

22638
22638

Soviet Energy Problems and Prospects

**CIA HISTORICAL REVIEW PROGRAM
RELEASE IN FULL
1999**

ER M 79-10108

9 February 1979

USSR: CRUDE OIL PRODUCTION

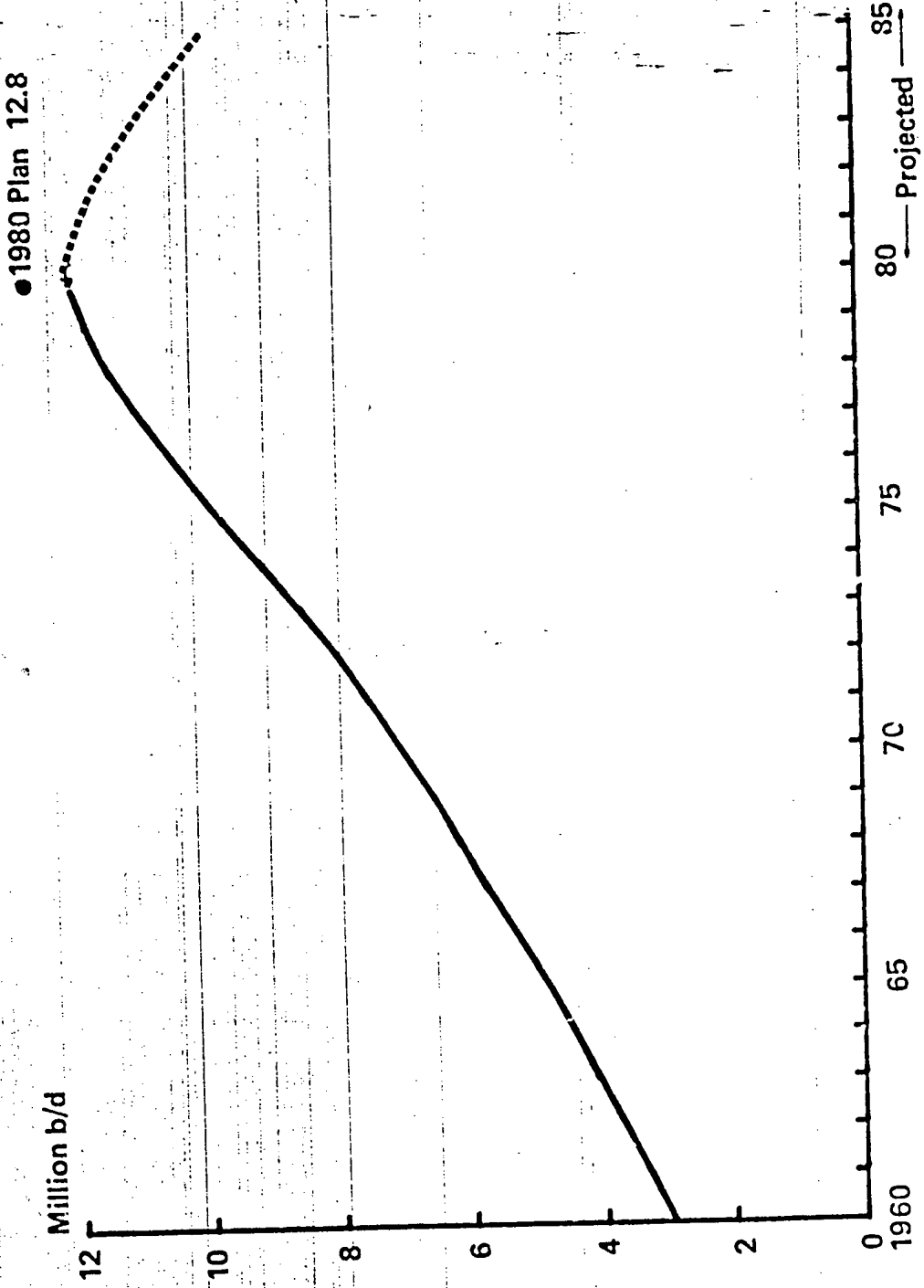
Soviet oil production increased at an average annual rate of 9.1% during the 1960s. During 1971-78 annual rate of increase has declined to an average of 6.2%.

Absolute annual production increases have declined since 1975 from 640,000 b/d to 510,000 b/d in 1978. The 1979 plan calls for a further decline in growth to about 430,000 b/d.

We expect oil output to reach 11.8-12 million b/d in 1980, falling short of the goal of 12.8 million b/d. After 1980, we believe that production will begin to decline, probably to a level of some 10 million b/d in 1985, but conceivably as low as 8 million b/d.

USSR: Crude Oil Production¹

Figure 1



1. Including a small amount of natural gas liquids (20,000 b/d in 1960 to some 300,000 b/d in the 1980s)

USSR: MONTHLY OIL PRODUCTION AND 1976-80 PLANS

Since 1977, Soviets have underfulfilled annual oil production goals and have subsequently revised targets below original Five Year Plan figures.

