Energy Project Financing & Capital Allocations

CIBO 2013 Annual Meeting

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Economic Terms

- Return on Sales = Net after tax/Sales Revenue
- Asset Turnover = Sales Revenue/Assets
- Leverage = Assets/Equity
- PE Ratio = Stock Price(per share)/Net after tax (per share)
- Market to Book = Stock Price/Equity
- Return on Assets = Net after tax/Assets
- Return on Equity = Net after tax/Equity
- Discount Rate = Time Value of Money
- Net Present Value = Present Value of Future Returns @ Discount Rate
- Internal Rate of Return = Discount Rate that yields and NPV of zero

Why do we care?

- ROS x Turnover x Leverage x PE = Market/Book
  - Listed firms want to increase stock price (shareholder value)
- The Discount Rate considers risk as well interest rates and inflation
  - The discount rate is often a project hurdle rate
- Many firms use IRR for project evaluation
- Return on Equity is a key consideration for any investment

Economic Methodologies

- A Power Plant is a long lived asset that is capital intensive.
- It also takes a long time to acquire the asset.
  - Construction times range from 2 years for a combined cycle plant to 3 – 4 years for a coal plant to 10 years for a nuclear plant.
- A key issue is treating the time value of money.
- Depreciation is a key consideration.
- Different entities treat these considerations differently.

Plant Cost

- **Plant Cost is exceptionally site specific.**
  - Labor costs
  - Shipping and material costs
  - Environmental costs
  - Site preparation costs
  - Site impacts on performance
  - Fuel costs
  - Cooling water type and availability
  - Connection costs
- **Today, we really don't know what the final cost of a plant will be.**
  - Raw material escalation
  - Shipping costs
  - Labor costs

Plant Cost Terminology

- **There are numerous ways to talk about plant cost.**
  - Engineered, Procured, and Constructed (EPC cost)
    - Most commonly used today
    - Fits best with Merchant Plant model
    - Does not included Owner's Costs
      - Land, A/E costs, Owner's Labor, Interconnection, Site Permits, PR, etc.
    - Can often be obtained as a fixed price contract for proven technology
  - Equipment Cost
    - Generally the cost to fabricate, deliver, and construct the plant equipment
  - Overnight Cost
    - Either the equipment cost or the EPC cost with the NPV of interest during construction. This was used in the 70s and 80s to compare coal plants with nuclear plants due to the difference in construction times.
  - Total Installed Cost (TIC)
    - The total cost of the equipment and engineering including interest during construction in present day dollars. This is the cost that a utility would record on its books without the cost of land and other home office costs.
  - Total Plant Cost (TPC) – includes all costs

Economic Methodologies

- **Simple payback**
  - The number of years it takes to pay back the original investment
- **Return on Equity**
  - For regulated utilities, the ROE is set by the regulatory body. The equity is determined by the total plant cost being allowed in the rate base. The equity portion is determined by the leverage of the company. The ROE is applied to the equity and added to the cost in determining the cost of electricity and thus the rate to be charged to the customer.
- **Capital Charge Rate**
  - This is the rate to be charged on the capital cost of the plant in order to convert capital costs (ie investment) into operating costs (or annual costs). This rate can be estimated in a number of ways. This rate generally includes most of our ignorance about the future (ie interest rates, ROE, inflation, taxes, etc.)
- **Discounted Cash Flow Analysis**
  - This method is preferred by economists and developers. A spread sheet is set up to estimate the cash flows over the life of the project. An IRR can be calculated if an electricity price is known (or estimated).

Economic Methodologies

- **All of these methods can be made equivalent to one another for any given set of assumptions.**
  - A simple payback time can be selected to give the same cost of electricity (COE) as the other methods.
  - A return on equity can be selected to give the same COE.
  - A capital charge rate can be selected to give the same COE.
  - The Discounted Cash Flow method is considered the most accurate. However, there are still a considerable number of assumptions that go into such a model such as the discount rate, inflation rate, tax rate, interest rates, fuel prices, capacity factors, etc. that the accuracy is typically less in reality.
- **The Independent Power Producer pioneered the use of the DCF model for smaller power projects.**
  - In this model, the developer attempted to fix as many costs as possible by obtaining fixed price contracts for all of the major cost contributors. These included the EPC price, the fuel contract, the Operations & Maintenance Contract (O&M), and the Power Purchase Agreement.

