3.3.3.1 RESULTS FOR H_2 AND SYNGAS PRODUCTION USING REVISED ENERGY SCENARIO

The results of H_2 and syngas price comparisons for product slate/plant sizes for the revised energy scenario are shown in Tables 3.35 through 3.39. Figures 3.11 through 3.16 illustrate the results for a Gulf Coast location. The revised scenario shows coal to be more competitive than the results of the original scenario.

1. With only one exception, coal is not competitive in year 1 of operation for any future plant start-up date regardless of plant size/slate and geographic region. The only exception is the production of 150 MM SCFD hydrogen in the Ohio Valley with start-up in year 2000.
2. The competitive position of coal depends more on product slate than plant size in 1982, but is more dependent on plant size for start-up years 1987 and 2000.
   a. Coal is least competitive with the H_2 slate for start-up in 1982, but is most competitive with the H_2 slate for 2000 start-up. The slate for which coal is most competitive for start-up in 1987 is region dependent.
   b. Coal is less competitive at 40 MM SCFD syngas than at 150 MM SCFD H_2 for plants with start-up in 1987 or 2000. In 1982, coal is more competitive at 40 MM SCFD syngas than at 150 MM SCFD H_2.
   c. The 1982 price premium for syngas from coal is about 50% averaged over regions at 40 MM SCFD and about 35% averaged over regions at 150 MM SCFD versus 70% for the hydrogen slate.
3. The high escalation rates of oil and natural gas as opposed to coal result in a steadily declining premium for coal based product (versus the least cost alternative). The average "year one" premium for coal for all product slates and plant sizes declines from 53% in 1982 to 9% in 2000.
4. Real annual escalation rates are significantly higher for natural gas and oil as compared to coal. The impact of the different escalation rates becomes significant in 1987

when the initial year prices difference coal and the least cost alternative is only about 20%. For example, for production of 150 MM SCFD H_2 in the Ohio Valley region, product from coal is the least cost alternative for the last half of the project life.

5. Lignite and bituminous coal types were compared for both product slates and plant sizes in the Gulf Coast region. Lignite results in about a 10% premium in product price compared with bituminous.
6. Year of start-up determines the least costly feedstock option, natural gas vs. oil. For all 1982 start-up, natural gas results in the lowest cost product. For 1987 start-up, oil is the least cost option with the exception of Gulf Coast and Ohio Valley location production of 150 MM SCFD hydrogen. For 2000 start-up, oil is the least cost alternative, again with the exception of Gulf Coast and Ohio Valley hydrogen production. The least cost option in the Gulf Coast for H_2 production is still natural gas, while that in the Ohio Valley is bituminous coal.

Table 3.35

ECONOMIC COMPARISONS FOR 150 MM SCFD SYNGAS
(Revised Energy Scenario)
($/MSCF)

Start-Up Year	1982			1987			2000		
Region	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*
Gulf Coast									
Natural Gas	$1.84	5.8%	--	$2.70	3.2%	--	$3.41	--	--
Oil	$2.06	1.9%	--	$2.30	1.1%	--	$2.62	--	--
Coal - Lignite	$2.71	0.8%	--	$2.90	0.1%	--	$3.07	--	--
Coal - Bituminous	$2.49	0.7%	35.3%	$2.64	0.1%	14.8%	$2.78	--	6.1%
Ohio Valley									
Natural Gas	$1.90	6.6%	--	$2.94	3.3%	--	$3.77	--	--
Oil	$2.11	2.1%	--	$2.41	1.1%	--	$2.75	--	--
Coal	$2.62	0.3%	37.9%	$2.70	0.1%	12.0%	$2.82	--	2.5%
Mid-Atlantic									
Natural Gas	$2.12	8.1%	--	$3.48	4.9%	--	$4.92	--	--
Oil	$2.16	1.9%	--	$2.43	1.1%	--	$2.78	--	--
Coal	$2.77	0.5%	30.7%	$2.88	0.1%	18.5%	$3.04	--	9.4%

*In year 1 of plant operation.