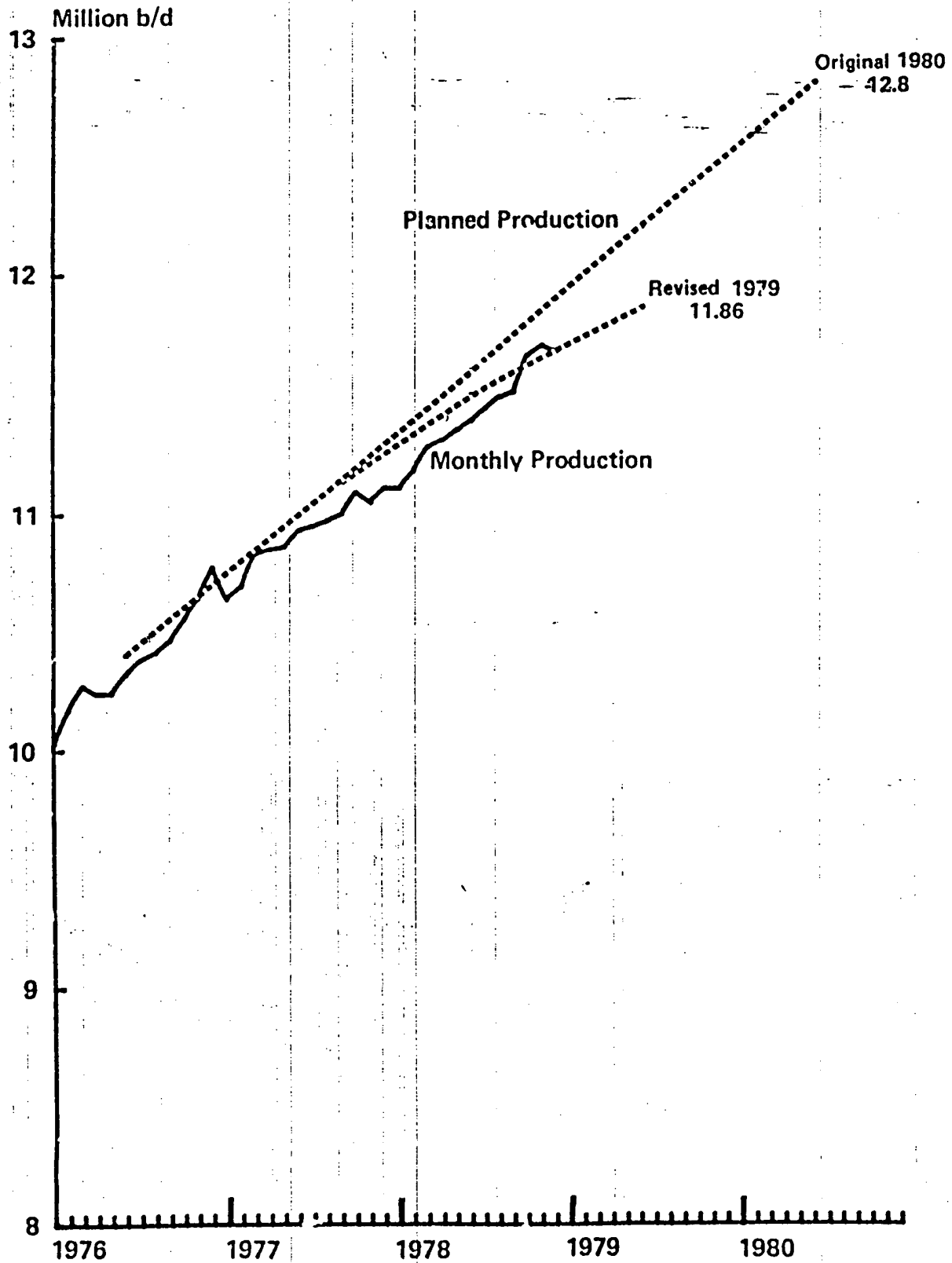
Oil production in 1978 rise about 510,000 b/d, the smallest gain since 1972.

The 1979 goal has been lowered from 12.2 million b/d to 11.86 million b/d and the present daily output rate is unlikely to rise much during the year.

Oil output is likely to peak this year or next, followed by a rather sharp decline in the early 1980s.

Figure 2

USSR: Monthly Oil Production and Plans¹



1. Including gas condensate.

INCREMENTS TO OIL PRODUCTION

Since 1973, growth in West Siberian oil output has accounted for almost all of the net increases in national production.

