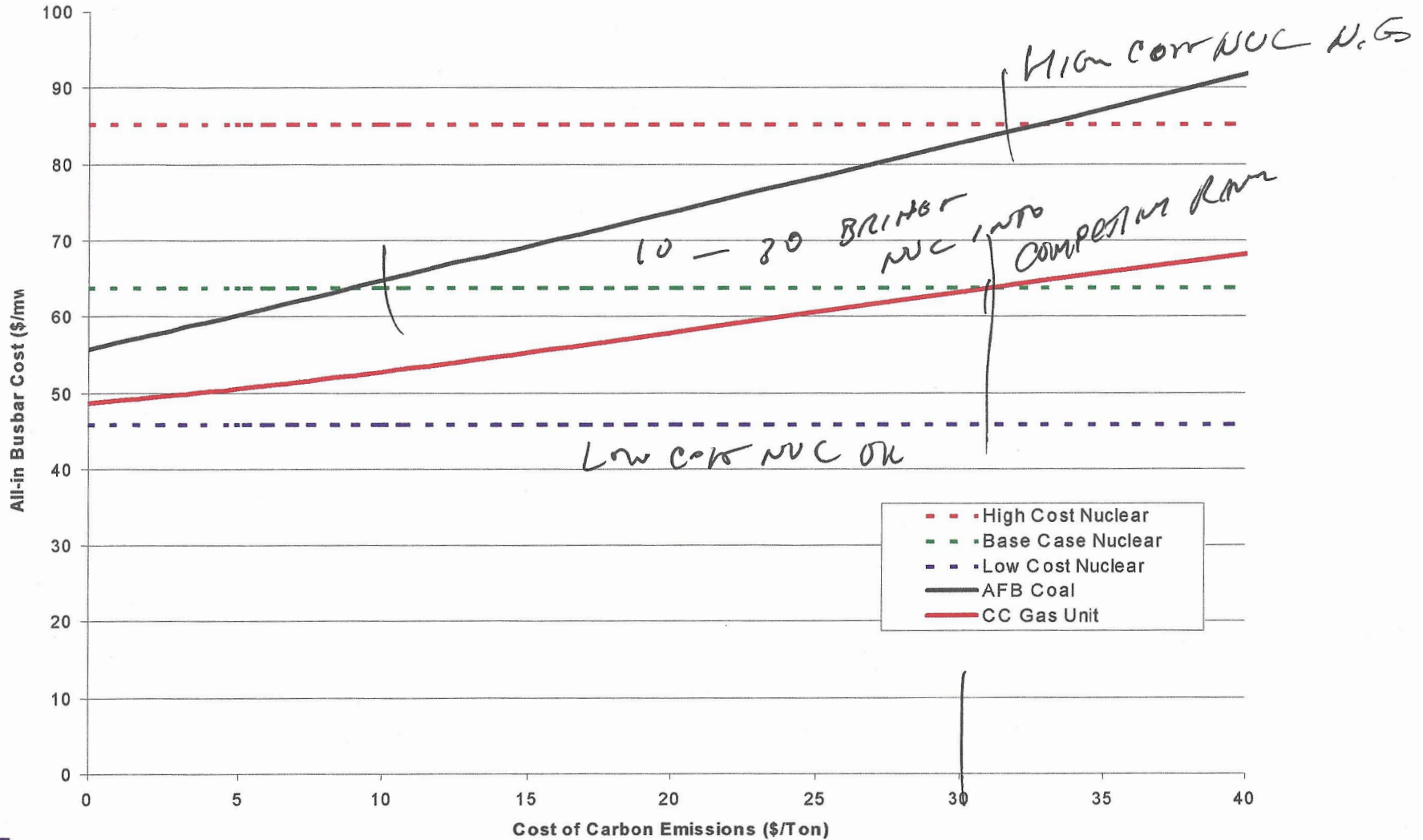
Added Generation Cost

• CC Gas (\$/MWhr)	0.2	0	4.0
• AFB Coal (\$/MWhr)	2.0	0.01	9.0

BIGGEST
POTENTIAL ~ 1.0 \$/kwh



Cost of Carbon Emissions on Supply Alternative Costs



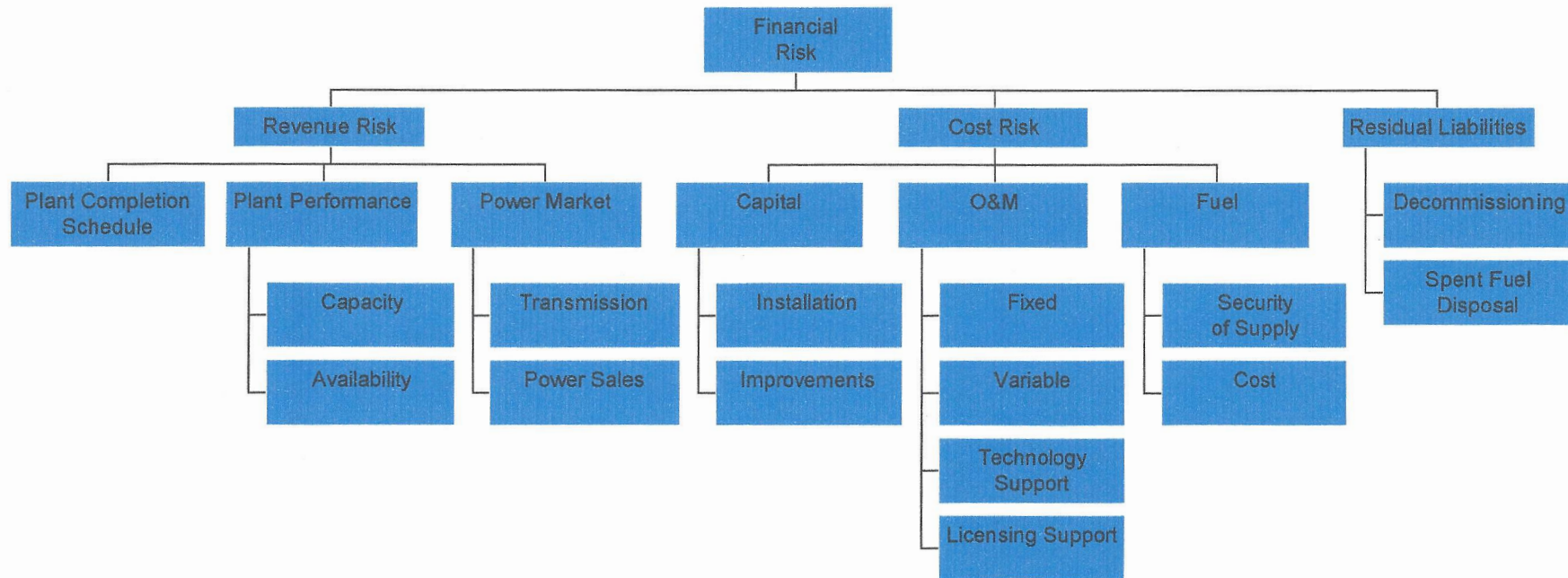
What Key Factors Will be Required to Make New Nuclear Plants Economically Viable?

- Reduced Construction Cost & Schedule *(100/1000 36 MONTHS)*
- High Demand Growth
- High Gas Prices *(> \$4/MMBtu)*
- Emissions Credits *(CAMBON TAX)*
- Investor Risk Mitigation *← STILL MUST CONVINCE INVESTORS TO PUT UP \$*