FIGURE 3.11

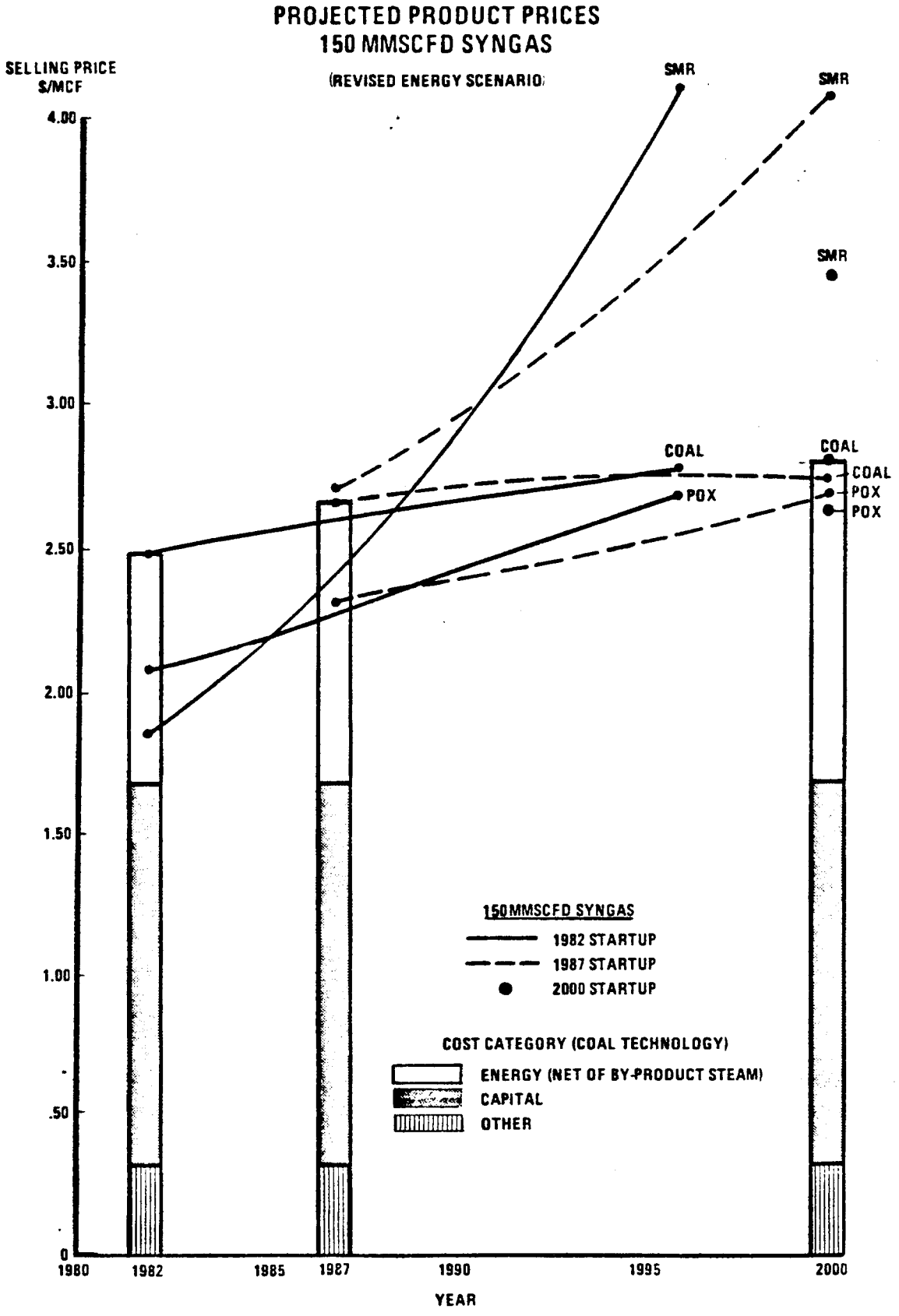

PROJECTED PRODUCT PRICES
150 MMSCFD SYNGAS
(REVISED ENERGY SCENARIO)
SELLING PRICE
$/MCF
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
0
SMR
SMR
SMR
COAL
COAL
COAL
POX
POX
POX
150 MMSCFD SYNGAS
1982 STARTUP
1987 STARTUP
2000 STARTUP
COST CATEGORY (COAL TECHNOLOGY)
ENERGY (NET OF BY-PRODUCT STEAM)
CAPITAL
OTHER
1980
1982
1985
1987
1990
1995
2000
YEAR

FIGURE 3.12

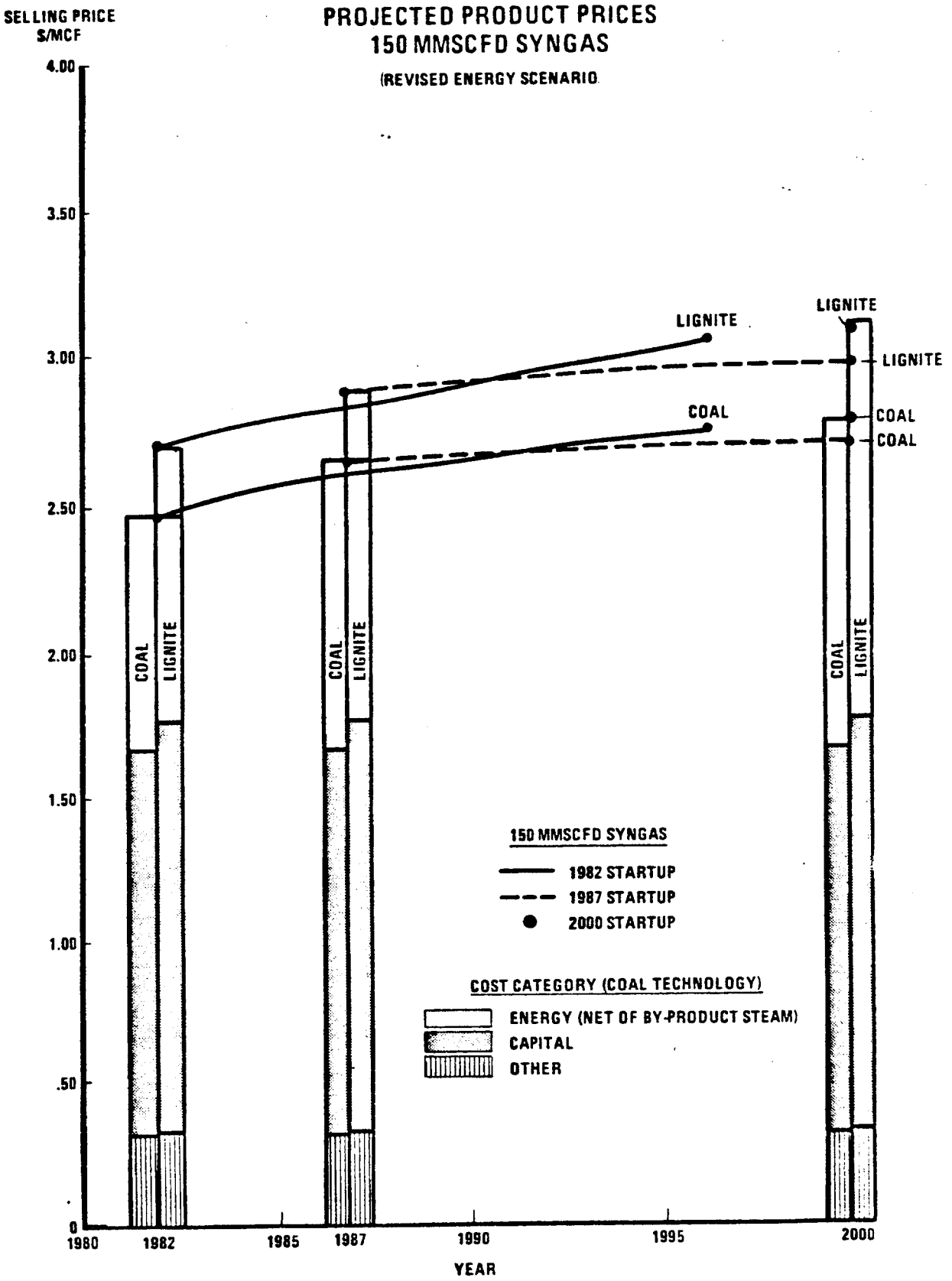


Table 3.36

ECONOMIC COMPARISONS FOR 150 MM SCFD H_2
(Revised Energy Scenario)
($/MSCF)

