Projections of Economic Competitiveness of Nuclear Power

Presentation By

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At The

LLNL Atoms for Peace Workshop II – Civil Applications of Nuclear Technology

Held At The

Keidanren Conference Center, Shizuoka-ken, Japan

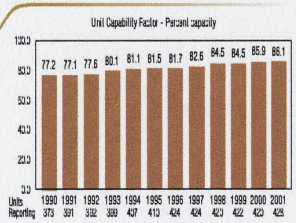
May 28th, 2003

WANO Performance Indicators 1990-2001

WANO 2001 Performance Indicators

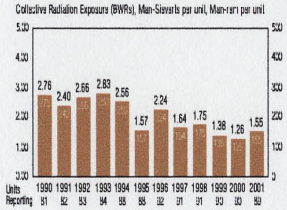
Unit Capability Factor

Unit capability factor is the percentage of maximum energy generation that a plant is capable of supplying to the electrical grid, limited only by factors within control of plant management. A high unit capability factor indicates effective plant programmes and practices to minimise unplanned energy losses and to optimise planned outages.



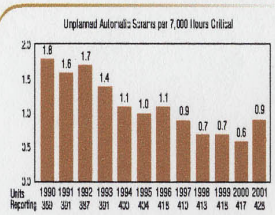
Collective Radiation Exposure

The collective radiation exposure indicator monitors the effectiveness of personnel radiation exposure controls for boiling water reactors (BWRs), pressurised water reactors (PWRs), pressurised heavy water reactors (PHWRs), light-water-cooled graphite reactors (LWCGRs), and gas-cooled reactors (GCRs). Low exposure indicates strong management attention to radiological protection.



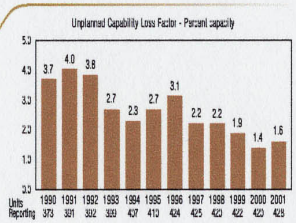
Unplanned Automatic Scrams per 7,000 Hours Critical

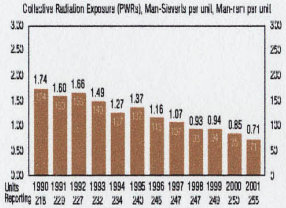
The unplanned automatic scrams per 7,000 hours critical indicator tracks the mean scram (automatic shutdown) rate for approximately one year (7,000 hours) of operation. Unplanned automatic scrams result in thermal and hydraulic transients that affect plant systems.

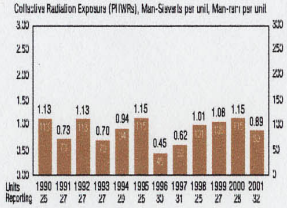


Unplanned Capability Loss Factor

The unplanned capability loss factor is the percentage of maximum energy generation that a plant is not capable of supplying to the electrical grid because of unplanned energy losses, such as unplanned shutdowns or outage extensions. A low value indicates important plant equipment is well maintained and reliably operated and there are few outage extensions.