Cost Models

- **Capital Charge Rate Model**
  - The goal is to select a capital charge rate that typically covers most of the future unknowns. This rate is applied to the EPC cost in order to provide an annual cost that will provide the desired return on equity.
  - In its simplest form, one can use the following:
    - Interest rate on debt - 8 - 10% for utility debt
    - ROE - 10 – 12 % for most utilities
    - Inflation rate - 3 – 4%
    - Depreciation - 2 – 4%
    - Taxes and Insurance - 3 – 5%
    - Risk - ? (typically 3% for mature technologies, higher for others)
  - Another approach would be to run a number of DCF cases with different assumptions and then assess a capital charge rate that is consistent.
  - A reasonable number for a regulated utility is 20% (one significant figure)

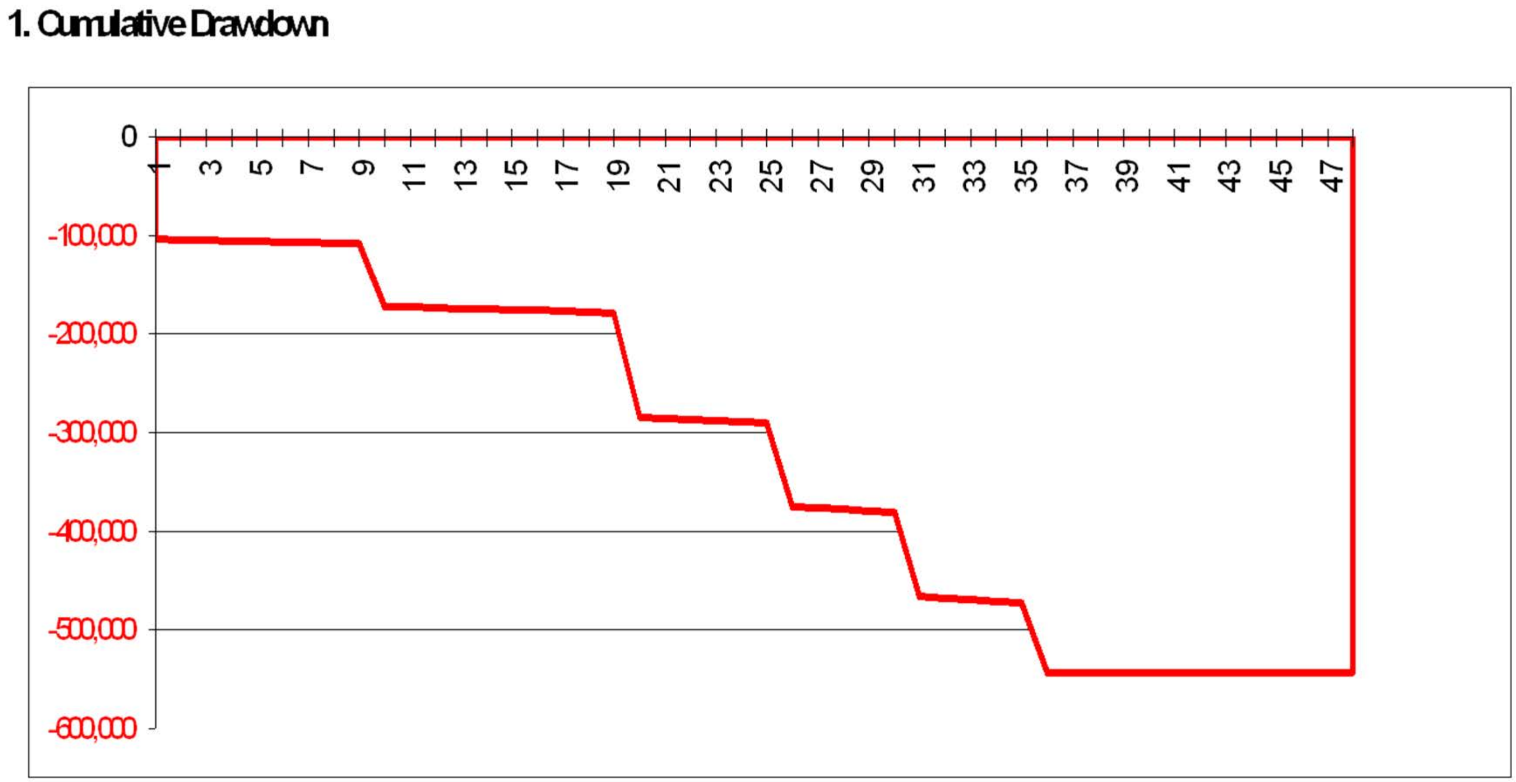
Discounted Cash Flow Model

- **The goal is to estimate the cash flows of the project over the life of the plant. A significant number of variables are involved and must be estimated or assumed in order to make the spread sheet work.**
  - Input variables include net output, capacity factor, availability, net plant heat rate (HHV), degradation, EPC price, construction period, insurance, initial spares/consumables, fixed O&M, variable O&M, fuel price, fuel heating value (HHV), financial closing date, reference date, depreciation, analysis horizon, owner's contingency, development costs, permitting costs, advisory/legal fees, start up fuel, fuel storage, inflation rates, interest rates, debt level, taxes, construction cash flow, discount rate, and ROE.
