THE PRODUCTION AND MARKET OUTLOOK FOR METHANOL IN THE 80'S AND 90'S

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by

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Introduction

We are here to talk about the methanol market outlook. Such talks generally deal with all sorts of market projections, looking only at market factors. This paper is different. Market is not unrelated to supply when you deal with a basic fungible commodity chemical that can double as a fuel. Fuel markets are very heavily price oriented. Fuel prices, in turn, are heavily influenced by supply-demand balance.

My basic thesis today is that the methanol market situation has gotten out of hand and that we are in for a long period of chaos unless a lot of valuable plants shut down. Out of that chaos may come a significant fuel market for methanol, and it may not. If it does, it will be created by private investment risk. It will not be created by government support as was transparently the case of the fuel ethanol market which was forced by subsidy, not by economics alone. The question as to whether government should similarly force the methanol market in motor fuel is a good one, but it is not the subject of this paper.

Background

In the euphoria over methanol as a fuel that was engendered by the synthetic and alternate fuel movement of the 70's, a lot of us forgot that new fuel markets must be supply driven which happens

when prices are forced down by oversupply. We also forgot that the market projections based on the undeveloped uses are not always a sound basis for creating a new supply.

The trouble started with cheap gas well before the 1973 oil embargo. In 1971-72 a project was seriously under consideration for Saudi Arabia by U. S. investors that was suppose to deliver methanol to the U. S. East Coast for 7.5¢/gal., the btu equivalent of natural gas at $1.15/MCF at the pipeline outlet. At the time there was a great debate over whether LNG or methanol represented the best way to deliver remote gas to markets. After 1973 everyone got on the coal to methanol kick and early methanol cost estimates (mid-70's) were in the range of 25-50¢/gal. at the plant and this range disregards the ridiculously low estimates of which there were many. The idea of methanol from cheap remote gas was put on the back burner, but not forgotten. Meanwhile the coal to methanol movement (along with methanol from garbage, wood, peat and, no doubt, even cow manure) gained strength and support. Finally nearly everyone in and out of government agreed that fuel methanol was really an answer whose time had come.

In all this sound and fury, almost no one had bothered to look at what methanol from coal would really cost. An exception was a privately financed joint study completed in early 1975 based on the Texaco gasifier and two 2580 ton/day methanol loops. This 5160 ton/day plant was to be built in Pennsylvania and was estimated to cost $462 $\overline{M}$ on an early 1975 cost basis which amounts to a fixed capital investment of:

$0.90/annual gallon
$26,000/daily bbl. of crude oil equivalent

If we had ignored working capital and taken a utility capital charge factor of 20% and $1/$\overline{M}$ btu for coal delivered, we would have found a required methanol selling price *on an instant plant basis* of roughly

45¢/gal. ± 10%. Methanol from the U.S. natural gas was then selling for 36¢ to 40¢/gal.; list and spot prices were the same. The coal to methanol project was dropped as a source of chemical methanol and very obviously dropped as a fuel source as natural gas was being delivered to the East for about $2-2.5/M btu, although expansion of supply was in serious question at that time.

Nothing much happened on coal to methanol until the price of crude oil went through the roof during the Iranian crisis in 1979. However, in the meantime many of us were looking for an answer to better economics in the form of:

(1) larger plants,
(2) technology that would permit lower capital cost,
(3) cheaper coal,
(4) locations where product transportation cost would be more favorable,
(5) price premiums over a straight btu basis to be justified by performance,
(6) government subidies in one form or another.

I might say, to get ahead of the story, we are still looking for better economics without success.

All of the excitement over coal to cheap methanol, the testing of cars with methanol blends and neat methanol, the development of MTBE, and the belief in a coming octane crunch with continuance of high crude price increases and the constant supply jeopardy generated a tremendous optimism among the existing and would-be producers of methanol from gas. As a result, everyone went out in the late 70's and started building new plants, revamping and enlarging old ones and planning even more plants on cheap gas. One large U.S. plant actually got built based on heavy high sulfur petroleum resid in the late 70's.