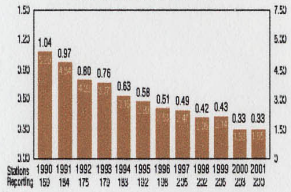


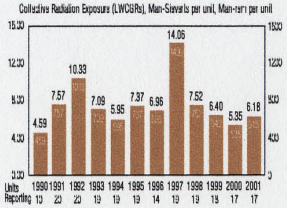


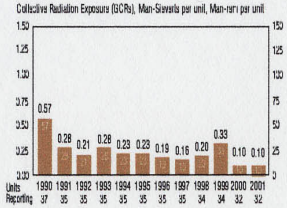


Industrial Safety Accident Rate

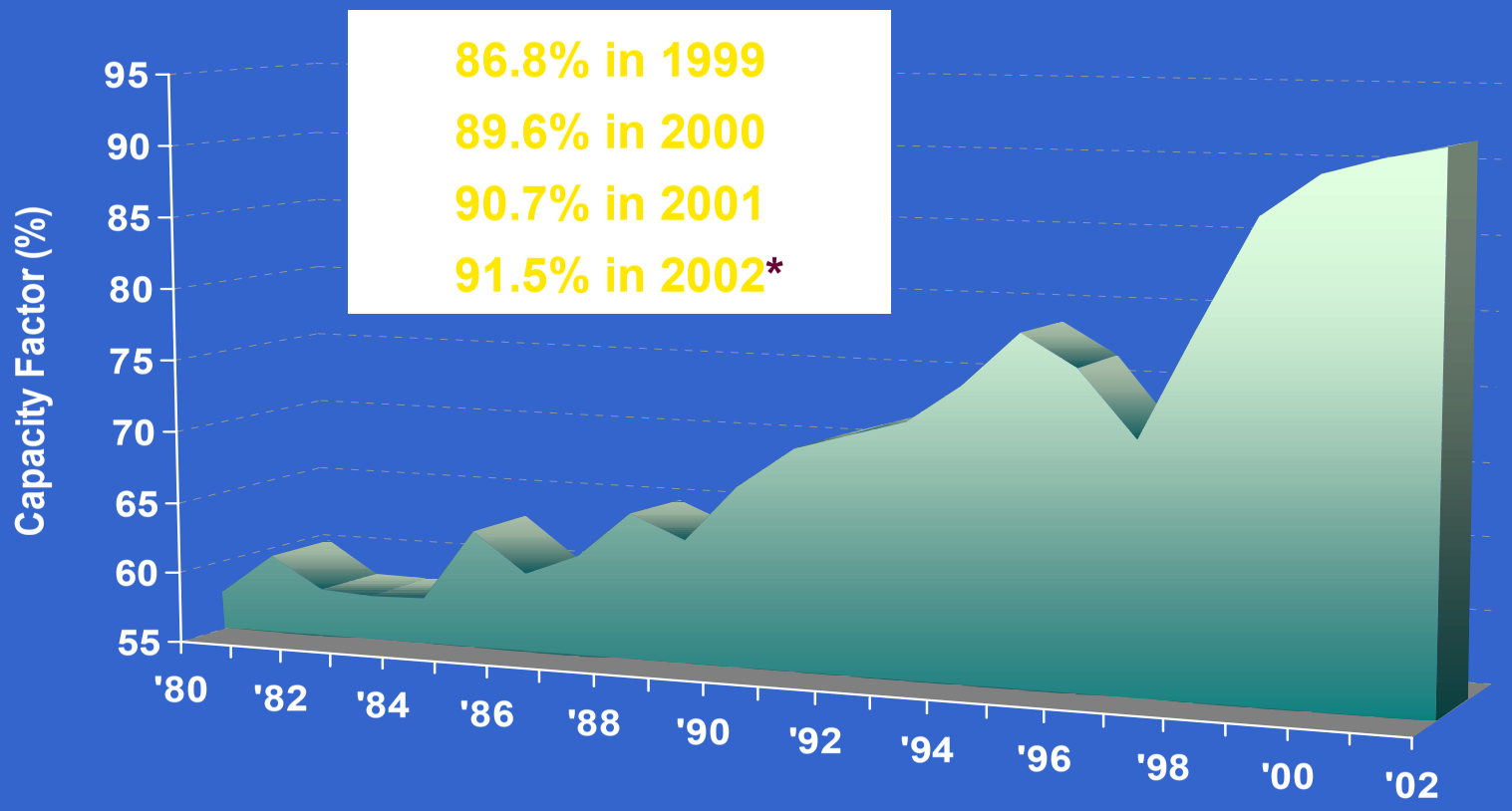
The industrial safety accident rate tracks the number of accidents that result in lost work time, restricted work, or fatalities per 200,000 work-hours. The nuclear industry continues to provide one of the safest industrial work environments.







Industry Capacity Factor Continues at Record Level



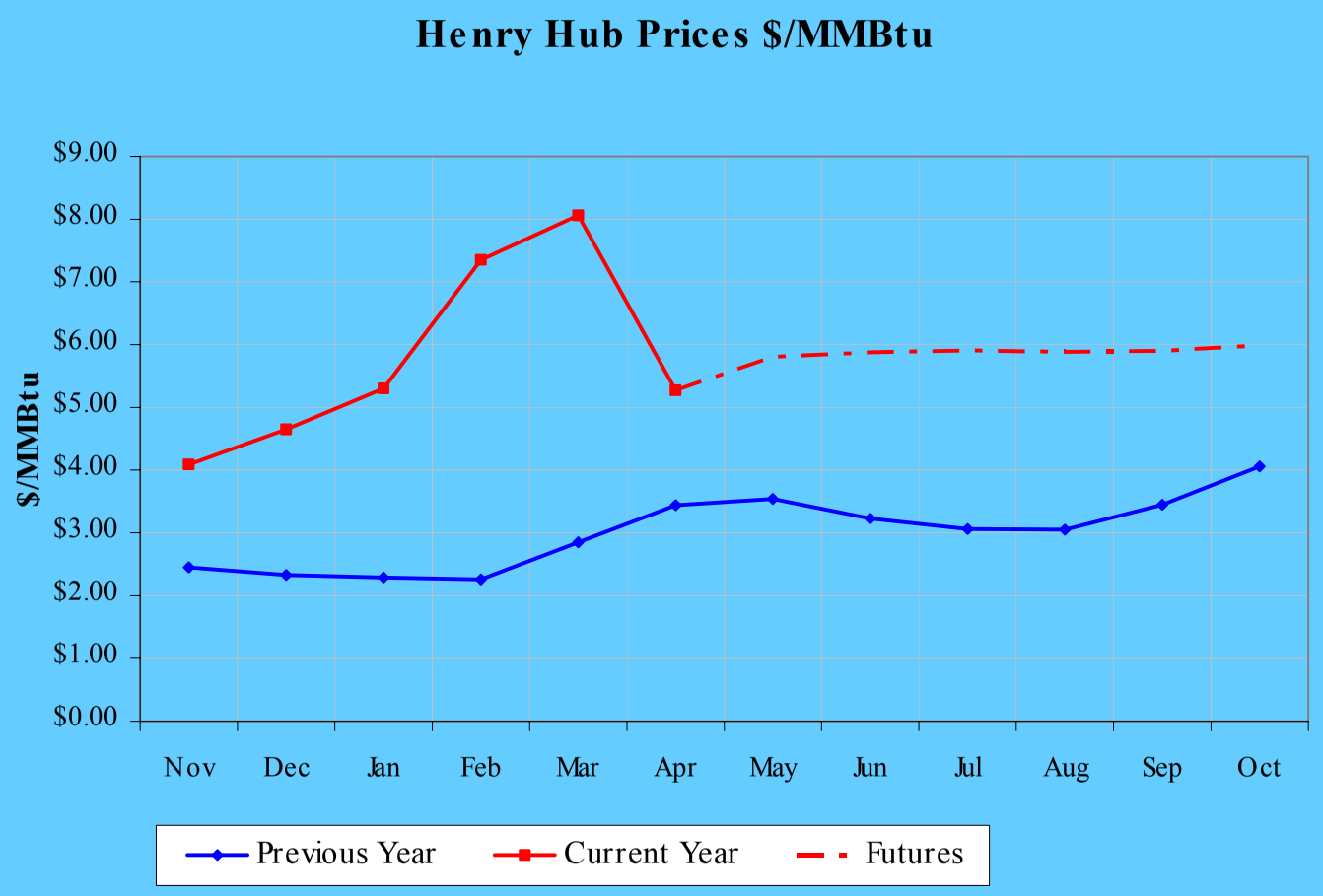
** Nuclear Energy Institute estimate*

Production Costs Show Steady Sustained Improvement

2.09 cents/kWh in 1998
1.90 cents/kWh in 1999
1.81 cents/kWh in 2000
1.68 cents/kWh in 2001