  - A detailed cash flow analysis is set up for each year of the project. For shorter term projects, these estimated cash flows are more realistic. For longer term projects, the accuracy is debatable.
  - Since the cash generation may be variable, it is often desirable to perform some kind of levelizing function to generate an average that is understandable. There are risks associated with this step.
  - The most common application is to assume a market price for electricity and then try to maximize the IRR for the project.

Discounted Cash Flow Model

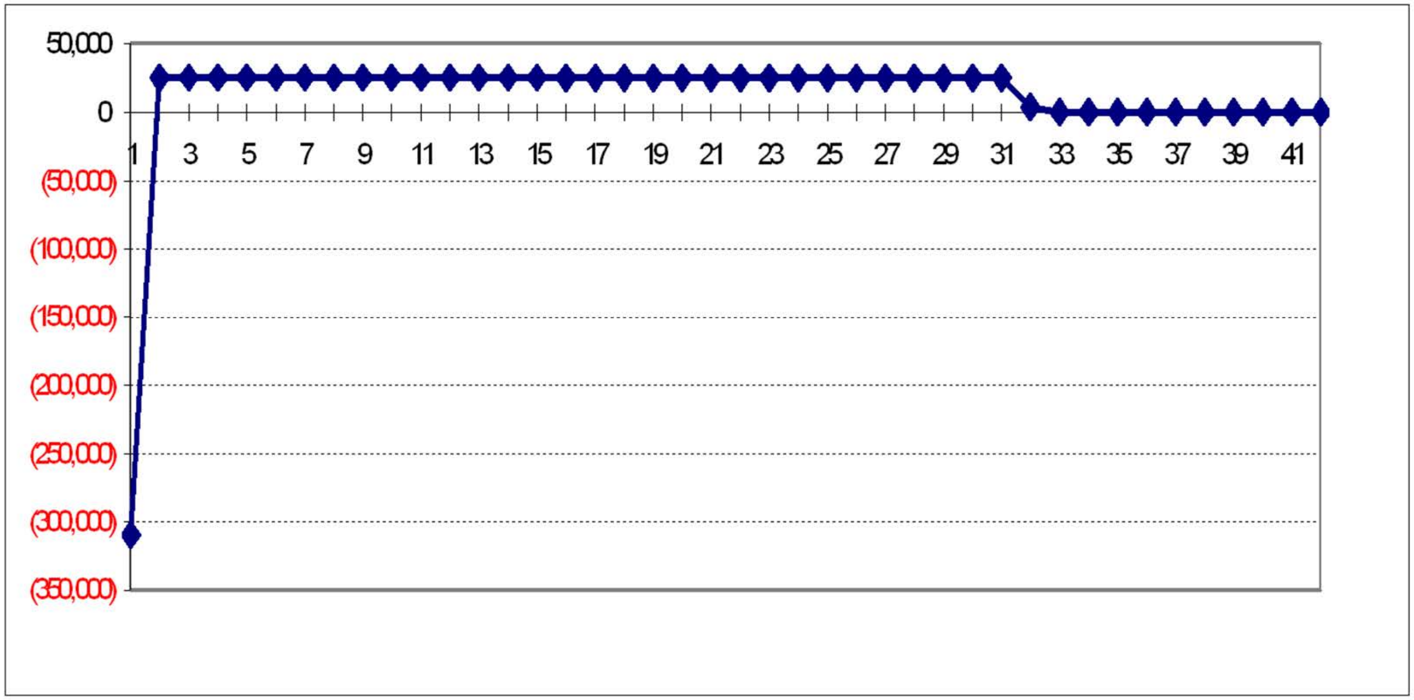
- The model assumes that we know a lot about the project and the number of variables. What if we don't know very much about the future project? For example, what if we don't know where the plant will be located? What if we don't know which technology we will use for the plant? What if we want to compare technologies on a consistent basis?
- One approach is to run the DCF model "backwards". In this approach, we stipulate a required return and calculate an average cost of electricity needed to generate that return. We still need to make a lot of assumptions, but at least we can be consistent.
- One advantage of having such spread sheet programs is that a wide range of scenarios and assumptions can be tested. This approach gives us a little more insight into the decision making process and helps us understand why some entities might chose one technology over another.