Now we have an oversupply of methanol in the U. S. and worldwide as well. It is aggravated by recession-depressed markets and even more

aggravated by oversupply. The fuel market is widely believed to be the bail-out for oversupply but, if so, it is agonizingly slow in coming to the rescue. It is time to take a realistic view at the whole fuel methanol question to see if it is a mere will-o'-the-wisp leading us to nowhere.

Without going into cost figures in detail here, it can be stated with a high degree of certainty that coal based methanol, in the absence of substantial government intervention, will not cause a fuel methanol market to develop. It is the other way around. If a fuel market develops anyway, then only coal can eventually supply a large market so it will grow into the major supply position over natural gas. But in this decade, the methanol market will be owned by natural gas methanol sources. If fuel methanol really gets off the ground, there is no reason natural gas should not supply a reasonable portion of it for the rest of the century.

Natural gas in remote places is no damned good. It has no market. It must be converted and hauled away in ships or pipelined away when this is feasible. Formerly, there was a lot of paper wasted on studies of LNG versus methanol. Now it is realized that the comparative economics of the two schemes does not tell the story. Instead, each project for either product must be examined in the context of the feasible market. If no one wants LNG, it doesn't matter what its economics are, and the same can be said of methanol, but to a lesser degree because it is a so much more flexible product as to handling, storing and markets. A viable methanol project can be based on as little as 65 $\bar{M}$ CFD of gas available for 15-20 years and the investment can be in the range of $250-500 $\bar{M}$ in dollars as spent starting now, depending on where the plant is located. This does not include ships. A viable LNG project will usually require in the range of 1 billion CFD of gas over 20-30 years and the investment will be in the $3-4 billion range, not including the cost of specialized ships. The number of customers for LNG is

small and regulatory requirements at the receiving end are severe. Methanol is shipped in a nonpressure tankers all over the world in small parcels and large. It is readily stored and handled and has been in the world commerce for decades. It has a multitude of customers and promises to have a much greater number if it becomes a fuel.

And so it is not LNG versus methanol, but each on its own merit when the conditions are right for a particular project. The two products are substantially noncompetitive with each other in the marketplace as well.

Much of the gas is available as assured long-term supplies too small for LNG but ample for a world scale methonal plant. In some cases where flaring of gas is frowned on, gas may be forced into methanol as in Saudi Arabia and possibly later in the Alaskan North Slope, whether the world needs the methanol or not. Nearly all countries with excess gas need income badly so this drives them toward methanol for export.

As a result of the gas situation plus the apparent attractiveness of the fuel market as well as the high past growth of the chemical market, much new methanol has come onstream or will come onstream in 2 or 3 years with still more firmly planned. Beyond this lies even greater but less certain production plans for the gas based methanol and similar plans for coal based methanol in the very late 80's and early 90's.

Currently U.S. oversupply of methanol has lead to discounts of 20 to 25¢/gal. from list price, placing the effective Gulf Coast price at 50 $\pm$ 5¢/gal. or \$7.7 $\pm$ \$0.8/$\bar{M}$ btu. Unleaded regular gasoline is as low as 88¢/gal. or \$7.3/$\bar{M}$ btu on the Gulf Coast currently. However, methanol used in gasoline blends can be sold by the blender at gasoline

volume price so there is a large economic incentive to put it in gasoline. If octanes were short, the incentive would be overwhelming, i.e. the alternate would be toluene at $1.2/gal. or MTBE at $1.1-1.15/gal. The two EPA waivers with cosolvent use make it legal but less attractive since the only available cosolvent, TBA, sells at 10¢ or so over unleaded gasoline. But there is still incentive and some sales, although no one knows how much. It is fairly safe that notover 50 to 100 M gallons of methanol will get into gasoline via blending in the U.S. in 1982. MTBE use will take 40-50 M gallons and neat fuel is negligible - possibly 1 M gallons. Thus we have a total fuel use in the range of 90 to 150 M gallons/yr. for the 1982 base line year. We favor the lower figure. It would represent a market penetration of 0.04% of all gasoline.

