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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Analysis Of Current Trends In U.S. Petroleum And Natural Gas Production

(Summary)

Given the realities of the U.S. resource base, it appears that U.S. petroleum and natural gas production will decline steadily through the 1980s, but could be stabilized in the 1990s provided there is reasonable success in new enhanced oil recovery techniques as well as frontier exploration activities. Failure to develop the frontier areas would result in continued declines in U.S. production through the 1990s. While enhanced oil recovery production will not become significant until the 1990s, it could, in combination with vigorous development of the frontier areas, even provide some limited growth prospects by the end of the century.

Prudhoe Bay and the frontier areas will significantly affect the future trends in U.S. petroleum and natural gas production. For petroleum, frontier production will become critical in the mid-1980s when Prudhoe Bay crude oil production begins to decline steeply. For natural gas, production will continue to decline through the end of the century and not stabilize in the 1990s, unless the proposed levels of Prudhoe Bay gas production can be maintained through the end of the century.



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SUMMARY

EMD-80-24
DECEMBER 7, 1979

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COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

ANALYSIS OF CURRENT TRENDS
IN U.S. PETROLEUM AND
NATURAL GAS PRODUCTION

D I G E S T

Estimates of future U.S. petroleum and natural gas supply are governed by a variety of factors some of which are amenable to policy initiatives (e.g., price, environmental standards, leasing policy) but whose effects and desirability are subject to dispute. However, there are certain physical factors (e.g., resource base, reserve addition profiles) governing energy supply which are not subject to as much dispute. Analysis of these physical factors does not provide a basis to precisely identify future production levels, but they can provide a basis to determine the future trends in petroleum and natural gas production.

These trends provide points of reference against which to assess the "believability" of a particular estimate or relative impact of a particular policy initiative. While production above or below these trends is possible, the likelihood is not large enough in GAO's view to be counted on for purposes of determining National energy policy. The purpose of this report is to develop these trends in the light of the physical factors affecting petroleum and natural gas production. (See pages 1 to 3.)

PETROLEUM PRODUCTION

Domestic petroleum production will probably decline steadily through 1990. Production in the 1990s could stabilize and perhaps begin to grow slightly because of new Alaskan and Outer Continental Shelf (OCS) production along with a significant growth in new enhanced oil recovery (EOR) output. Without the addition of production from these areas, U.S. production would continue to decline to little more than half of 1978 production.

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Table 1 shows the expected trends in U.S. petroleum production. (See pages 29 to 30.)

Table 1

Estimated Trend of U.S. Petroleum
Production by Sources
(millions of barrels per day)

	<u>1978</u> (actual)	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<u>CRUDE OIL</u>						
Lower 48 Onshore	6.3	6.0	5.0	4.2	3.9	3.7
Alaska						
Existing	1.2	1.5	1.6	0.9	0.4	0.2
Frontier	-	-	0.1	0.4	0.9	1.3
Total	1.2	1.5	1.7	1.3	1.3	1.5
Lower 48 Offshore						
Existing	0.7	0.6	0.5	0.4	0.3	0.2
Frontier	-	-	0.1	0.2	0.3	0.4
Total	0.7	0.6	0.6	0.6	0.6	0.6
EOR	-	-	-	0.2	0.5	1.0
NATURAL GAS LIQUIDS	1.9	1.8	1.6	1.7	1.7	1.7
Totals	<u>10.1</u>	<u>9.9</u>	<u>8.9</u>	<u>8.0</u>	<u>8.0</u>	<u>8.5</u>

Lower 48 Onshore

More than half of the recent reserve additions in the Lower 48 onshore have come from revisions to existing reserves, mostly as a result of improvements in oil recovery. Reserve additions from drilling activities have remained relatively constant despite dramatic increases in drilling activity since 1973. This is because 90 percent of new drilling activity is for development, not exploration. Furthermore, the exploration finding rate has fallen one-fourth since 1974. If current trends in drilling activity and revisions continue, the annual decline in Lower 48 onshore production could gradually

slow from 3.1 percent a year to about 1 percent by the end of the century (See pages 12 to 19.)

Lower 48 Offshore

Production from existing Lower 48 offshore areas is expected to continue to decline at about 6 percent a year through the end of the century. Frontier offshore production should stabilize total Lower 48 offshore production by the mid-1980s. (See pages 19 to 20.)

Alaska

Current South Alaskan production is expected to decline to insignificant levels by 1990. Prudhoe Bay production should increase to almost 1.5 million barrels per day (BPD) by the early 1980s. In the mid-1980s, it will decline sharply, falling to 200,000 BPD by 2000. Very little new Alaskan production will begin until almost 1990, and it would only stabilize Alaskan production in the 1990s at about 75 percent of the expected 1985 peak.

Current land use laws and decisions have closed or restricted some of the most promising Arctic Ocean areas. This could result in Alaskan production falling to pre-Prudhoe Bay levels, and continuing the decline in overall U.S. production into the late 1990s. (See pages 21 to 24.)