Typical Construction Period w/Cash Drawdown



Typical Levelized Cash Flow

4. Ending Equity Cashflow



Pitfalls

- The biggest pitfall is thinking that these numbers are "real". They are only indicative. Just because a computer can calculate numbers to the penny does not mean that the numbers are accurate. There is a lot of uncertainty due to the number of assumptions that have to be made.
- It is important to understand what the goal and/or objective of the analysis is. In the following study, the goal was to compare technologies that might be used in the future. This goal is different from looking at a near term project where the site, technology, fuel, customer, and vendors have already been selected.
- There is no substitute for sound management judgement.
- The analysis itself does not identify the risks. The analyzer must consider the risks and ask the appropriate "what if" questions. In the following study, over 3,000 spread sheet runs were made in order to analyze the comparisons effectively.
- Avoid the "Swiss Watch" mentality.

Baseline Economic Inputs – 1997 100 MW Class

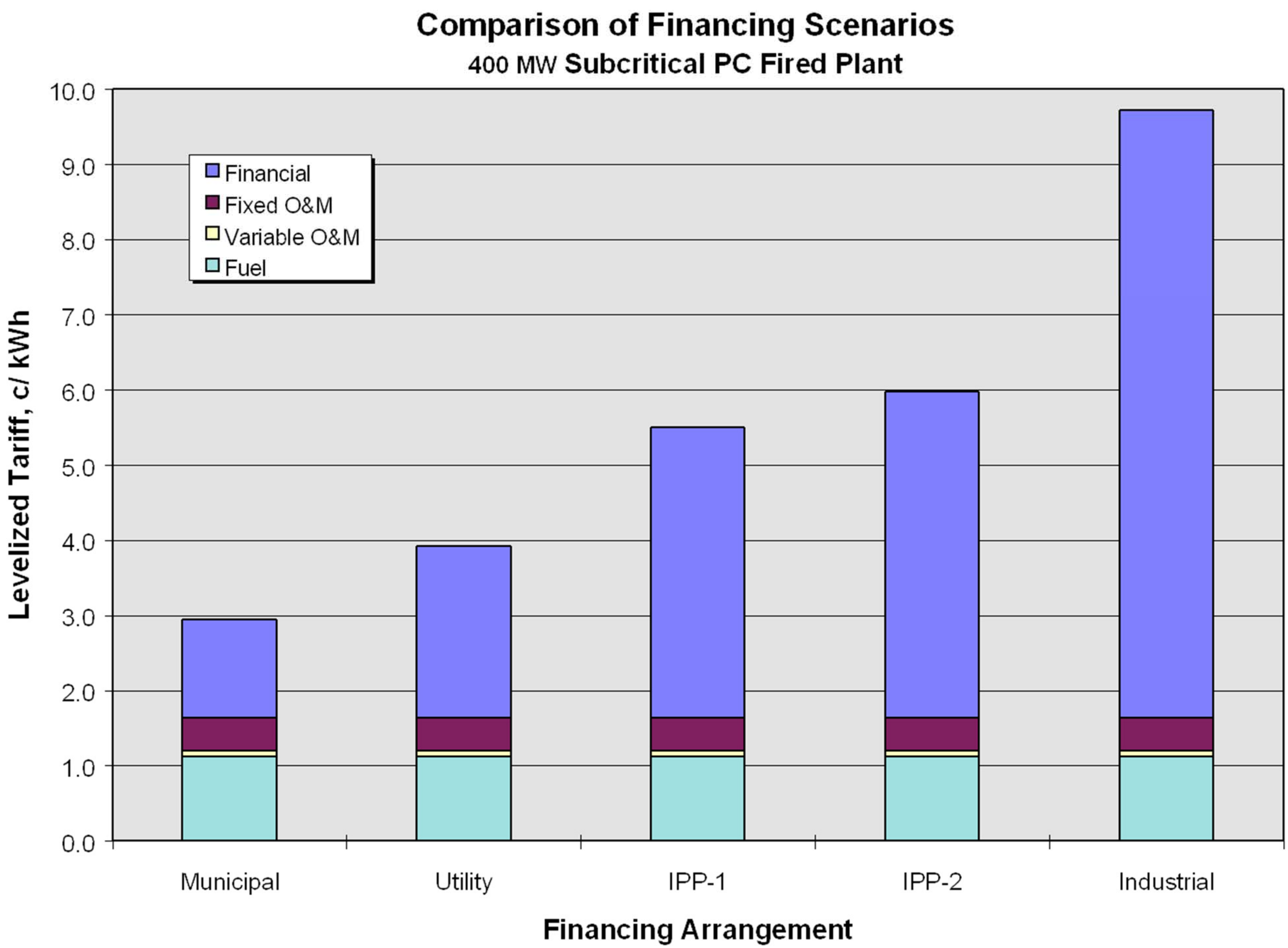
	CFB	P200 PFBC	NGCC
Size (MW)	100	100	270
Capital Cost ($/ kW)	1,000	1,200	500
Heat Rate (Btu/ kWh)	10,035	8,815	6,640
Availability (%)	80	80	80
Cycle Time (months)	30	32	24
Fixed O&M ($/ kW)	44.13	55. 41	16.92
Variable O&M (mills/ kWh)	1.18	1.06	0.01