** Nuclear Energy Institute estimate*

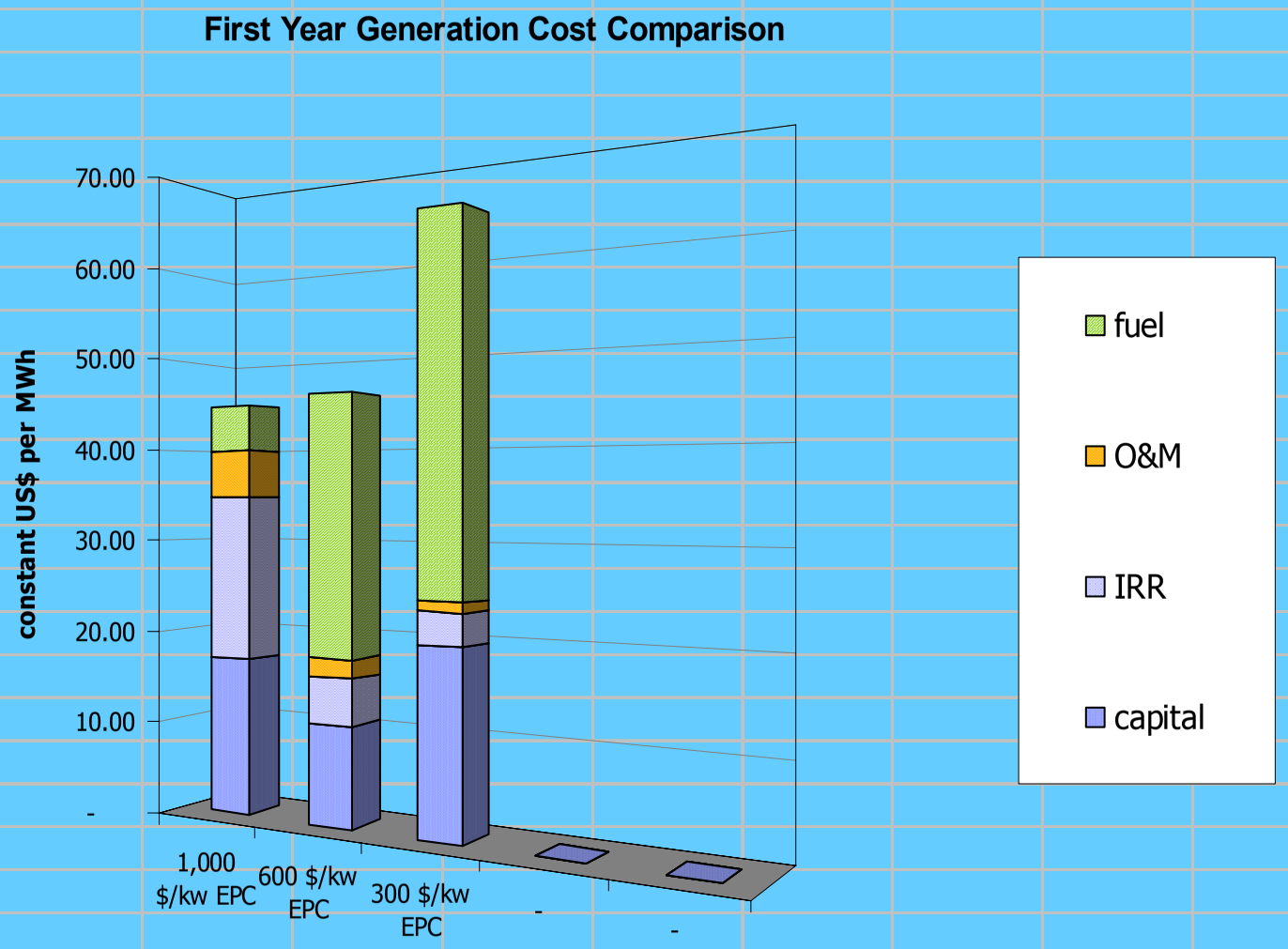
NYMEX Natural Gas Futures Prices [$/MMBTU]