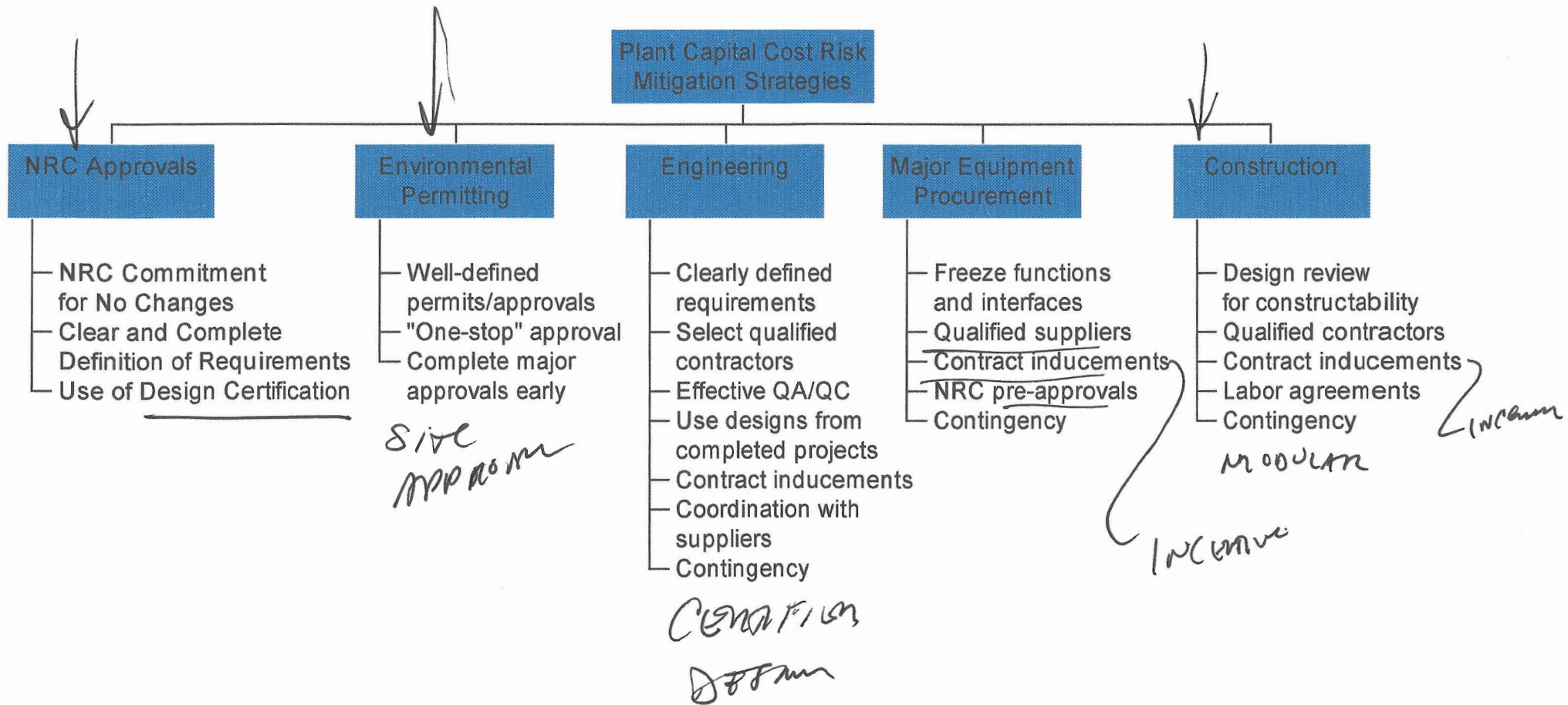
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Risk Profile



Mitigation of Cost Risk

Plant Initial Capital Cost and Schedule



Overcoming Unique Financing Challenges

Unusual Financing Challenges:

- **High development costs**
- **Dependence on full-recourse debt**
- **High project execution risk**
 - **Technology risks**
 - **Regulatory risks**

Approaches for Sharing Risk:

- **Joint ventures with major vendors**
- **Consortium of multiple owners**
- **Sale/leaseback arrangement**
 - **Government supports**
- **Isolate non-nuclear risks**



Summary of Risk Mitigation Strategies

- Proactive NRC relationship
- Use of pre-certified designs and early site approvals
- Qualified contractors with contract inducements to succeed
- Build on successful industry experience
- Fleet management benefits
- Use of ^{fixed incentives} contracts and agreements
- Sharing risk in financing arrangements
- Government support arrangements (TAA

IN ~~THE~~ INTEREST OF
ENERGY SECURITY

CONSTRUCTION
IN CONTRACT
GUARANTEE



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