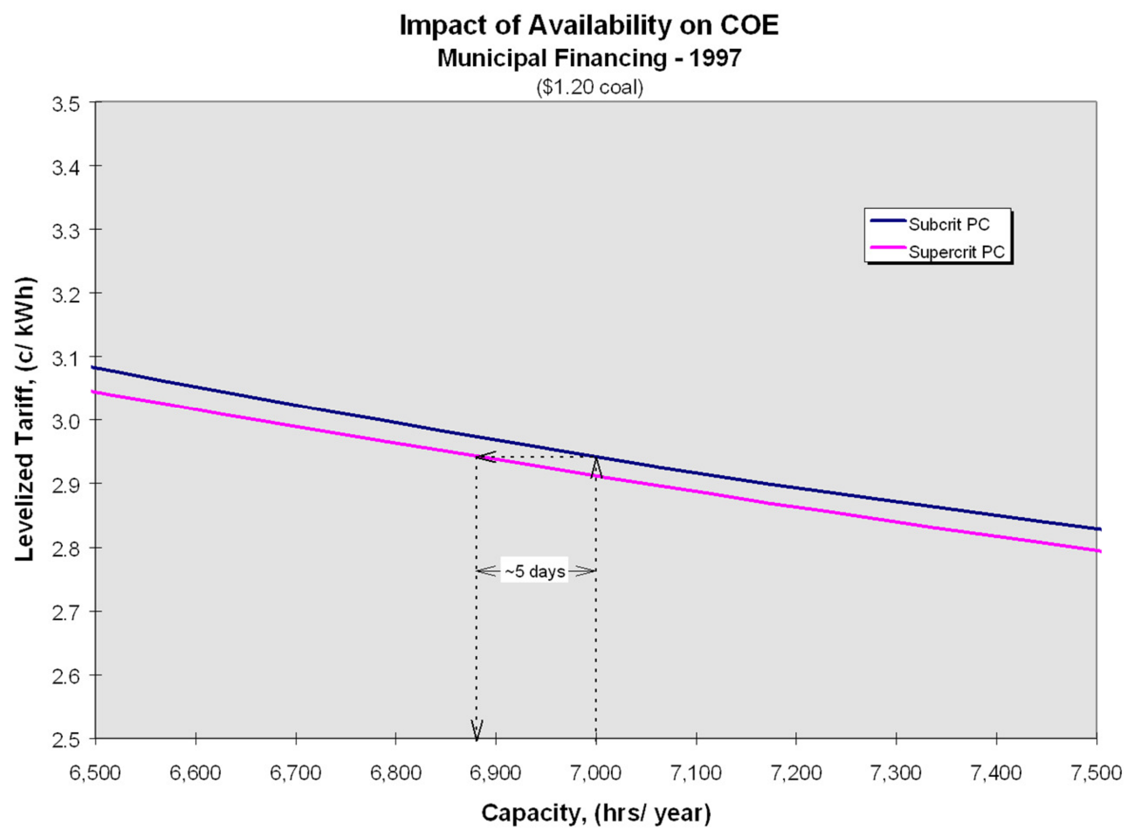
Baseline Economic Inputs – 2005 100 MW Class