Start-Up Year	1982			1987			2000		
Region	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*
Gulf Coast									
Natural Gas	$1.50	6.2%	--	$2.22	3.4%	--	$2.80	--	--
Oil	$2.30	2.0%	--	$2.57	1.1%	--	$2.92	--	--
Coal - Lignite	$2.92	0.9%	--	$3.14	0.2%	--	$3.33	--	--
Coal - Bituminous	$2.64	0.8%	76.0%	$2.81	0.2%	26.6%	$2.97	--	6.1%
Ohio Valley									
Natural Gas	$1.61	6.3%	--	$2.44	3.3%	--	$3.13	--	--
Oil	$2.39	2.1%	--	$2.70	1.0%	--	$3.07	--	--
Coal	$2.79	0.4%	73.3%	$2.89	0.0%	18.4%	$3.02	--	(1.7%)
Mid-Atlantic									
Natural Gas	$1.80	7.8%	--	$2.90	4.8%	--	$4.07	--	--
Oil	$2.45	1.9%	--	$2.74	1.0%	--	$3.12	--	--
Coal	$2.96	0.5%	64.4%	$3.08	0.1%	12.4%	$3.25	--	4.2%

*In year 1 of plant operation.

FIGURE 3.13

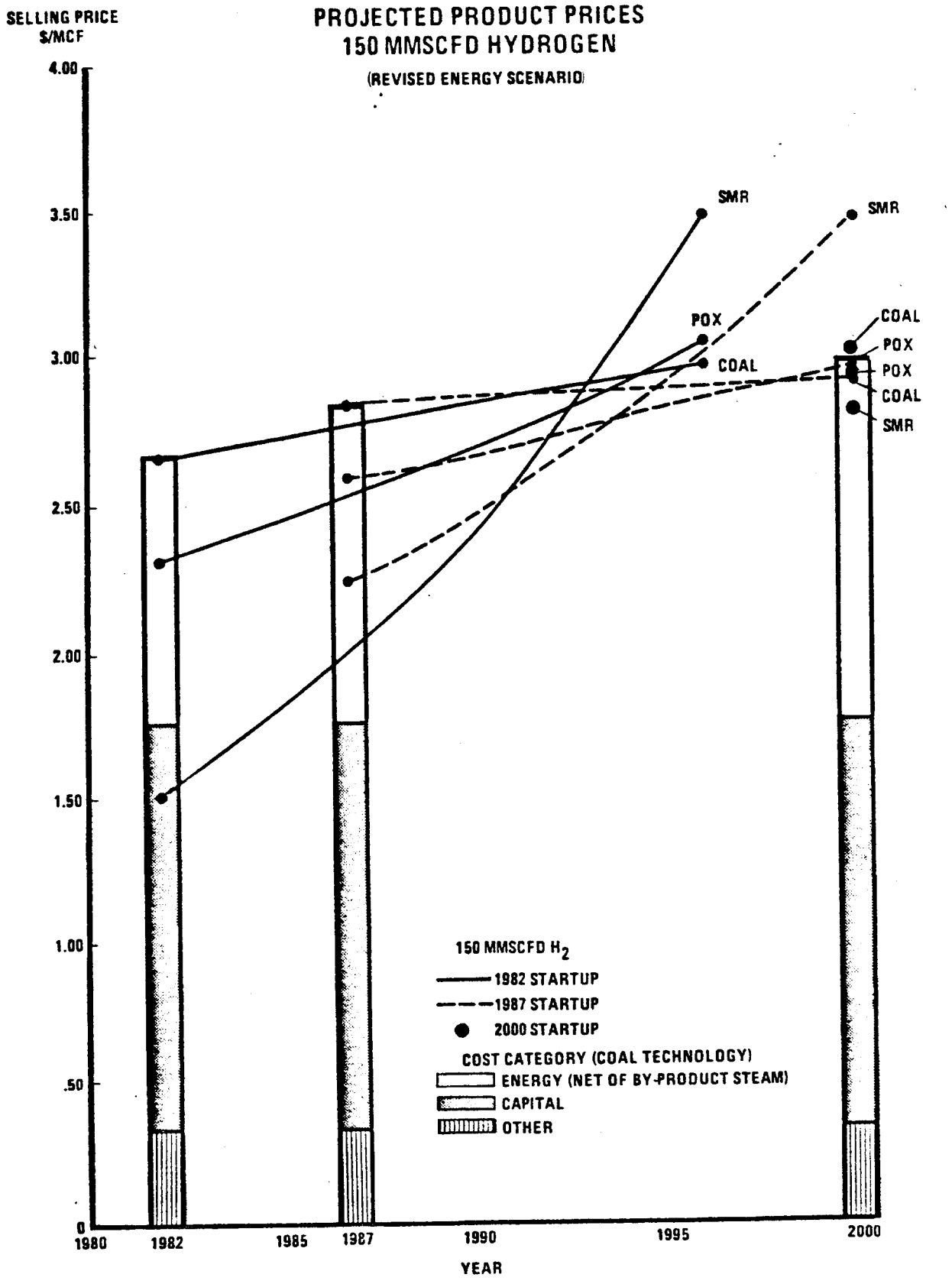

PROJECTED PRODUCT PRICES
150 MMSCFD HYDROGEN
(REVISED ENERGY SCENARIO)
SELLING PRICE
$/MCF
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
0
SMR
SMR
POX
COAL
COAL
POX
POX
COAL
SMR
150 MMSCFD H_2
1982 STARTUP
1987 STARTUP
2000 STARTUP
COST CATEGORY (COAL TECHNOLOGY)
ENERGY (NET OF BY-PRODUCT STEAM)
CAPITAL
OTHER
1980
1982
1985
1987
1990
1995
2000
YEAR