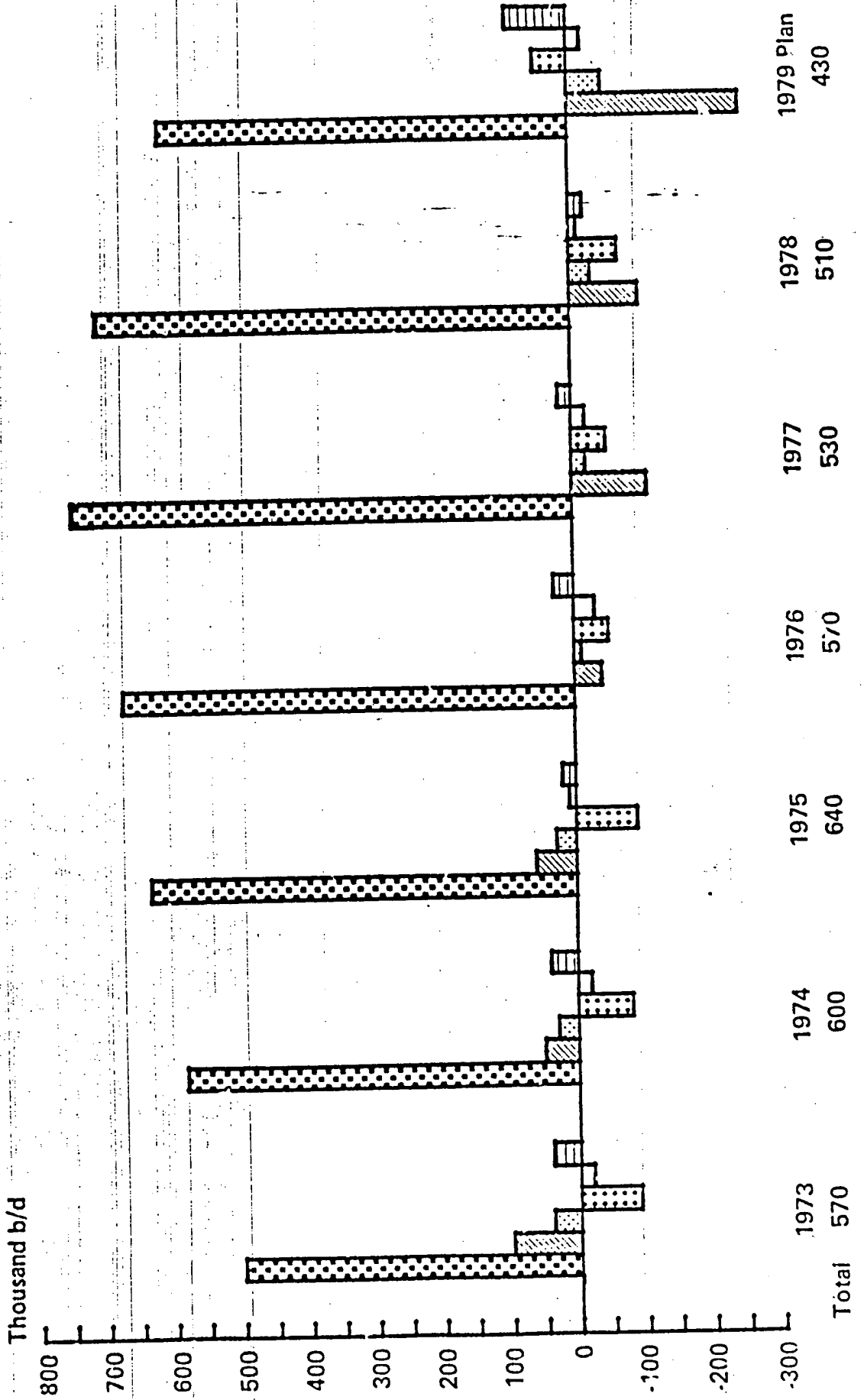
Despite steady growth in West Siberian oil output, net increases in total Soviet production have declined since 1975 as output in most other producing regions has begun to decline.

West Siberia has accounted for almost 45% of total Soviet oil production in 1978 and should reach 50% in 1980. Only 4 of 26 oil producing associations in the USSR were scheduled to increase output during 1978-79.

USSR: Increments in Oil Production

Figure 3

- West Siberia
- North Caucasus and Azerbaydzhan
- Urals-Volga
- Ukraine
- Central Asia
- Other



REGIONAL OIL PRODUCTION

West Siberia has accounted for the bulk of Soviet increases in oil production since the early 1970s. In 1978, West Siberian output rose 716,000 b/d -- the second largest gain ever -- more than compensating for the output declines in older regions, especially in the Urals-Volga.