	CFB	P200 PFBC	NGCC
Size (MW)	100	100	270
Capital Cost ($/ kW)	725	850	325
Heat Rate (Btu/ kWh)	9,350	8,530	6195
Availability (%)	80	80	80
Cycle Time (months)	18	22	18
Fixed O&M ($/ kW)	38.84	48.67	16.44
Variable O&M (mills/ kWh)	1.15	1.12	0.01

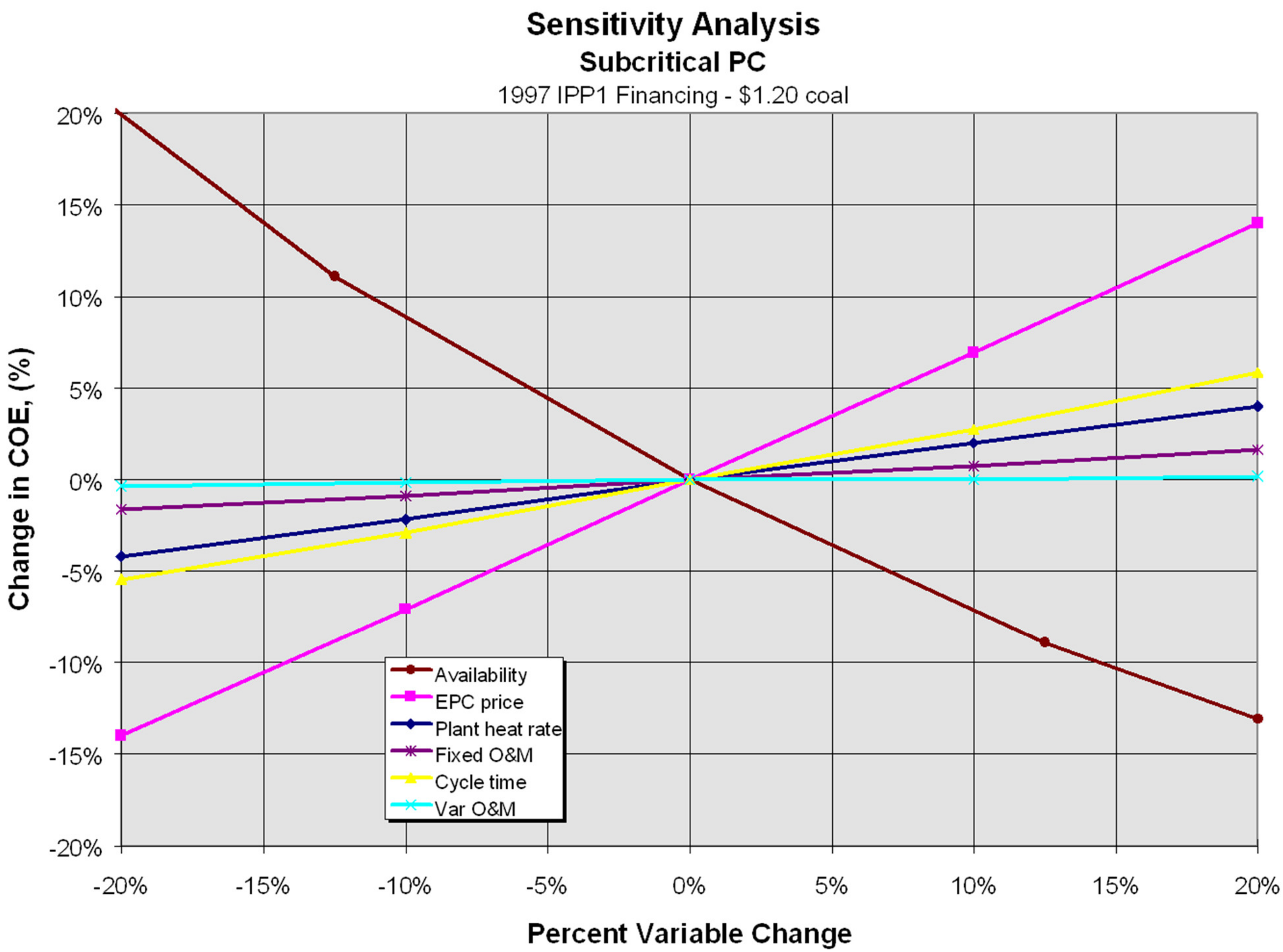
Financing Scenario Summary

Loan structure	Municipal	Utility	IPP 1	IPP 2	Industrial
Horizon (years)	40	30	15	15	10
Interest rate (%)	5.75	7.75	8.75	8.75	8.25