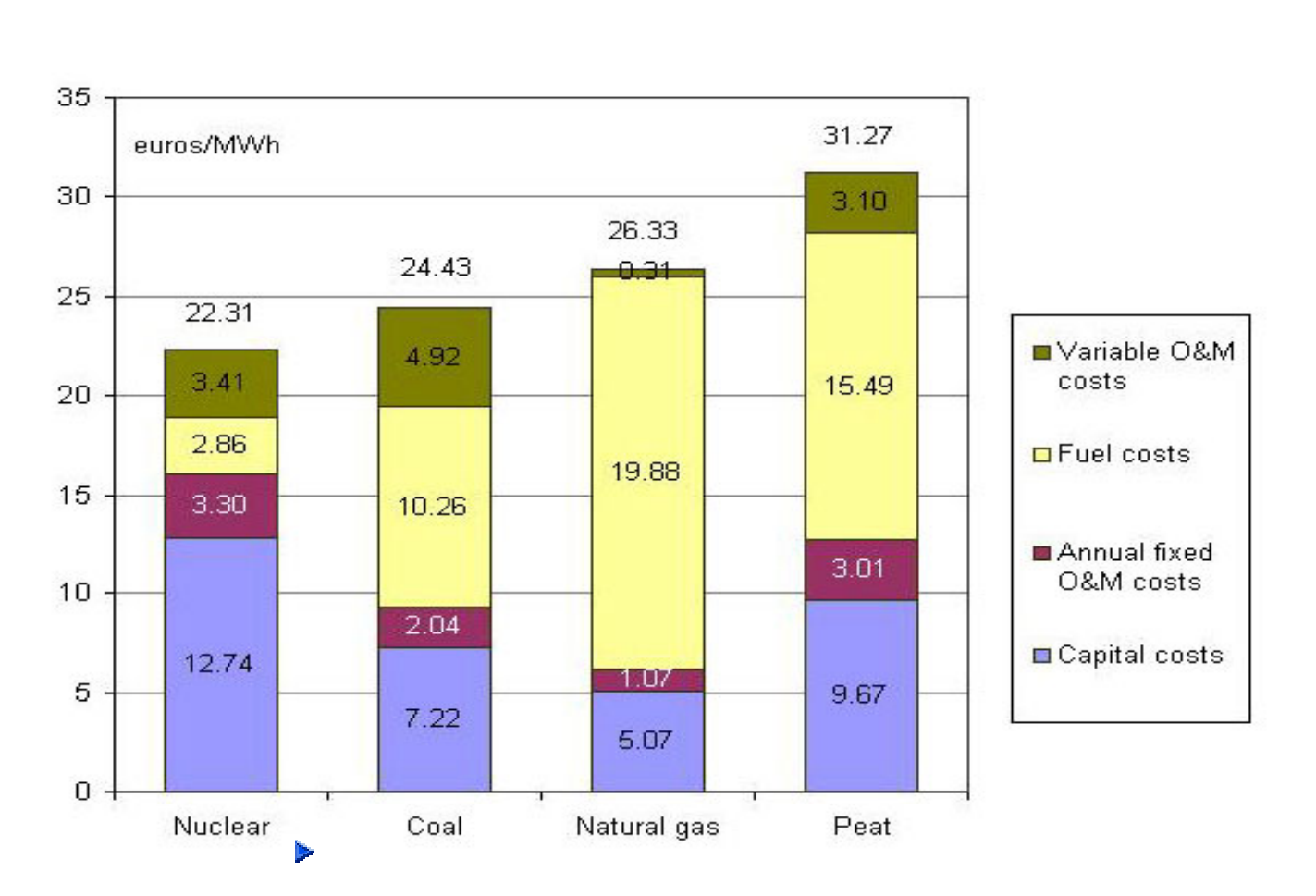
New Nuclear Plants
Why Nuclear in the Generation Portfolio?

- **Financial Stability**
  - Base load versus intermediate and peaking
  - High levels of cash flow for bondholder coverage
  - Excellent positive return to investors with narrow long–term risk profile
- **Portfolio Stability**
  - Negative correlation to more volatile generation (gas) provides diversification and portfolio stability
- **Fuel Stability**
  - Plentiful supply in US
  - Stable cost
- **Operational Stability**
  - Average capacity factors of >90% over past 5 years
  - Operational production costs of < $15 per MWh including fuel

Figure 1 - First Year Generation Costs Comparison - ALWR, Gas-Fired Combined Cycle Plant & Gas Turbine - Constant Year 2000 $/MWh - Natural Gas Price 4.0 $/MMBTU



Electricity Costs of Base-load Generation Alternatives in Finland at 8000 Full-load Operating Hours