For the foreseeable future, methanol will have to be used with a cosolvent, whether realistically needed or not, given good filling station housekeeping and overlooking blend vapor pressure. By 1985 the available TBA, after other market uses, will be on the order of 20,000 bbls. per CD and, by 1990, perhaps 25,000. It is likely that use will be about 9% methanol/3% TBA. If so, the amount of methanol that could be brought into the gasoline pool would be 920 M gals. in 1985 and 1150 M gals. in 1990.

If we assume only 20% of the market is available in 1985 and 30% in 1990, due to most refiners having enough octane and an aversion to alcohol blending, the market saturation is 82% in 1985 and 77% in 1990 based on total gasoline market of 93 and 83 B gallons respectively. From these figures, you can pretty well conclude that we have estimated the maximum likely market for methanol in gasoline blending unless there is a gasoline crisis or the U.S. Government steps in with a free ride like ethanol gets.

In that connection, if the Energy Security Act had omitted a single word, the word "renewable," methanol in gasoline would be off to the races with a 40¢/gal. of methanol credit for a 10% blend. A

subsidy like that would have created a fuel methanol industry over night. One wonders where the coal state legislators and their staffs were when this shenanigan was pulled off. By an error of omission, which apparently was boneheadedness, not lobbying, the word "peat" was not included in describing nonrenewable resources so peat now confers as a source of methanol the 40¢ credit on methanol made from it. If this kind of Congress is the friend of people, God help us if we ever meet our enemies!

Having put a rough upper limit on the 1985 and 1990 market for methanol in gasoline blending, let's look at some other ways to estimate. On the cost per octane number barrel, the methanol/TBA blend will beat toluene. Its market level for blending (exclusive of the much larger amount left in reformate) is around 300 $\bar{M}$ gal/yr. Benzene production, now that more LPG's and ethane are being pushed out of the gasoline and pulled into another use.

Ethanol, looking at the way it is headed at subsidized prices, can probably build up to a market level of around 300 $\bar{M}$ gal/yr. This entire market is vulnerable to methanol/TBA blends by 1992 and sooner if state subsidies are reduced to the vanishing point by the late 1980's. So here is another 300 $\bar{M}$ gal/yr.

Give methanol a little credit for making it on its own, not at the expense of toluene or ethanol, and you are back at the billion gallons per year level by about 1990.

But what is the supply side telling us all this time? As table I-A brings out clearly, the excess U.S. methanol supply can take care of 300 $\bar{M}$ gals. of gasoline blend until 1985, but after that the excess fades to deficit. If we assume only 85% of the U.S. methanol capacity is realized for one reason or another (Table I-B),

There is essentially no fuel methanol available.

However, the North American situation is far better, as depicted in Table II. Here we have roughly 1 B gallons available from 1985-1990. If some Canadian and Mexican methanol goes elsewhere, then we can bring in SABIC methanol very nicely, always on the chance that Europe does not gobble it up for fuel.

There are a lot of methanol production plans standing in the wings around the world which are backed up by solid resource bases of natural gas or coal. Table III presents a carefully culled list of these planned capacities which is based on some knowledge of the situation surrounding each proposed project. The world as a whole, however, seems to have plenty of methanol without the "could-be" capacity. This is brought out in Table IV. If we add the "could-be" methanol, there is a flood of fuel methanol available.

To be more conservative, Table V looks at fuel methanol supply if only half of the "could-be" methanol is pulled into the market.

On the other hand, the U.S. at best can skimp out some fuel methanol supply until 1985 by running plants at capacity and then must import its fuel methanol. At worst, the U.S. must depend on imports from now on until coal based plants come onstream, presumably late in the decade. Our figures, however, do not allow for business recessions such as now when normal demand may be more depressed than we show.