Loan term (years)	40	30	9	9	10
Depreciation (years)	40	30	15	15	10
Equity (%)	0	50	30	50	75
Debt (%)	100	50	70	50	25
ROE (%)	n/a	10	20	20	23
Taxes (%)	0	20	30	30	30

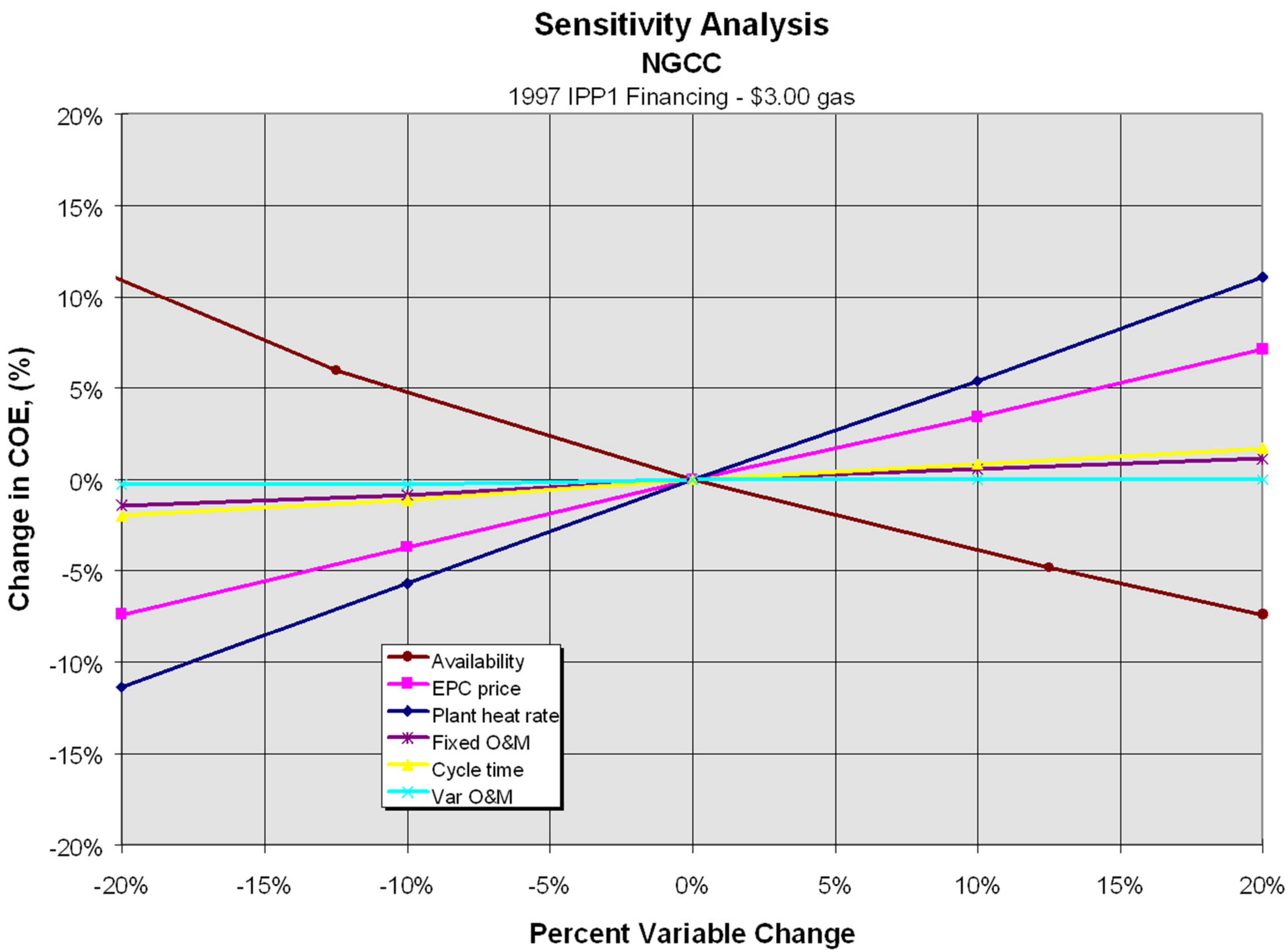

Comparison of Financing Scenarios
400 MW Subcritical PC Fired Plant
Levelized Tariff, c/ kWh
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Financial
Fixed O&M
Variable O&M
Fuel
Municipal
Utility
IPP-1
IPP-2
Industrial
Financing Arrangement