FIGURE 3.14

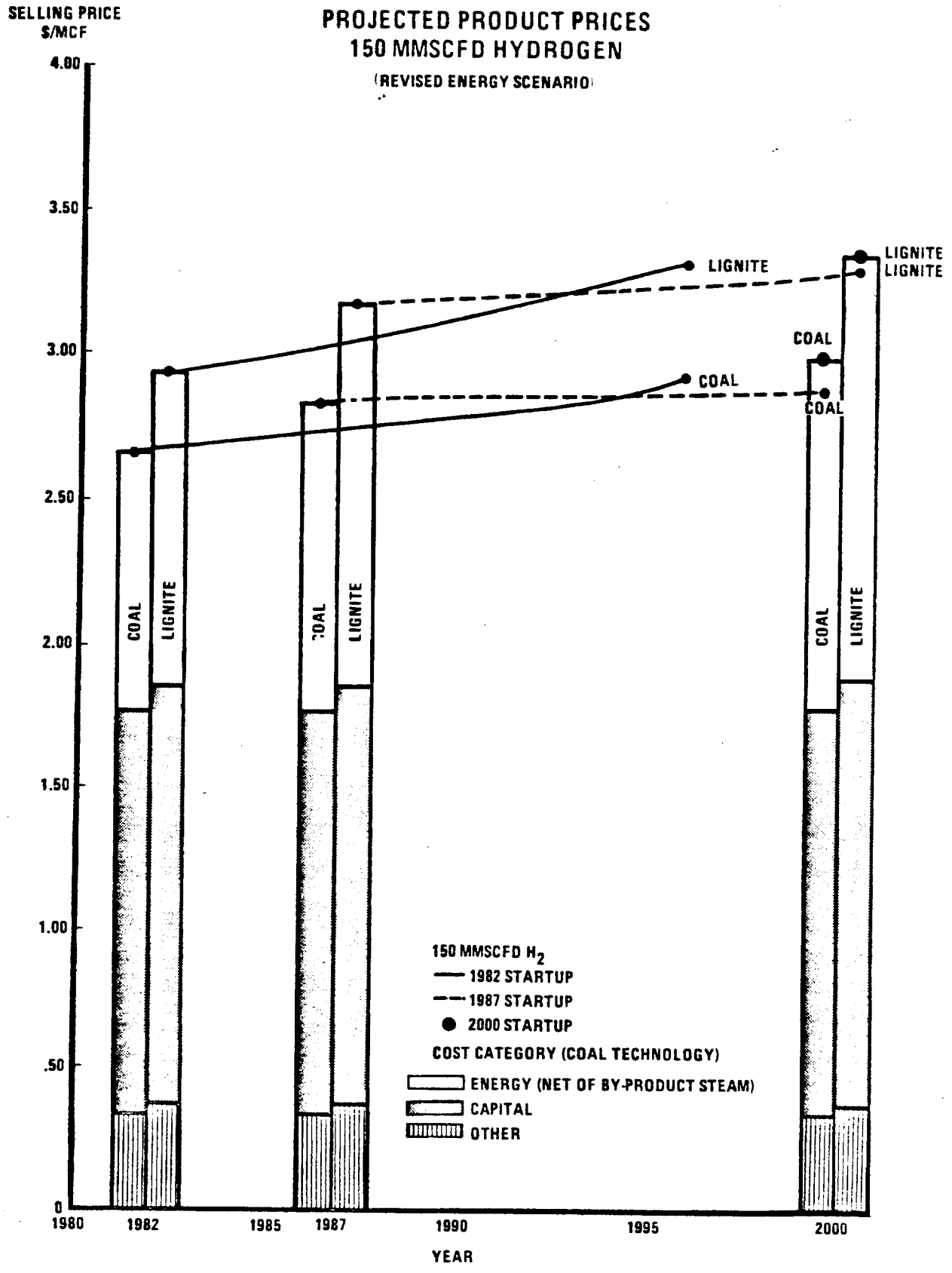

PROJECTED PRODUCT PRICES
150 MMSCFD HYDROGEN
(REVISED ENERGY SCENARIO)
SELLING PRICE
$/MCF
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
0
LIGNITE
LIGNITE
LIGNITE
COAL
COAL
COAL
COAL
LIGNITE
COAL
LIGNITE
COAL
LIGNITE
150 MMSCFD H_2
1982 STARTUP
1987 STARTUP
2000 STARTUP
COST CATEGORY (COAL TECHNOLOGY)
ENERGY (NET OF BY-PRODUCT STEAM)
CAPITAL
OTHER
1980
1982
1985
1987
1990
1995
2000
YEAR

Table 3.37

ECONOMIC COMPARISONS FOR 40 MM SCFD SYNGAS
(Revised Energy Scenario)
($/MSCF)

Start-Up Year	1982			1987			2000		
Region	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*	Initial Price	Annual Escal.	Coal Premium*
Gulf Coast									
Natural Gas	$2.20	5.6%	--	$3.12	3.3%	--	$3.87	--	--
Oil	$2.51	2.1%	--	$2.76	1.4%	--	$3.09	--	--
Coal - Lignite	$3.75	0.5%	--	$3.94	0.0%	--	$4.11	--	--
Coal - Bituminous	$3.45	0.4%	56.8%	$3.59	0.0%	30.1%	$3.74	--	21.0%
Ohio Valley									
Natural Gas	$2.29	6.2%	--	$3.37	3.4%	--	$4.23	--	--
Oil	$2.67	1.7%	--	$2.97	0.9%	--	$3.32	--	--
Coal	$3.61	0.1%	57.6%	$3.70	0.0%	24.6%	$3.82	--	15.1%
Mid-Atlantic									
Natural Gas	$2.56	7.3%	--	$3.97	4.7%	--	$5.46	--	--
Oil	$2.69	1.7%	--	$2.97	0.9%	--	$3.33	--	--
Coal	$3.73	0.2%	45.7%	$3.83	0.0%	29.0%	$3.99	--	19.8%

*In year 1 of plant operation.