To get into gasoline blends, both methanol and TBA must keep a low price profile with respect to unleaded gasoline. At a 2/1 methanol/TBA usage ratio, methanol, in our judgment, needs to stay at least 5% below gasoline if TBA is to remain 10% above, which

level was more or less established when gasoline was $1/gal. at the refinery. This is a very rough assessment. The exact value of methanol in any given refinery depends importantly on:

(1) gasoline price levels,
(2) butane price,
(3) toluene and MTBE prices,
(4) the cost or incremental octanes processing changes,
(5) the TBA price level,
(6) the methanol/TBA ratio.

To be sure of selling methanol into gasoline, it may be necessary to have a convincing $0.25 per gallon spread below gasoline. This would place the price of methanol, when gasoline price normalizes to crude again, at about:

$$P = \frac{1.35\ C}{42} - 0.25 = 0.032\ C - 0.25$$

where P is methanol price $/gal. and C is crude price $/bbl., both at the refinery. If crude is $30/bbl., methanol could be $0.71/gal. At $36/bbl., methanol could be $0.90/gal. The first condition is about where we are now except that methanol is even weaker than $0.71/gal., which happens to be very near the list price. The second condition is where we were a year ago when the list price was about $0.80 and headed toward $0.90 to keep certain newcomers not yet on-stream and certain old high-cost producers happy. We may be a bit conservative in the longer pull in pegging methanol price for gasoline blending so low, but right now methanol producers would welcome such a price. Our philosophy is that it will take considerable economic advantage to develop the market for methanol blends. Once the market is established, methanol can set a price level more nearly commensurate with its cost per octane number barrel in blends.

Since fuel methanol comes into the U.S. without tariff, we see absolutely no problem in supplying the U.S. with gasoline blending methanol in this decade through low cost imports.

The trouble with the gasoline blending market is that it is not the real McCoy. At an eventual market penetration of 30% and assuming a blend level of 3/1, or at the 9%/3% level with cosolvent, and assuring cosolvent is not a bottleneck, then the market in 1990 with a base of 83 B gallons of motor fuel would be 2.2 B gallons of methanol versus a fairly certain supply around 3 B gallons (Table IV) and a possible supply of 9 to 14 B gallons (Table IV and V).

The real McCoy is the neat fueled car. Here our estimates indicate something on the order of 2 to 5 M cars by 1995 if all went well. Assume 10,000 miles per year and 20 mpg versus 25 mpg for gasoline (rather optimistic for methanol), then the methanol market would be 1 to 2.5 B gallons/yr. and the growth could easily take it to 4 to 10 B gallons a year in 10 years that expense of gasoline, never mind the total motor fuel growth. This matches up quite well to what might be available from coal and natural gas as indicated in Tables IV and V.

The power generation market for fuel methanol has been talked about for 10 years or more and nothing has happened but tests. Why? Purely price. Methanol is a superb power generation fuel, but its chances of competing, if coal based, in this decade without subsidy are almost nil unless there is a severe and favorable distortion in oil price versus plant cost inflation. Then it is another ball game. Only when new intermediate load facilities are required and oil and gas are either not available or not allowed does methanol begin to look good as a power generation fuel. Another exception is the possible use of fuel cells if natural gas and petroleum naphtha are not available. We are not apt to see in this decade methanol from coal compete with a base loaded, coal fired power station, but it could eventually happen if we get the overall capital cost per KW for the methanol plant plus a combined cycle plant down in the range of a grass roots, coal fired station. The former combination offsets an

ultimate effeciency of around 30% (state-of-the-art is more like 22%) while the latter seems pegged around 35% due to SO_x and NO_x control costs. But methanol will move the pipeline on a btu basis a lot cheaper than coal by rail so the efficiency difference can be offset. The operating costs of the two systems will be comparable, although direct fired system may have a small advantage.