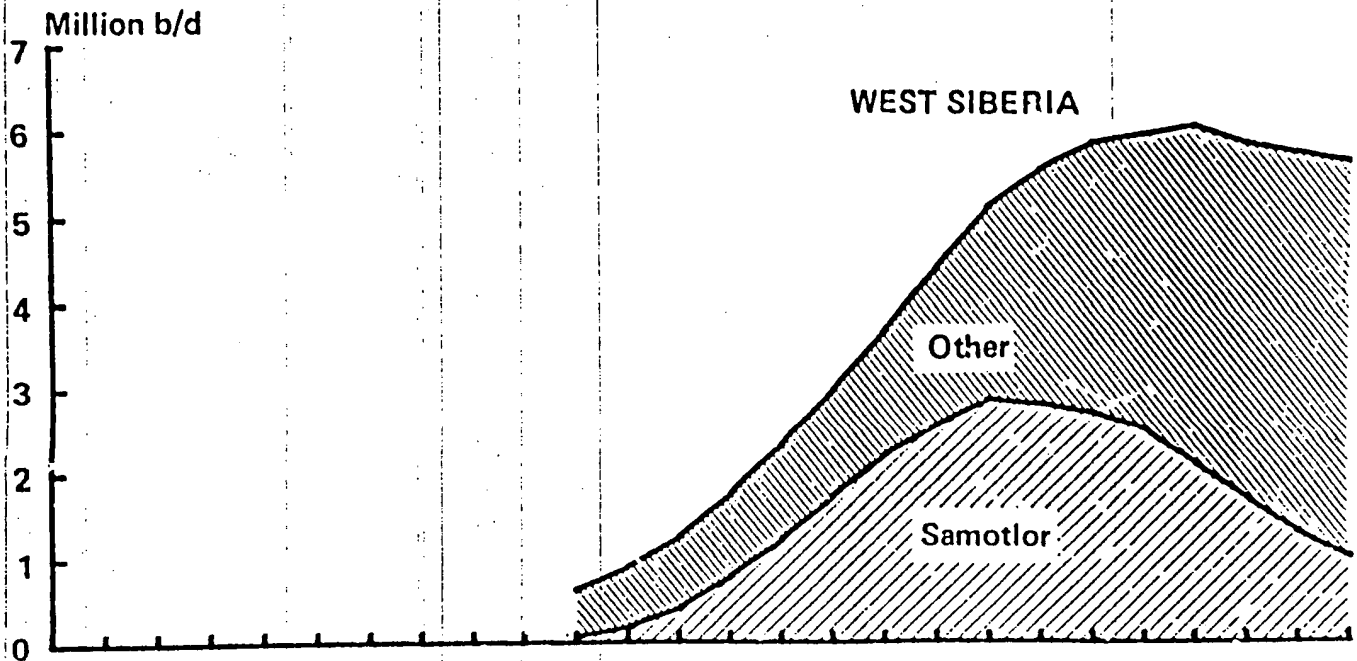
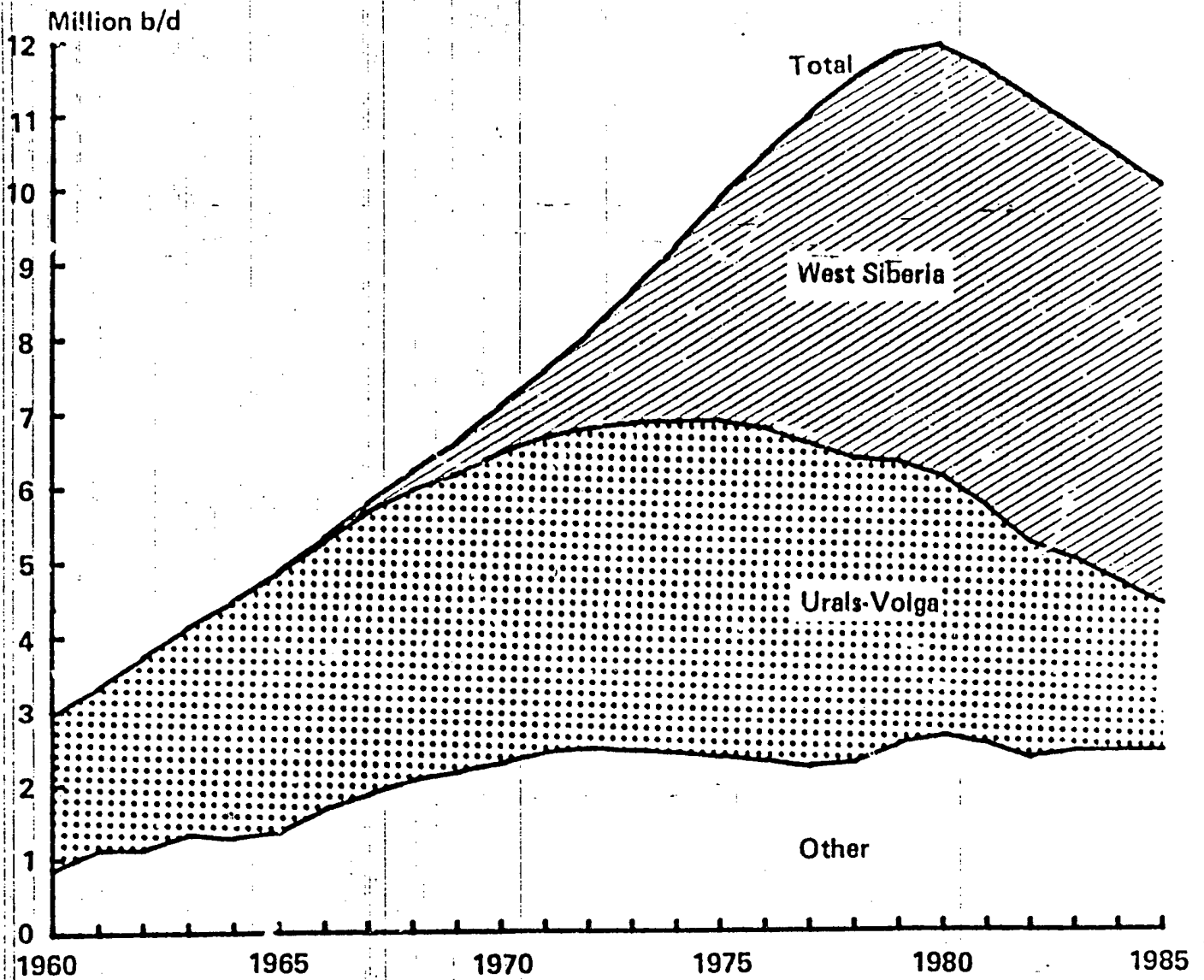
Production declines in other regions began in 1975 and rose to more than 200,000 b/d in 1978.