FIGURE 3.15

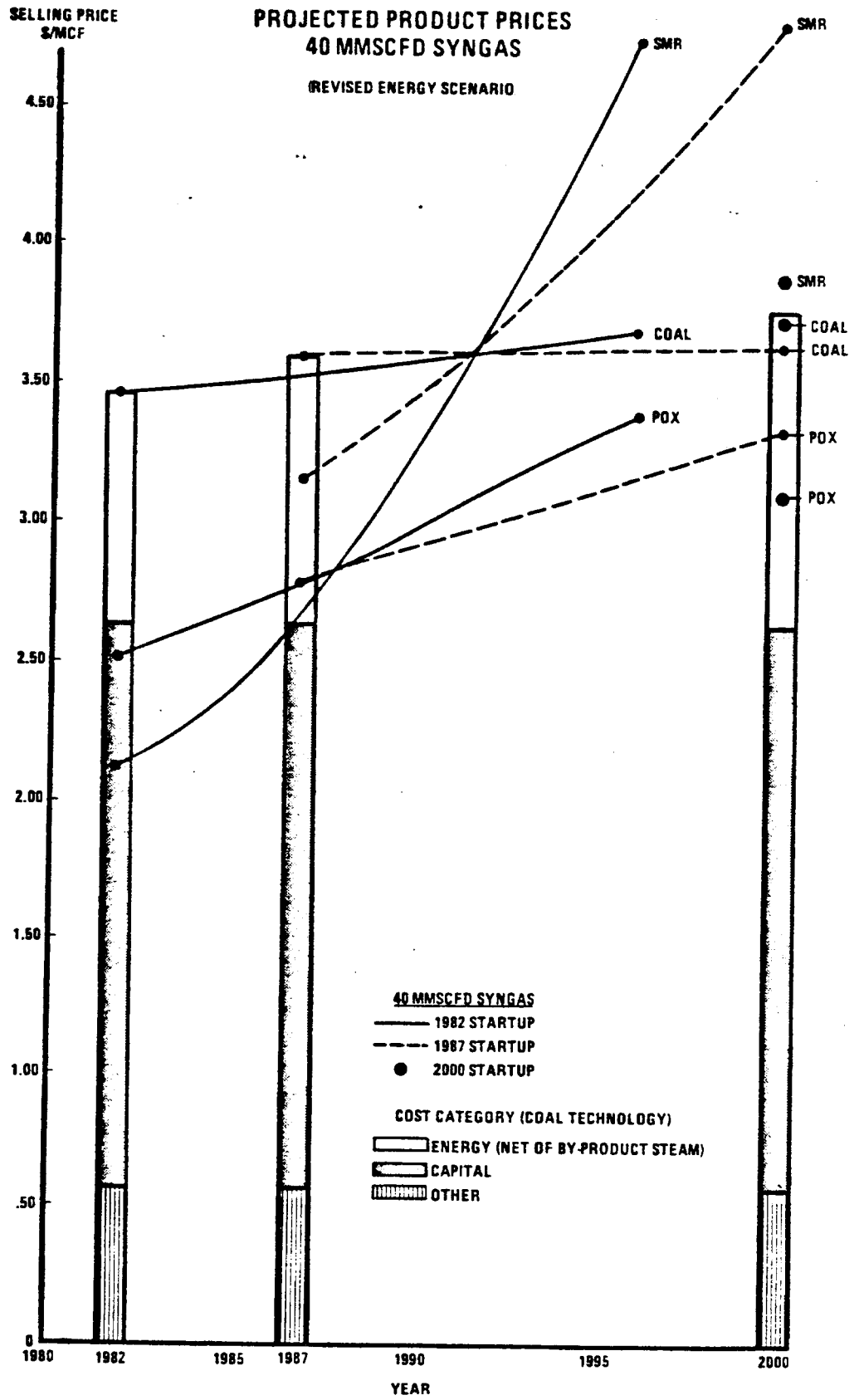
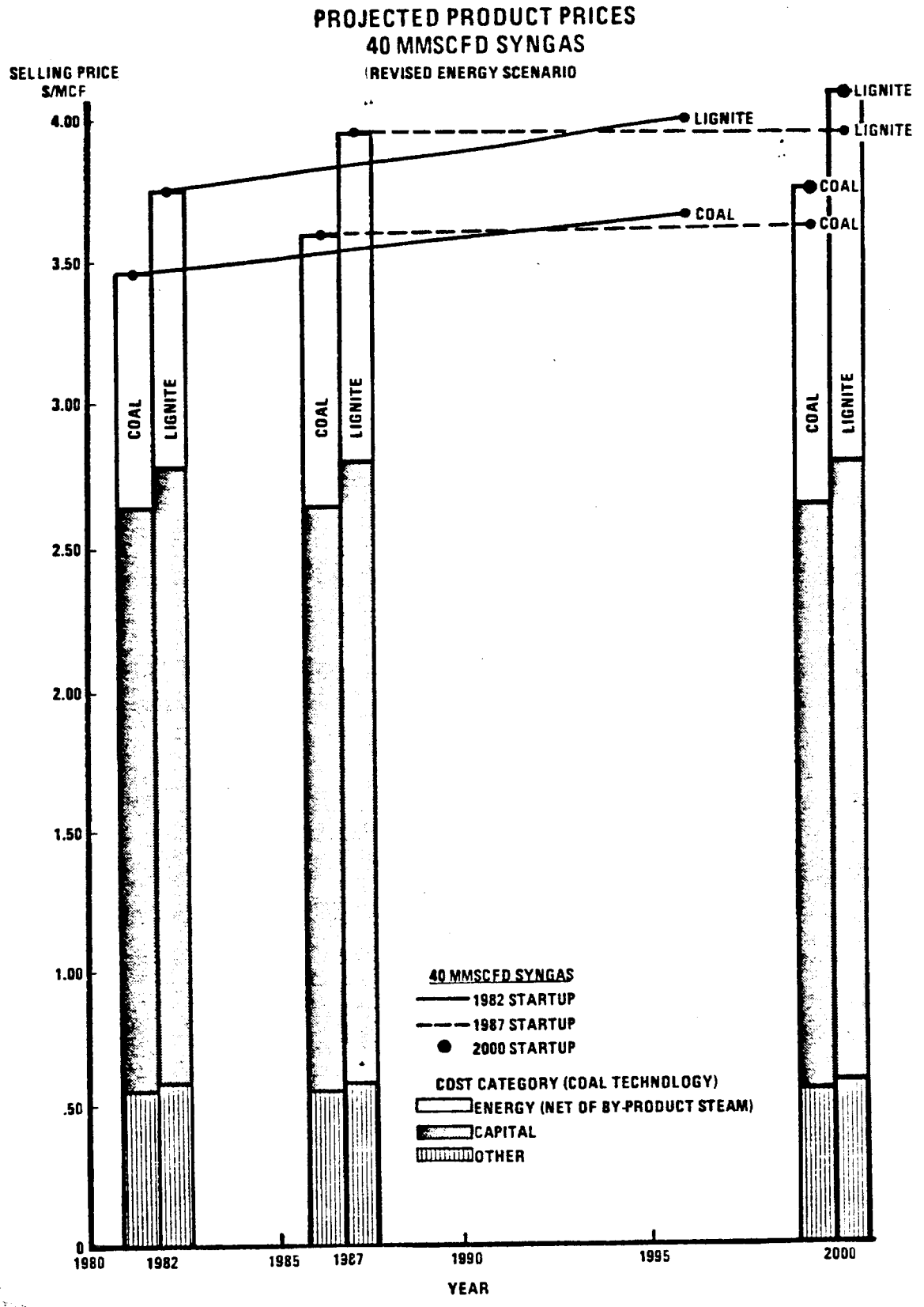