Peak shaving is not the answer for three reasons:

(1) The market potential is too small to justify huge methanol from coal investments.

(2) The heat rate of peaking combustion turbines is roughly twice that of modern combined cycle plant and the load is only 5 to 15% of the year, so someone has to store a lot of methanol to keep the methanol plant on a steady load.

(3) Natural gas and low S distillate are apt to be available for peaking use for a long time to come, even if other uses are curtailed in emergencies. Power comes first.

We need to say something about methanol pricing. With the U.S. coming closely into balance on supply and demand by 1985 at a more or less normal 85% usage of capacity and shortly after 1985 even if we operate at 100% capacity, and with the possibility of a "catch-up" year in demand in 1983 or 1984, U.S. methanol prices would be expected to recover to the $0.80/gal. level and move on to the $0.90/gal. level by 1984/85. Only an excess of imports from Canada can prevent this. After 1985, however, excess imports from Canada, Mexico and Saudi Arabia can hold U.S. prices down to the point that some U.S. producers may shut down when natural gas exceeds about $6/MCF. If this happens, import prices could gradually rise as it became clear that such plants could not afford to start up again. U.S. producers will not take kindly to many shutdowns and will clamor for protection and file dumping charges as has happened before.

But the heavy oversupply of methanol in the late 1980's should hold import price down for fuel grade by a margin approximating the tariff on chemical grade, thus establishing a two-tier price system: chemical grade and fuel grade. These will differ in quality.

We have taken you on a long tour over the fuel methanol battleground. The battle for markets is far from settled. At this stage, we can conclude:

(1) Based on the likely availability of imports at reasonable prices, the gasoline blending and neat alcohol motor fuel uses are market, not supply, limited.

(2) The motor fuel market is more apt to be forced by supply at low prices than to pull methanol in out of mere lack of alternative.

(3) The neat motor fuel market is not apt to be significant in this decade without government stimulation or a severe upset in crude oil supply and/or price. There is likely to be ample methanol available from abroad to develop the market. It is the"real McCoy" market for methanol.

(4) Power generation use of methanol is price limited as well as limited because there is no demand in sight for new combined cycle intermediate load generating facilities.

(5) For a decade or more, fuel grade methanol from natural gas should be able to compete in gasoline blending and very likely in neat motor fuel market if supply credibility at such pricing induces the auto makers finally to introduce the all-methanol car.

(6) There will be some suprises for all of us in the methanol picture. Computer market prediction programs are not able to encompass all the variables, particularly the political ones at home and abroad.

TABLE I-A

U.S. SUPPLY OF METHANOL FOR FUEL USES
FROM SOURCES THAT ARE CERTAIN
(AT 100% OF CAPACITY)

	B GAL/YR.			
	1981	1985	1990	2000
100% OF NAMEPLATE CAPACITY	1.48	1.98	1.98(1)	1.98(1)
DEMAND FOR CHEMICAL USES	1.12	1.49	1.88	3.10
BALANCE FOR FUEL USES & EXPORTS INCLUDING MTBE	0.36	0.49	0.10	(1.12)
MTBE USE	0.04	0.17	0.20	0.40
EXCESS AVAILABLE FOR FUEL USES	0.32	0.32	(0.10)	(1.52)

(1) CAPACITY CONSTANT BECAUSE HIGH GAS COST MAKES NEW CAPACITY UNECONOMIC IN U.S.

TABLE I-B

U.S. SUPPLY OF METHANOL FOR FUEL USES
FROM SOURCES THAT ARE CERTAIN

(AT 85% OF CAPACITY)

B GAL/YR.