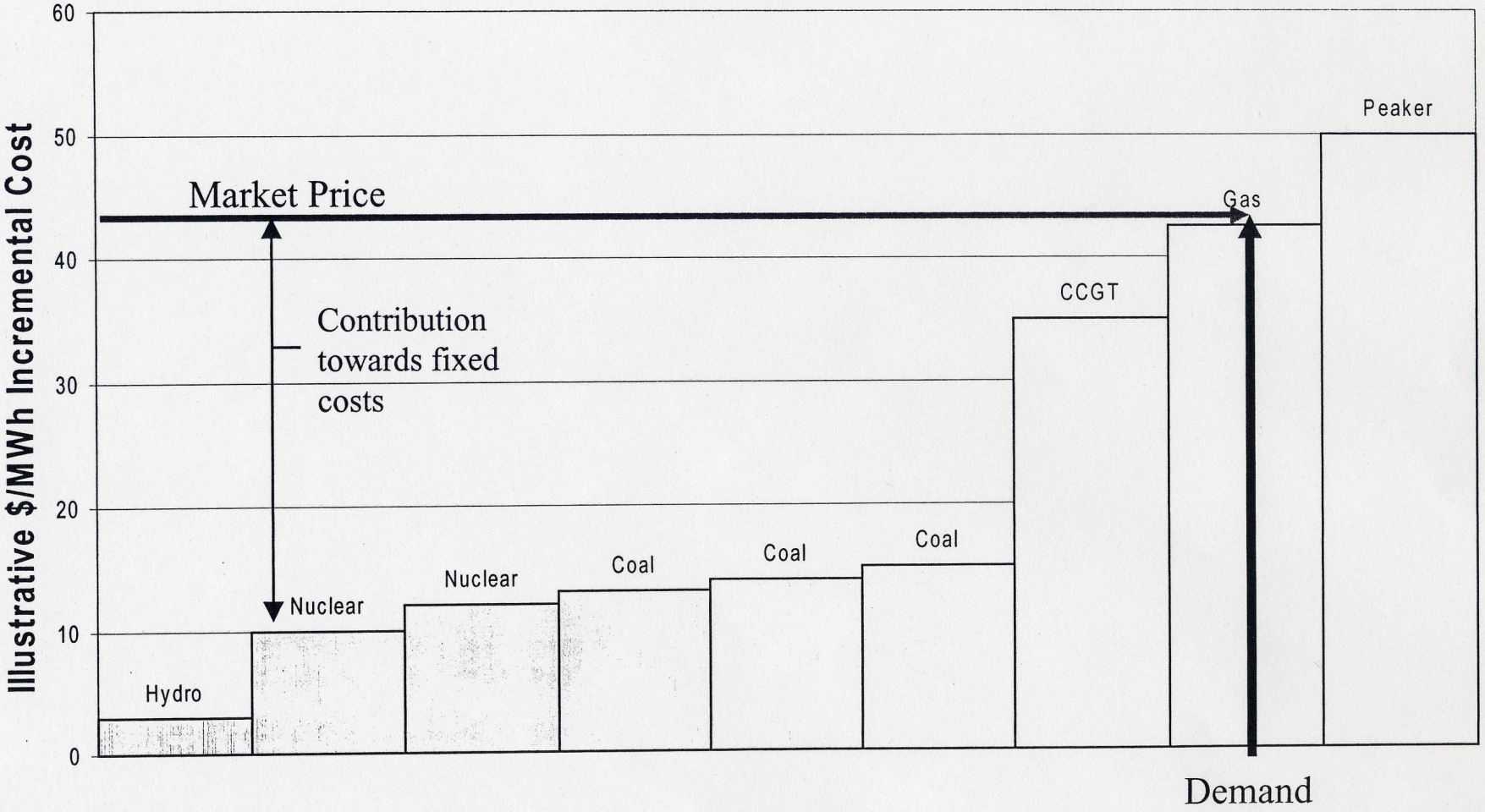


Rising Gas Prices Have Dramatic Impact on Electricity Cost

Approximate Equivalence of ALWR EPC Capital Cost & Natural Gas Price to CCGT Plant

ALWR Capital Cost [$/KWe]	Electricity Generation Cost [$/MWh]	Natural Gas Price to CCGT [$/MMBTU]
1,000	41.5	3.8
1,100	44.5	4.2
1,200	47.5	4.8
1,300	50.5	5.1
1,400	53.5	5.5
1,500	55.5	5.8
1,600	58.5	6.2