PROJECTED PRODUCT PRICES
40 MMSCFD SYNGAS
(REVISED ENERGY SCENARIO
SELLING PRICE
$/MCF
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.50
0
SMR
SMR
SMR
COAL
COAL
COAL
POX
POX
POX
40 MMSCFD SYNGAS
1982 STARTUP
1987 STARTUP
2000 STARTUP
COST CATEGORY (COAL TECHNOLOGY)
ENERGY (NET OF BY-PRODUCT STEAM)
CAPITAL
OTHER
1980
1982
1985
1987
1990
1995
2000
YEAR

FIGURE 3.16



3.3.3.2 PRESSURIZED VS. ATMOSPHERIC COAL GASIFICATION

The advantage of pressurized versus atmospheric gasification for the production of syngas was found to be practically identical under the revised energy scenario as compared to the original scenario. Results are shown in Table 3.38. The price advantages of the 40 MM SCFD size is 13.9% for both 1982 and 1987 start-ups. At 150 MM SCFD, the price advantage is 14.5% for 1982 start-up and 14.8% for 1987 start-up.

3.3.3.3 EVALUATION OF CO-PRODUCING FUEL AND SYNGAS

Under the revised energy scenario, the disadvantage of fuel gas from coal has been greatly reduced as shown in Table 3.39. However, medium Btu fuel gas from coal still requires a 25% premium over the least cost clean fuel in 1987.

Table 3.38

COMPARISON OF ATMOSPHERIC AND PRESSURIZED COAL GASIFICATION FOR SYNGAS PRODUCTION

40 MM SCFD Syngas
(Gulf Coast Location)

	1982			1987		
	Initial Price	Annual Escalation	Pressurized Advantage*	Initial Price	Annual Escalation	Pressurized Advantage*
Atmospheric	$3.45	0.4%	--	$3.59	0.0%	--
Pressurized	$2.97	0.4%	13.9%	$3.09	0.1%	13.9%

150 MM SCFD Syngas
(Gulf Coast Location)

	1982			1987		
	Initial Price	Annual Escalation	Pressurized Advantage*	Initial Price	Annual Escalation	Pressurized Advantage*
Atmospheric	$2.49	0.7%	--	$2.64	0.1%	--
Pressurized	$2.13	0.7%	14.5%	$2.25	0.1%	14.8%

*In year 1 of plant operation.

Table 3.39

EVALUATION OF FUEL GAS PRICES CO-PRODUCED WITH SYNGAS

150 MM SCFD "Medium Btu" Fuel Gas
(50 MM SCFD Natural Gas Equivalent)
Dollars per MM Btu

	1982		1987	
	Price	Disadvantage of Medium Btu Fuel Gas*	Price	Disadvantage of Medium Btu Fuel Gas*
Medium Btu Fuel Gas	$5.01	--	$5.37	--
Natural Gas	$2.50	$2.51	$4.30	$1.07
Fuel Oil	$4.21	$0.80	$4.92	$0.45

*In year 1 of plant operation.

4.0 TASK II ANALYSIS OF TECHNICAL/NON-TECHNICAL PROBLEM AREAS

4.1 ANALYSIS OF POTENTIAL R & D IMPACT

4.1.1 ANALYSIS OF POTENTIAL R & D IMPACT UNDER ORIGINAL ENERGY SCENARIO

The potential impact of research and development on the competitive position of coal gasification has been analyzed. The objective of this task is to assess the degree of cost improvement required in these areas in order to make gasification of coal viable without legislative incentives. For this analysis, it has been assumed that the results of research and development can take two forms: improvements in capital cost or improvements in operating cost. For this analysis, operating cost improvements were assumed to entail a reduction in energy-based inputs only, i.e., an improvement in the overall efficiency of the process. Results of R&D effort were estimated by performing product cost sensitivity calculations for capital cost improvements of 10%, 20% and 30%, and operating cost improvements of 10% and 20%. Also, the potential of combined improvement in capital and operating costs was assessed. The calculations were done for a syngas product slate of 40 MM SCFD and 150 MM SCFD using atmospheric gasification of bituminous coal at a Gulf Coast location. Results are shown in Tables 4.1 through 4.4.

Table 4.1 and Table 4.2 illustrate the results for production of 40 MM SCFD of syngas. Given no captial or operating cost improvements, the most economic alternative for a plant with start-up in 1982, 1987 or 2000 is partial oxidation of oil (POX), followed by steam-methane reforming (SMR). A capital cost improvement of 10% does little to enhance the year 1 competitive position of coal gasification. With a capital cost improvement of 20%, coal gasification is more economical than SMR for a plant starting up in year 2000, but is still not competitive with POX. With a 20% capital cost improvement, a coal gasification plant starting up in 1987 would not produce a lower cost product than a similar SMR plant until 1991. If a 30% capital cost improvement were achieved, a coal gasification plant starting up in 1987 would produce less costly product after 1994 than a SMR plant with 1987 start-up. Product cost in year 15 would be $3.44 from reforming as opposed

to $3.14 from coal. Even with this improvement, gasification would still not be competitive in the year of start-up with SMR in 1982 or POX in 1982 or 1987. However, coal gasification would be the least cost alternative for a plant starting up in year 2000 given this assumption.

As shown in Table 4.2, operating cost improvements of up to 20% do not change the competitive ranking of coal gasification for any year of start-up.