Enhanced Oil Recovery (EOR)

New EOR technologies have significant economic and technological uncertainties along with lead times approaching 10 years to develop a single field. A major part of the resource base accessible to the new EOR techniques is found in small fields, further complicating the economics and pace of EOR production. It does not appear likely that new EOR production will become significant until about 1990. (See pages 24 to 29.)

NATURAL GAS

The aggregate trends in associated, non-associated and total domestic gas supply from conventional sources are shown in Table 2. The decline in U.S. natural gas production should slow significantly in the mid-1980s as a result of the beginning of natural gas production from Prudhoe Bay and the frontier areas (Alaska and OCS). Throughout the 1990s U.S. natural gas production is likely to be essentially stable. (See pages 41 to 43.)

TABLE 2

Estimated Trend of U.S. Natural Gas
Production by Sources
1978 to 2000
(trillion cubic feet)

	<u>1978</u> (actual)	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<u>Associated Gas:</u>						
Lower 48	3.6	3.4	2.8	2.3	2.2	2.0
Frontier OCS & Alaska	-	0.1	0.2	1.2	1.4	1.7
Sub-total	3.6	3.5	3.0	3.5	3.6	3.7
<u>Non-Associated Gas:</u>						
Lower 48	15.5	14.7	13.7	12.5	11.8	11.5
Frontier OCS & Alaska	0.2	0.2	.4	.8	1.4	1.4
Sub-total	15.7	14.9	14.1	13.3	13.2	12.9
<u>Total Gas:</u>						
Lower 48	19.1	18.1	16.5	14.8	14.0	13.5
Frontier OCS & Alaska	0.2	0.3	0.6	2.0	2.8	3.1
Total	<u>19.3</u>	<u>18.4</u>	<u>17.1</u>	<u>16.8</u>	<u>16.8</u>	<u>16.6</u>

Associated Gas

Lower 48 production declines rather steeply through 2000, but Alaska and Frontier OCS production begin to compensate for this decline in the 1990s.

If current industry plans to hold Prudhoe Bay production constant at 2 billion cubic feet a day through the end of the century can occur, associated production could grow back almost to current levels by 2000. (See pages 35 to 36.)

Lower 48 Non-Associated Gas

Negative (downward) revisions have strongly affected non-associated natural gas reserve additions since 1969. The apparent rise in reserve additions since 1973 has been solely due to the gradual disappearance of negative revisions, not to exploration activity. Most natural gas drilling activity has been directed towards production, not finding new reserves. The significant natural gas price increases since 1973 have only served to hold exploratory reserve additions level. Even with increases in drilling activity comparable to those since 1973, it is likely that reserve additions would only average about 11 tcf a year, and this assumes positive revisions on the order of 2 tcf a year. (See pages 36 to 40.)

Frontier OCS and Alaska Non-Associated Gas

Hostile environments, institutional constraints, and high costs of developing frontier areas makes significant production, even by 1990, somewhat problematic. Nevertheless, production could reach 1.2 tcf by 1995. Existing Alaskan areas are expected to continue to produce at about .2 tcf a year through the end of the century. (See pages 40 to 41.)

COMPARISON WITH OTHER WORK

In general our mid-term petroleum production trends (through 1990) tend to be more conservative than other studies, while our long-term estimates (2000) tend to be somewhat in the middle. On the other hand, our natural gas

trends tend to be more optimistic than most of the studies. (See pages 45 to 52.)

GAO OBSERVATIONS

The existing resources realities in the Lower 48 States provide little or no opportunity for increased prices and drilling activity to reverse or even stop the long-term decline in Lower 48 production. However, higher prices will provide an opportunity to slow the rate of decline.

The frontier areas are not likely to counteract the decline in Lower 48 production unless there are significantly more resources than currently expected.

A significant amount of frontier production areas and some future Lower 48 producing areas are on lands which have drilling and exploration restrictions, or even prohibitions. If these lands are not developed, production declines will be even steeper.

Production from the giant Prudhoe Bay field on Alaska's North Slope has temporarily reversed the decline in total U.S. production. However, by 1980 the decline will resume. If insufficient new oil is found in Alaska, the steep decline in Prudhoe output after 1985 will accelerate the decline rate of U.S. output.

New enhanced recovery technologies will not become significant until 1990 because of high costs, long lead times, and field size economies of scale.

Long term trends in petroleum production would tend to be more sensitive to price than natural gas because of the EOR possibilities for petroleum.

The NGPA is unlikely to have any long-term effects on U.S. natural gas supplies simply because the pre-NGPA natural gas prices were at a rate such that

effective deregulation might have been achieved by the mid-1980s. (See pages 53 to 56.)

CONCLUSIONS

Any policy designed to encourage petroleum and natural gas production must have two equally important purposes:

- To provide adequate incentives to drill for new reserves and improve recovery in existing fields.
- To provide incentives to focus new drilling activities in the areas where it is most likely to find new large fields (e.g., the frontier areas of Alaska and the OCS).

To aim for one with little attention given to the other will significantly impair the likelihood of success for any Government initiatives to stimulate domestic oil and gas production and thereby restrain oil imports. (See page 56.)



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