Illustrative Example: Market Price For Energy In A Competitive Market



SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL℠ Company

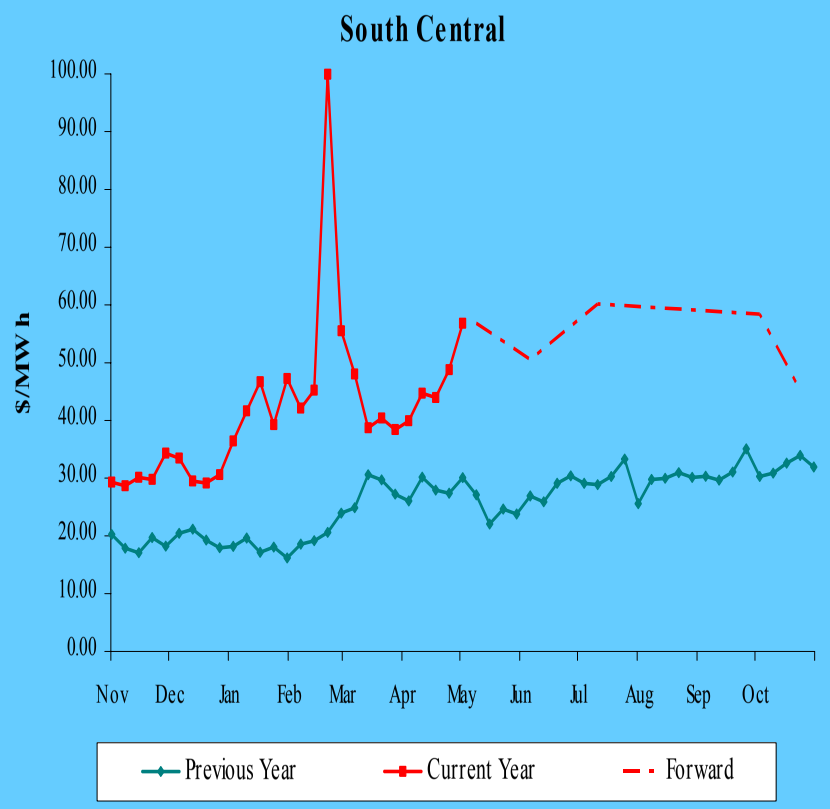
What Happens If…

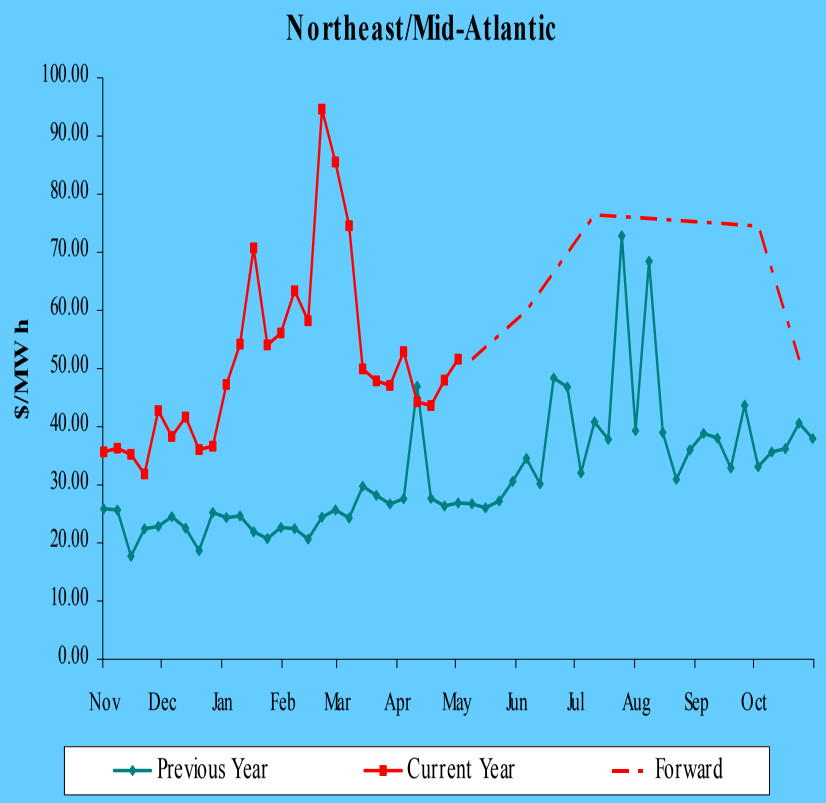
1. Reduce cost to produce electricity by 10%
2. Increase plant output by 10%

		$35 per megawatt-hour
	–	**$27 per megawatt-hour**
	x	**11 million MWh**
Gross profit	**=**	**$88 million**

Gross profit increases by 76%

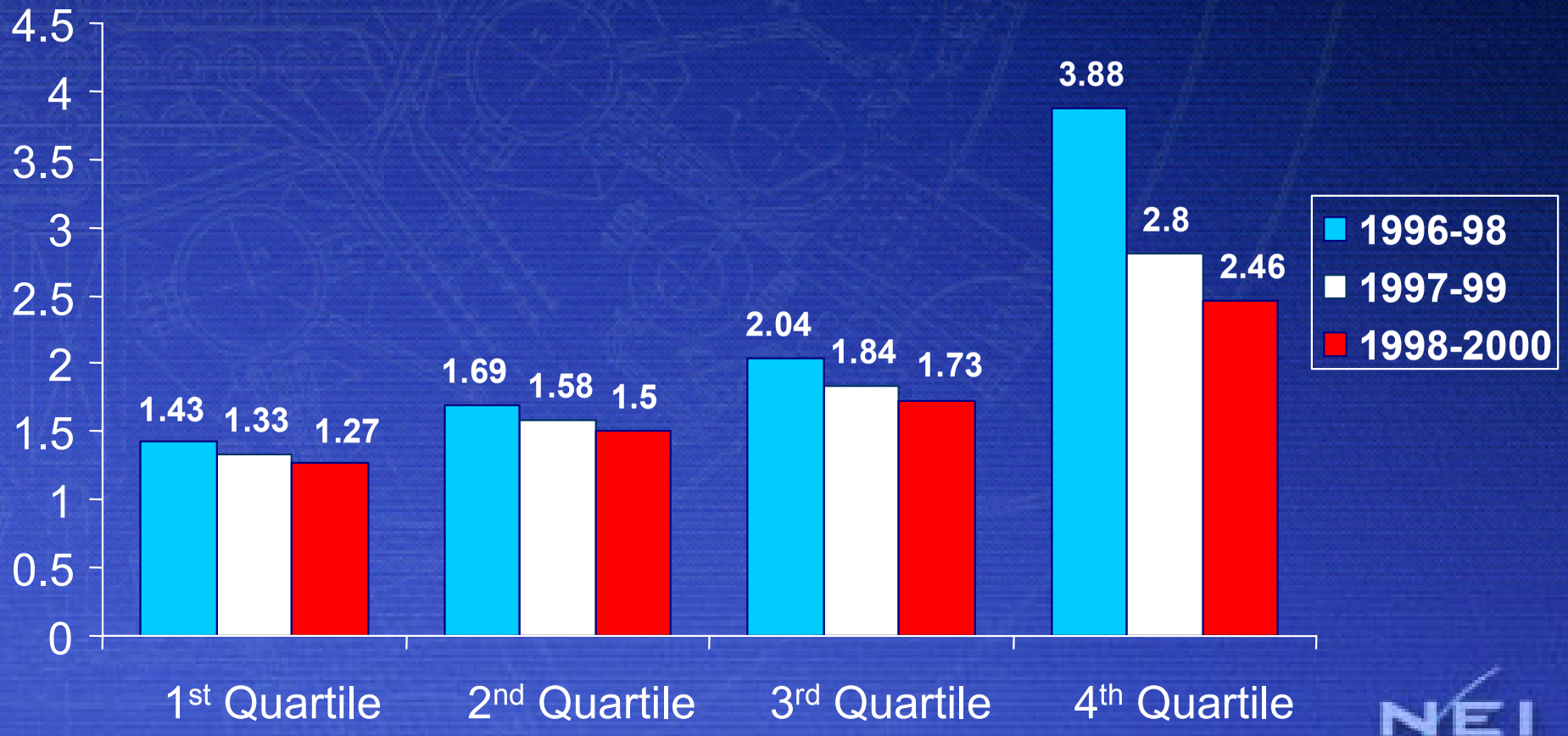
Electricity Spot & Forward Prices [$/MWh]