Table 4.1

PROJECTED IMPACT OF POTENTIAL R&D IMPROVEMENT ON PRODUCT PRICE AT 40 MM SCFD SYNGAS
Gulf Coast

Year of Start-Up	1982		1987		2000	
	Price	Esc.	Price	Esc.	Price	Esc.
Steam-Methane Reforming	$2.28	2.4%	$2.61	2.0%	$3.61	--
Partial Oxidation of Oil	$2.29	1.5%	$2.50	1.4%	$3.33	--
Coal Gasification						
Base Case	$3.48	0.6%	$3.67	0.2%	$3.94	--
Capital Cost Improvement						
- 10%	$3.24	0.7%	$3.43	0.3%	$3.71	--
- 20%	$3.01	0.7%	$3.20	0.3%	$3.47	--
- 30%	$2.77	0.9%	$2.96	0.4%	$3.24	--
Operating Cost Improvement						
- 10%	$3.39	0.5%	$3.56	0.2%	$3.81	--
- 20%	$3.30	0.5%	$3.46	0.1%	$3.68	--
"Best" Case (-30%/-20%)	$2.59	0.7%	$2.75	0.2%	$2.97	--

Table 4.2

YEAR OF PRODUCTION IN WHICH 40 MM SCFD SYNGAS VIA COAL GASIFICATION IS LESS COSTLY THAN ALTERNATIVES*

Year of Start-Up	1982		1987		2000	
	SMR	POX	SMR	POX	SMR	POX
Base Case	--	--	--	--	--	--
Capital Cost Improvement						
- 10%	--	--	--	--	--	--
- 20%	--	--	14	--	1	--
- 30%	15	--	8	--	1	1
Operating Cost Improvement						
- 10%	--	--	--	--	--	--
- 20%	--	--	--	--	--	--
"Best Case" (-30%/-20%)	8	--	4	10	1	1

*Given 15 year production life.

A 30% improvement in capital cost and a 20% operating cost improvement were selected for product cost comparisons resulting from coal gasification R & D. For a 40 MM SCFD plant, this resulted in a less costly product than either SMR or POX for a plant starting up in 2000. For a 1987 start-up, syngas from coal was less costly than SMR beginning in 1990 and less costly than POX beginning 1996. For start-up in 1982, coal gasification produces less costly product than SMR beginning in 1990, but cannot produce syngas competitive with POX throughout the 15 year production life of the plant.

Potential R & D impact on the larger scale plant (150 MM SCFD) is shown in Tables 4.3 and 4.4. As can be seen, large improvements are necessary for coal gasification to achieve a competitive position in year 1 product pricing. With no capital or operating cost improvements, a coal plant starting up in 2000 is more economical than SMR, but more expensive than POX.

A 10% capital cost improvement makes coal gasification somewhat more competitive with SMR, but provides for little improvement with relation to POX. A coal plant starting up in 2000 is more economic than a SMR plant in the year of start-up, and a 1987 start-up coal plant produces less costly product than SMR beginning in 1998.

With a capital cost improvement of 20%, a coal plant starting up in 1987 produces less costly syngas than SMR beginning 1994, but still is significantly more costly than the least cost alternative, POX.

Table 4.3

PROJECTED IMPACT OF POTENTIAL R&D IMPROVEMENT ON PRODUCT PRICE AT 150 MM SCFD SYNGAS

Gulf Coast

Year of Start-Up	1982		1987		2000	
	Price	Esc.	Price	Esc.	Price	Esc.
Steam-Methane Reforming	$1.86	2.5%	$2.15	2.1%	$3.06	--
Partial Oxidation of Oil	$1.77	1.8%	$1.96	1.7%	$2.68	--
Coal Gasification						
Base Case	$2.53	1.0%	$2.72	0.4%	$2.99	--
Capital Cost Improvement						
- 10%	$2.37	1.1%	$2.57	0.4%	$2.84	--
- 20%	$2.22	1.2%	$2.41	0.5%	$2.69	--
- 30%	$2.06	1.4%	$2.26	0.6%	$2.53	--
Operating Cost Improvement						
- 10%	$2.44	0.9%	$2.61	0.4%	$2.86	--
- 20%	$2.35	0.8%	$2.51	0.3%	$2.72	--
"Best" Case (-30%/-20%)	$1.89	1.1%	$2.04	0.5%	$2.26	--

Table 4.4

YEAR OF PRODUCTION IN WHICH 150 MM SCFD SYNGAS VIA COAL GASIFICATION IS LESS COSTLY THAN ALTERNATIVES

Year of Start-Up	1982		1987		2000	
	SMR	POX	SMR	POX	SMR	POX
Base Case	--	--	--	--	1	--
Capital Cost Improvement						
- 10%	--	--	12	--	1	--
- 20%	--	--	8	--	1	--
- 30%	9	--	5	15	1	1
Operating Cost Improvement						
- 10%	--	--	13	--	1	--
- 20%	15	--	10	--	1	--
"Best Case"	8	11	1	5	1	1

A 30% capital cost improvement, however, shows coal gasification to be the least cost alternative for 2000 start-up. In addition, syngas from a 1987 start-up plant will be less costly than that from SMR beginning in year 1991, and less costly than POX in the final year of the 15 year production life. Syngas from a coal plant with 30% capital cost improvement starting up in 1982 will be less costly than SMR beginning in year 1990.

As with the smaller scale plant, operating cost improvements do little to enhance the competitive position of coal gasification with respect to POX. For a plant starting up in 1987, coal gasification produces less costly product than SMR beginning in 1999 given a 10% operating cost improvement, and beginning in 1996 given a 20% operating cost improvement.

Assumed R & D effort resulting in 30% capital and 20% operating cost improvements results in coal gasification being the least cost alternative for production of 150 MM SCFD syngas for a plant with year 2000 start-up. For 1987 start-up, coal gasification is clearly the choice over SMR, and produces less costly syngas than POX beginning in year 1991. For a plant starting up in 1982, syngas from coal gasification is competitive with SMR with 1989, and less than POX in 1992.

From the results discussed above based on the initial JPL Energy Scenario, it appears a massive and very successful R & D program would be required to make coal gasification competitive with the least cost alternative before 2000 without external incentives.

4.1.2 ANALYSIS OF POTENTIAL R&D IMPACT UNDER REVISED ENERGY SCENARIO

Under the revised energy scenario, the effect of potential R&D on the competitive position of coal gasification was examined. As expected, results show coal gasification to be more competitive in year 1 under the revised scenario than the original energy scenario. The cost of syngas from both a 40 MM SCFD and a 150 MM SCFD atmospheric gasification facility as compared to alternatives are shown in Tables 4.5 through 4.8.

The effects of R&D effort through decreases in capital and operating costs on production of 40 MM SCFD syngas via coal are shown in Table 4.5. Given no cost improvements in coal gasification, the most economic alternative is steam-methane reforming (SMR) for start-up in 1982, and partial oxidation of oil (POX) for 1987 and 2000 start-up. With a capital cost improvement of 10%, coal gasification is less costly than SMR for 2000 and produces less costly product than SMR in years 10 and 6 for plants starting up in years 1982 and 1987, respectively, but is not competitive with the least cost alternative, POX.