Increase in oil production from West Siberian fields will become more difficult as output at the super giant Samotlor oilfield peaked in 1978 and is expected to decline, and major problems are being encountered in developing the smaller, more remote deposits.

The outlook for Soviet oil production is bearish because large new fields have not been discovered to offset the decline in the Urals-Volga area and the impending levelling off of production in West Siberia.

USSR: Regional Oil Production

Figure 4



TRENDS IN OIL PRODUCTION CAPACITY

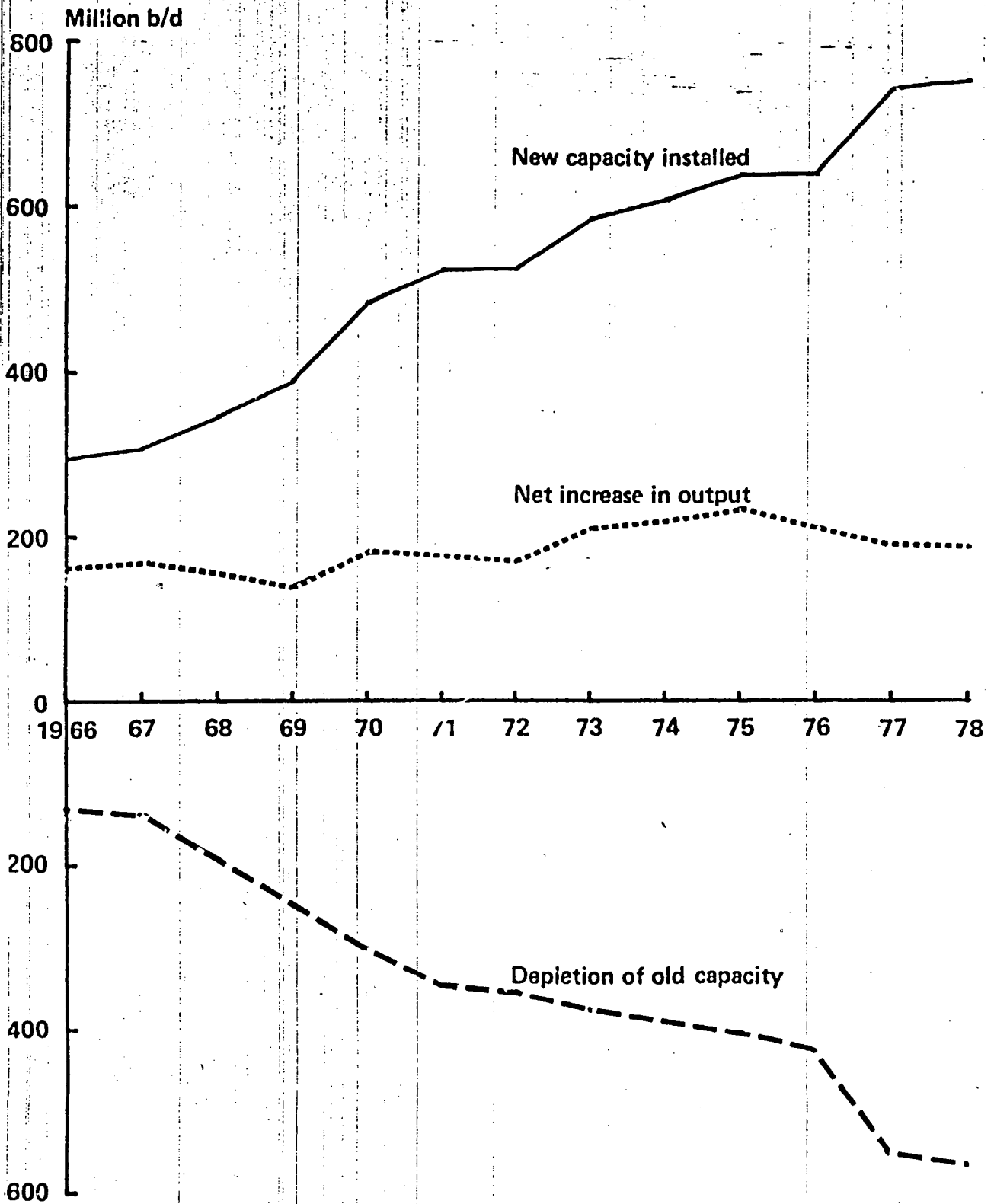
Requirements for new oil production capacity are increasing rapidly as older fields are being depleted.