Economic Performance: Steady Improvement Continues

(3-year rolling average production costs in cents per kilowatt-hour)



Source: Utility Data Institute and company reports to Electric Utility Cost Group (EUCG)

New ALWR – Margin Analysis

- We can Further Assume:

  - Higher Electricity prices – U.S. Northeast, South Central Regions
  - Lower ALWR Production Cost (All-In)

$ 43 per Megawatt-hour
\- $ 19 per Megawatt-hour
x 11 Million MWh

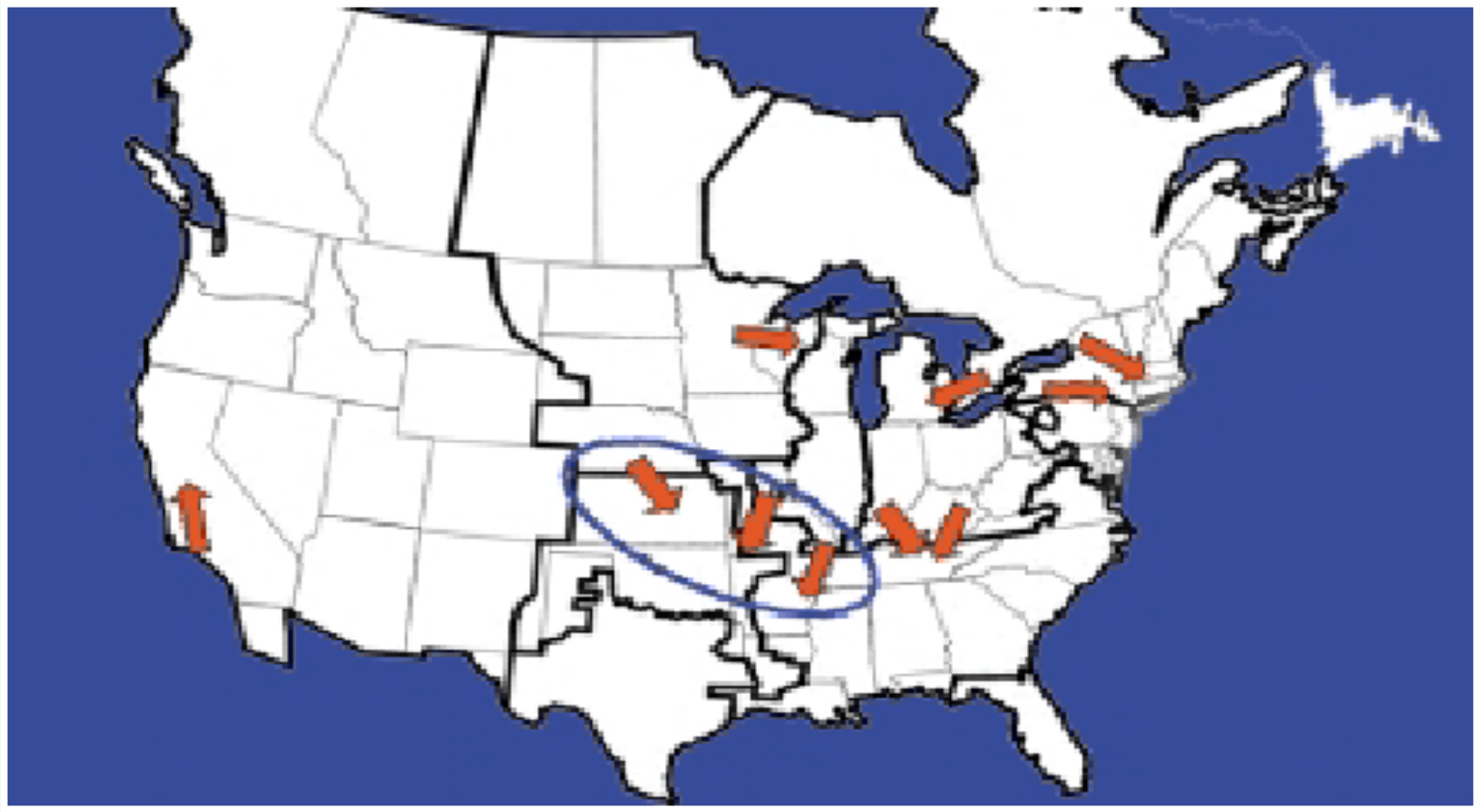
Gross Margin = $ 264 Million

New ALWR – Margin Requirements

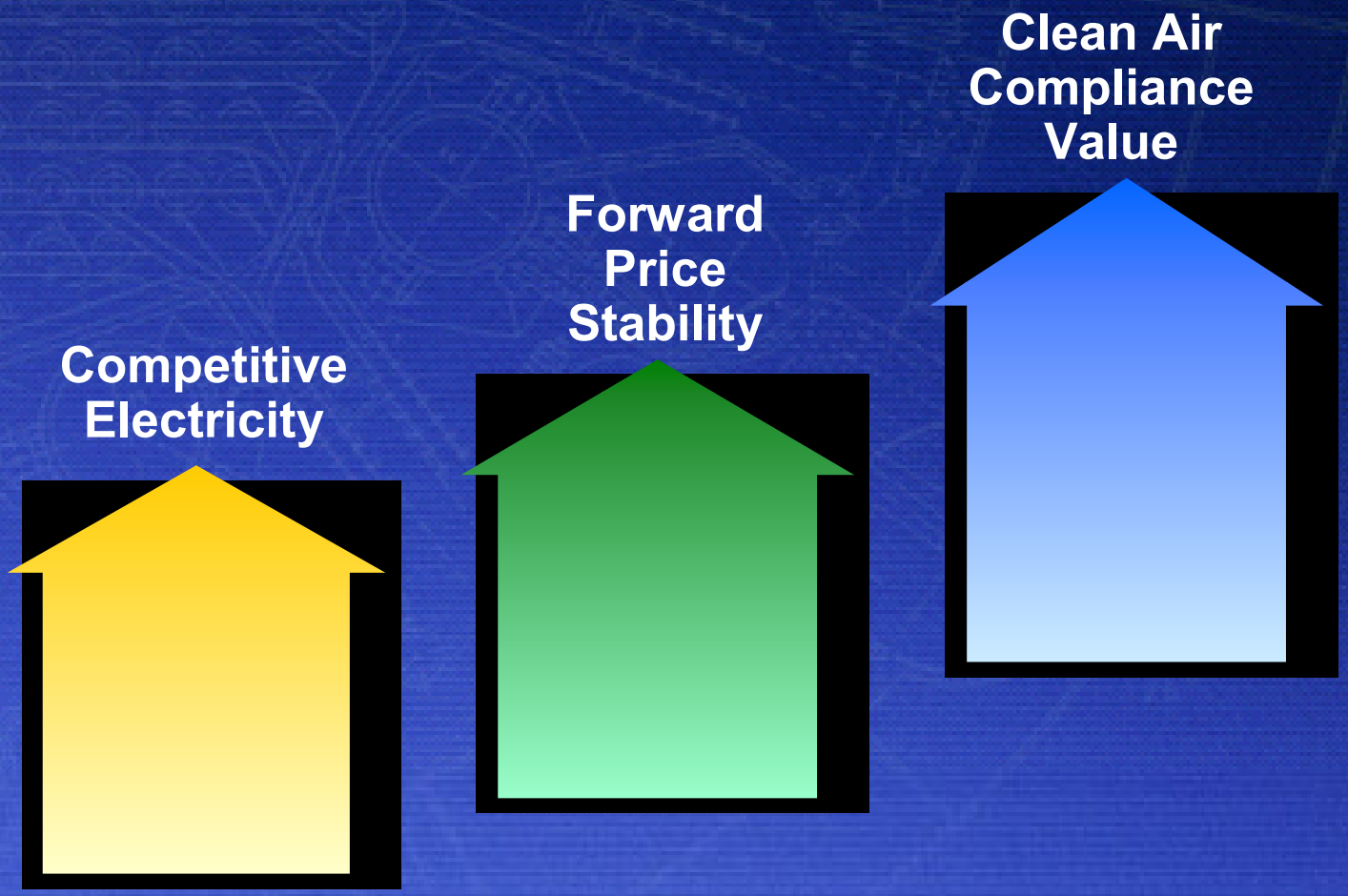
- Assume: 1,300 MWe ALWR
- Assume: EPC Cost 1,100 $/KWe
  Overnight Cost ~ 1,400 $/KWe
  Total Cost (Incl. IDC) ~1,700 $/KWe
  Total Cost ~ 2.2 Billion Dollars
- Assume: Annual Fixed Charges Rate 11-15 %

- Compute Annual Fixed Charges (Margin) Requirements ~ 240 – 330 Million Dollars

Electricity Transmission Bottlenecks: Vulnerable Points



Beyond Competitive Electricity: Value Added From Nuclear Energy



Outlook for Nuclear Power

- **Existing Nuclear Plants Fleet remains the core of the nation's base-load capacity, despite recent bulk power market uncertainties. This is due to the initiatives taken by the industry to confront and address long-term reliability and safety issues**
- **Demand for new base-load capacity in the US, including new Nuclear Plants, in the next several years is still limited.**
- **New Nuclear Plant projects now do reach the detailed evaluation phase**