	1981	1985	1990	2000
BALANCE FOR FUEL USES AND EXPORTS INCLUDING MTBE	0.14	0.19	(0.20)	(1.42)
MTBE USE	0.04	0.17	0.20	0.40
EXCESS AVAILABLE FOR FUEL USES OTHER THAN MTBE	0.10	0.02	(0.40)	(1.82)

TABLE II

NORTH AMERICAN SUPPLY OF METHANOL FOR FUEL USES
FROM SOURCES THAT ARE CERTAIN

(AT 100% OF CAPACITY)

	B GAL/YR.			
	1981	1985	1990	2000
NORTH AMERICAN SUPPLY AT 100% OF NAMEPLATE	1.69	2.70	3.00	4.4(1)
NORTH AMERICAN SUPPLY DEMAND FOR CHEMICAL USES	1.23	1.77	2.2	3.7
BALANCE FOR FUEL USES AND EXPORTS INCLUDING MTBE	0.46	0.93	0.80	0.70(1)
MTBE USE	0.04	0.17	0.20	0.40
EXCESS AVAILABLE FOR FUEL USES OTHER THAN MTBE	0.42	0.76	0.60	0.30

(1) ASSUMES CAPACITY EQUALS DEMAND /0.85 WHICH FORCES THE 0.7 FIGURE.

TABLE III

ADDITIONAL METHANOL CAPACITY THAT COULD BE MADE AVAILABLE IF MARKET DEMANDS IT

B GAL/YR.

	1985	1990	2000
UNITED STATES(1)	0	3.25	7.6(2)
CANADA	0	1.02	1.5
JAPAN	0	0	0
W. EUROPE	0	0.61	1.9(3)
E. EUROPE	0.28	1.40	2.4
MEXICO	0	0.25	0.5
SOUTH AMERICA(4)	0.25	1.0	2.5
ASIA EX JAPAN	0.24	0.48	1.0
MIDDLE EAST/AFRICA	0.11	1.1	2.0
AUSTRALIA/NEW ZEALEND	0	0	0.5
N. SLOPE ALASKA	0	1.0	5.0
ROUNDED TOTAL	0.9	10	25

(1) EXCEPT N. SLOPE ALASKA
(2) METHANOL FROM COAL ONLY
(3) METHANOL PARTLY FROM COAL
(4) INCLUDES TRINIDAD

REVISIONS TO TABLE III

	1985	1990	2000
	0		
METHANOR '86		167	
DYNO STATOIL '88		167	
ICI ?		275	
		609	
SHELL '87 COAL			72
MOBIL/RUBRK COAL			217
NORSK HYDRO			160
VEBA			330
PORTUGAL			20
NYNAES			233
BP			217
			1249
			609
			1858

TABLE IV

OPTIMISTIC ESTIMATE OF WORLD FUEL METHANOL SUPPLY IF DEMAND PULLS SUPPLY

	B GAL/YR.			
	1981	1985	1990	2000
WORLD METHANOL SUPPLY ON "CERTAIN" BASIS, NAMEPLATE	4.7	8.3	8.8	11.1
FORECAST DEMAND FOR TRADITIONAL USES	3.5	4.7	5.9	9.4
EXCESS AVAILABLE FOR MTBE AND OTHER FUEL USES	1.2	3.6	2.9	1.7
ADDITIONAL METHANOL CAPACITY THAT "COULD BE" AVAILABLE	N.A	0.9	10	25
OPTIMISTIC SUPPLY OF FUEL METHANOL (ROUNDED)	1.2	4.5	13	27

TABLE V

CONSERVATIVE ESTIMATE OF WORLD FUEL METHANOL SUPPLY IF DEMAND PULLS SUPPLY

	$\bar{M}$ GAL/YR.			
	1981	1985	1990	2000
100% OF CERTAIN CAPACITY	4.7	8.3	8.8	11.1
PLUS 50% OF "COULD BE" CAPACITY	N.A.	0.5	5.0	12.5
TOTAL	4.7	8.8	13.8	23.6
FORECAST DEMAND FOR TRADITIONAL USES	3.5	4.7	5.9	9.4
CONSERVATIVE FUEL METHANOL SUPPLY INCLUDING MTBE USE	1.2	4.1	7.9	14.2