A 20% capital cost improvement results in coal gasification being competitive with SMR for 1987 start-up and years 8-15 of a plant starting up in 1982. With this level of capital cost improvement, coal gasification produces less expensive syngas than POX beginning in year 10 for a 1982 start-up, and 12 for 1987 start-up. An improvement of 30% results in coal gasification being the lowest cost alternative for 2000 start-up, and better than SMR in 1987. However, POX is still the lower cost method of production for the first four years of production for a plant starting up in 1987. For a 1982 start-up, coal gasification is more economical than SMR beginning in year 6, and POX beginning in year 7.

As shown in Table 4.6, an operating cost improvement of up to 20% does little to enhance the competitive position of coal gasification over POX. However, such an improvement results in coal gasification product costs in the year of start-up being lower than SMR in 2000, and producing less costly product in years 9 and 3 for plants with 1982 and 1987 start-up, respectively.

To generate competitive product prices, a "best case" (30% capital cost improvement and 20% operating cost improvement) was examined. The results show coal gasification to have the lowest cost in the year of start-up for 1987 and 2000, and to produce competitively priced product in 1982.

Similar results were obtained for the larger scale plant (150 MM SCFD syngas), with improvement in the competitive position of coal gasification manifesting itself with less capital and operating cost improvement. The base case shows SMR as having the lowest cost in year of start-up for 1982 and POX as least expensive for 1987 and 2000 start-up. A 20% capital cost improvement results in coal gasification having the lowest cost for start-up in 2000, and becoming very competitive for 1987, producing least costly syngas by the third project year. A 30% capital cost improvement results in coal gasification producing least costly syngas in the fourth year of a project with 1982 start-up, and overall least cost product for 1987 and 2000 start-up. An operating cost improvement of 20% results in coal gasification producing syngas at lowest cost in year 7 of 1987 start-up plants, and lowest cost for 2000 start-up.

The achievement of "best case" cost improvements would result in coal gasification as the most economic alternative for any start-up year; 1982, 1987, and 2000. In summary, and assuming no new incentives, results for the large scale plant reveal that for coal gasification to be most economic in year 2000, a 20% capital cost improvement, 20% operating cost improvement or combination of 10% capital and 10% operating cost improvement must be achieved. For coal gasification to be most economic in 1987, a 30% capital cost improvement or 20% capital and 10% operating cost improvement must be attained. Finally, for coal gasification to result in least costly product in 1982, the best case of 30% capital and 20% operating cost improvement is required. Clearly, a significant capital and operating cost improvements will be needed to permit coal gasification to become a more competitive alternative, under the revised energy scenario and assuming no other new incentives.

Table 4.5

PROJECTED IMPACT OF POTENTIAL R&D IMPROVEMENT ON PRODUCT PRICE AT 40 MM SCFD Syngas

(Revised Energy Scenario)

Year of Start-up	1982		1987		2000	
	Price	Esc.	Price	Esc.	Price	Esc.
Steam-Methane Reforming	$2.20	4.5%	$3.12	3.3%	$3.87	--
Partial Oxidation of Oil	$2.51	2.1%	$2.76	1.4%	$3.09	--
Coal Gasification Base Case	$3.45	0.4%	$3.59	0.0%	$3.74	--
Capital Cost Improvement						
-10%	$3.21	0.4%	$3.36	0.0%	$3.50	--
-20%	$2.97	0.6%	$3.12	0.0%	$3.26	--
-30%	$2.74	0.6%	$2.88	0.0%	$3.03	--
Operating Cost Improvement						
-10%	$3.36	0.3%	$3.49	0.0%	$3.62	--
-20%	$3.28	0.3%	$3.39	0.0%	$3.51	--
"Best" Case (-30%/-20%)	$2.57	0.5%	$2.69	0.1%	$2.80	--

Table 4.6

YEAR OF PRODUCTION IN WHICH 40 MM SCFD SYNGAS VIA COAL GASIFICATION IS LESS COSTLY THAN ALTERNATIVES*

Year of Start-up	1982		1987		2000	
	SMR	POX	SMR	POX	SMR	POX
Base Case	10	--	6	--	1	--
Capital Cost Improvement						
-10%	9	--	4	15	1	--
-20%	8	12	1	10	1	--
-30%	6	7	1	5	1	1
Operating Cost Improvement						
-10%	10	--	5	--	1	--
-20%	9	--	3	15	1	--
Best "Case" (-30%/-20%)	5	3	1	1	1	1

*Given 15 year Project Life

Table 4.7

PROJECTED IMPACT OF POTENTIAL R&D IMPROVEMENT ON PRODUCT PRICE AT 150 MM SCFD Syngas

Gulf Coast

Year of Start-Up	1982		1987		2000	
	Price	Esc.	Price	Esc.	Price	Esc.
Steam-Methane Reforming	$1.84	5.8%	$2.70	3.2%	$3.41	--
Partial Oxidation of Oil	$2.06	1.9%	$2.30	1.1%	$2.62	--
Coal Gasification Base Case	$2.49	0.7%	$2.64	0.1%	$2.78	--
Capital Cost Improvement						
-10%	$2.34	0.8%	$2.49	0.2%	$2.63	--
-20%	$2.19	0.9%	$2.33	0.2%	$2.48	--
-30%	$2.03	0.9%	$2.18	0.2%	$2.32	--
Operating Cost Improvement						
-10%	$2.41	0.6%	$2.54	0.0%	$2.67	--
-20%	$2.32	0.6%	$2.44	0.0%	$2.56	--
"Best" Case (-30%/-20%)	$1.86	0.8%	$1.98	0.1%	$2.09	--

Table 4.8

YEAR OF PRODUCTION IN WHICH 150 MM SCFD SYNGAS VIA COAL GASIFICATION IS LESS COSTLY THAN ALTERNATIVES*

Year of Start-Up	1982		1987		2000	
	SMR	POX	SMR	POX	SMR	POX
Base Case	8	--	1	15	1	--
Capital Cost Improvement						
-10%	6	14	1	9	1	--
-20%	5	7	1	3	1	1
-30%	4	1	1	1	1	1
Operating Cost Improvement						
-10%	7	14	1	11	1	--
-20%	6	11	1	7	1	1
"Best Cast" (-30%/-20%)	2	1	1	1	1	1

*Given 15 year Project Life