The depletion rate is rapid even in West Siberia, where production began only in 1964.

By 1980 depletion offset will account for more than one-half of the total capacity added in West Siberia.

Figure 5

USSR: New Capacity and Depletion of Old Capacity



SOVIET DRILLING REQUIREMENTS

Three factors are generating increased drilling requirements:

- the growth of capacity depletion
- increasing depth of new wells
- declining well productivities, particularly in West Siberia.

The Soviets have maintained a steady rate of growth in drilling since 1970 but have allowed exploratory drilling to stagnate.

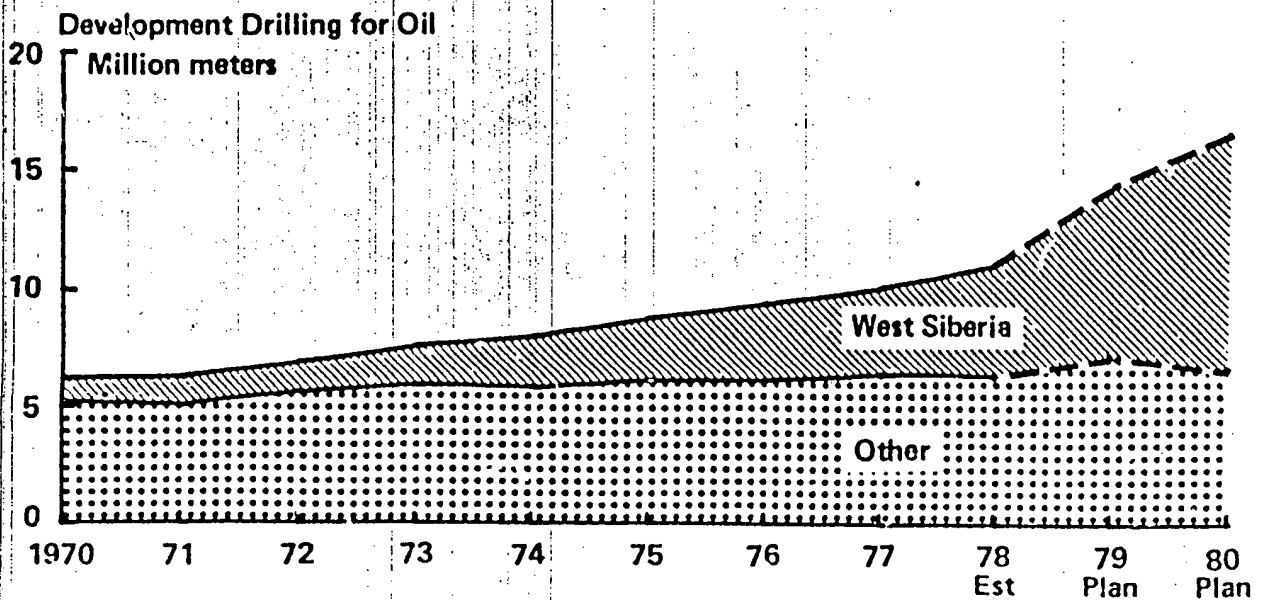
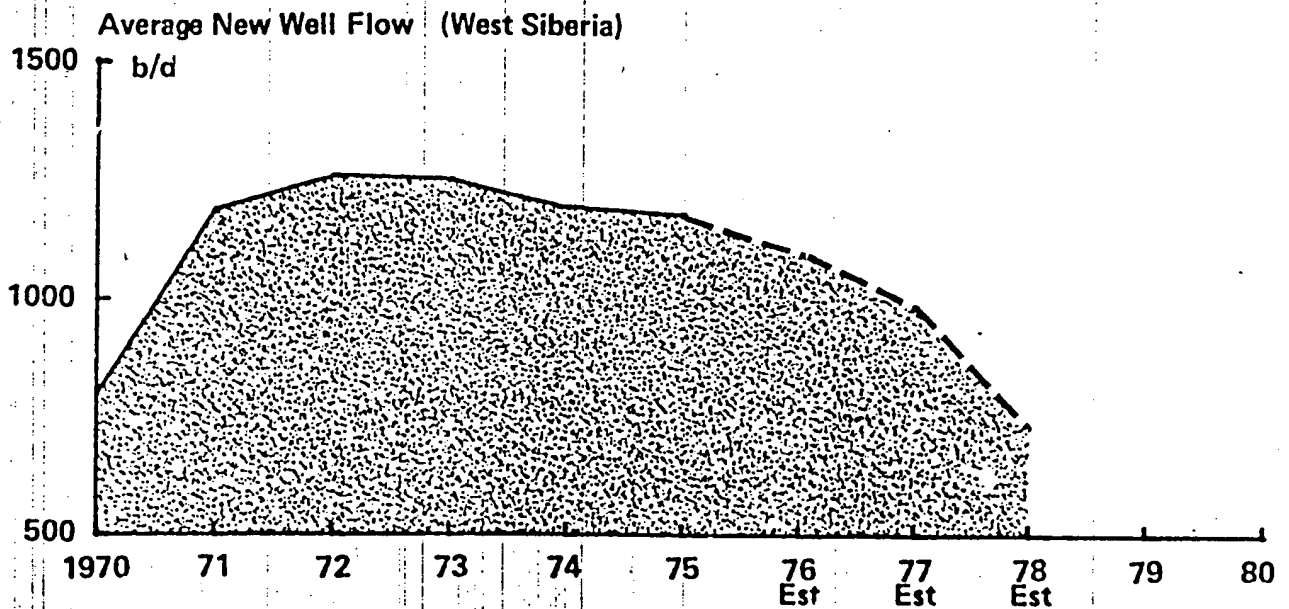
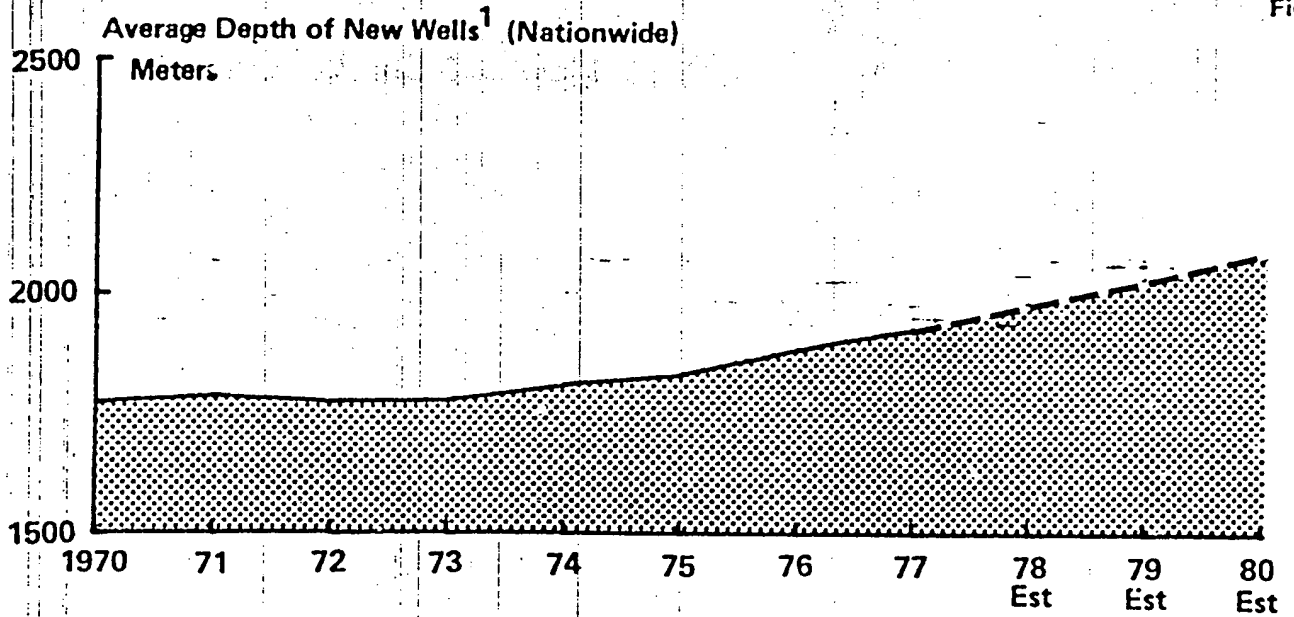
Plans for 1979 and 1980 call for unprecedented increases in drilling, primarily in West Siberia. We believe that they will fall 7-8 million meters short of their 5-year plan goal of 75 million meters.