Impact of Availability on COE
Municipal Financing - 1997
($1.20 coal)
Levelized Tariff, (c/ kWh)
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
Subcrit PC
Supercrit PC
~5 days
6,500
6,600
6,700
6,800
6,900
7,000
7,100
7,200
7,300
7,400
7,500
Capacity, (hrs/ year)



Sensitivity Analysis
Subcritical PC
1997 IPP1 Financing - $1.20 coal
Change in COE, (%)
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-20%
-15%
-10%
-5%
0%
5%
10%
15%
20%
Percent Variable Change
Availability
EPC price
Plant heat rate
Fixed O&M
Cycle time
Var O&M


Sensitivity Analysis
NGCC
1997 IPP1 Financing - $3.00 gas
Change in COE, (%)
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-20%
-15%
-10%
-5%
0%
5%
10%
15%
20%
Percent Variable Change
Availability
EPC price
Plant heat rate
Fixed O&M
Cycle time
Var O&M

Economies of Scale

- The origins of economies of scale comes from the material cost to enclose a given volume.
- The surface area of the vessel increases as the square of the basic dimension.
- The volume of the vessel increases as the cube of the basic dimension.
- Therefore, the amount of material needed to enclose a given volume should increase by the 2/3 power of the basic dimension.

Economies of Scale

- Since the basic cost of a vessel is directly related to the amount of material needed, this gives rise to the cost scale up formula:

$$\frac{\text{Cost}(1)}{\text{Cost}(2)} = \left[\frac{\text{Size}(1)}{\text{Size}(2)}\right]^{0.7}$$

Economies of Scale

- For most process type equipment, the use of 0.7 for the exponent is reasonable. This would include scrubbers, precipitators, bag houses, tanks, pumps, etc.
- For boilers less than 800 kpph, the exponent is more like 0.8.
- For boilers between 800 kpph and 5,000 kpph, the exponent is closer to 0.85.
- For larger boilers the exponent approaches 0.9.

A Cogeneration Plant

- We have seen the utility industry move to natural gas combined cycle plants for new units.
- We have read that the EPC cost for a new NGCC plant of 540 Mw is $1000/Kw.
- The plant has 2 x 180 Mw gas turbines and a 180 Mw steam turbine.
- We don’t need 540 Mw at our facility.
- We want a 20 Mw gas turbine with an HRSG to provide steam to our plant.

A Cogeneration Facility

- The cost breakdown for the larger plant was given as:
  - One GT $ 45 million
  - One HRSG $ 13 million
  - BOP $ 40 million
  - Construction $ 250 million
  - "Soft Costs" $ 70 million

A Cogeneration Facility

- The basis for the gas turbine and the HRSG are 180 Mw each.
- The basis for the rest of the plant is 540 Mw.
- From this information, the scaling laws can be used to approximate a “one significant figure” estimate for the smaller plant.

A Cogeneration Facility

- The costs for the smaller plant would be:

– One 20 MW gas turbine	$ 9.7
– One HRSG	$ 2.2
– BOP	$ 6.5
– Construction	$ 40.4
– “Soft Costs”	$ 11.3
– Total	$ 70.1

A Cogeneration Facility

- This facility would be approximately the equivalent of a 40 Mw plant without the steam turbine.
- Thus, the $70 million project would come in at the rough equivalent of $1750/Kw.
- If the steam turbine system were included the costs would be closer to $2000/Kw.

A Cogeneration Facility

- Now estimate the cost of electricity from the two plants (ie the large utility plant with utility financing and the small cogen plant with industrial financing).
  - Utility (540 Mw) 5.9 cents/Kwhr
  - Cogen (40 Mw) 16.6 cents/Kwhr
- My electric bill in CT for last month was 16.2 cents/Kwhr.