- **Regional and local electricity transmission bottlenecks and supply constraints, support specific cases for new base-load Nuclear Plants**
- **No consensus agreement yet on providing premium to generating assets that produce no CO2 emissions**
- **Implementation of the Nuclear Waste Bill commencing, subject to further litigation**

Outlook for Nuclear Power (Cont.)

- **Assuming:**
  - Current pro-nuclear Administration re-elected in 2004
  - Economic recovery continues, accelerates (Tax cuts, interest rate cut, lower energy costs)
  - Electricity demand increases, while natural-gas prices remain high
  Then - a window of opportunity for new nuclear capacity growth could emerge by 2005
- **Multiple, standardized New Nuclear Plant orders will achieve learning-curve capital cost reductions – France, Korea, PRC (both positive and negative examples)**
- **Regulatory guarantees against open-ended licensing reviews resulting in spiraling plant costs sought by utilities prior to commitment to new plants**
- **Regional, Federal, support (Loan Guarantees, Price Guarantees, PPAs), under regulated market conditions, improves the prospects of implementing a standardized new Nuclear Plants program**
- **One-off new Nuclear Plant projects still represent near FOAK situations (Limited learning, high engineering content, high contingencies) – trade-off of political & economic risks**
- **Both Commitment models could materialize in the U.S. before the end of this decade**