The ambitious plans for West Siberia call for massive assistance from drillers of other regions, thus disrupting drilling in their home regions.

The inattention to exploratory drilling has caused reserve/production ratios to decline, limiting the potential for future growth.

USSR: Drilling Requirements

Figure 6



FLUID LIFT REQUIREMENTS

The total amount of fluid (water plus oil) that needs to be lifted to produce the oil is increasing more rapidly than is oil production.

The growing fluid levels basically reflect a rising water cut.

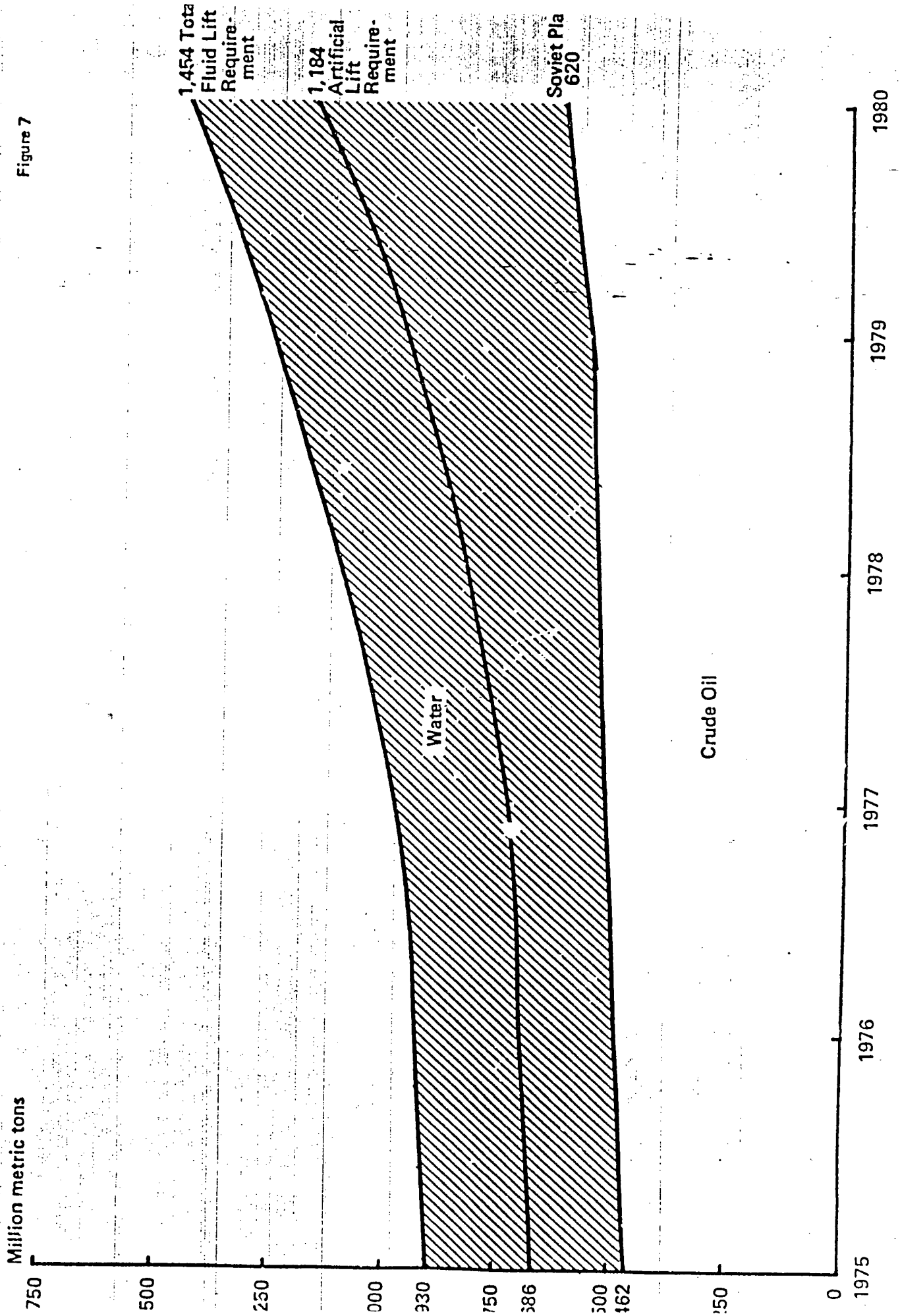
In 1976 the national water cut was roughly 50% and rising -- 15.8% in West Siberia and an average of 59% in the rest of the country.

In older Urals-Volga regions the water cut was over 80%, e.g., in the Tuimazy field it was 84%.

The Samotlor field in West Siberia had a water cut of only 10% in 1976 but a number of older wells had water cuts of 50%; the drilling of more than 500 wells a year keeps the average down.

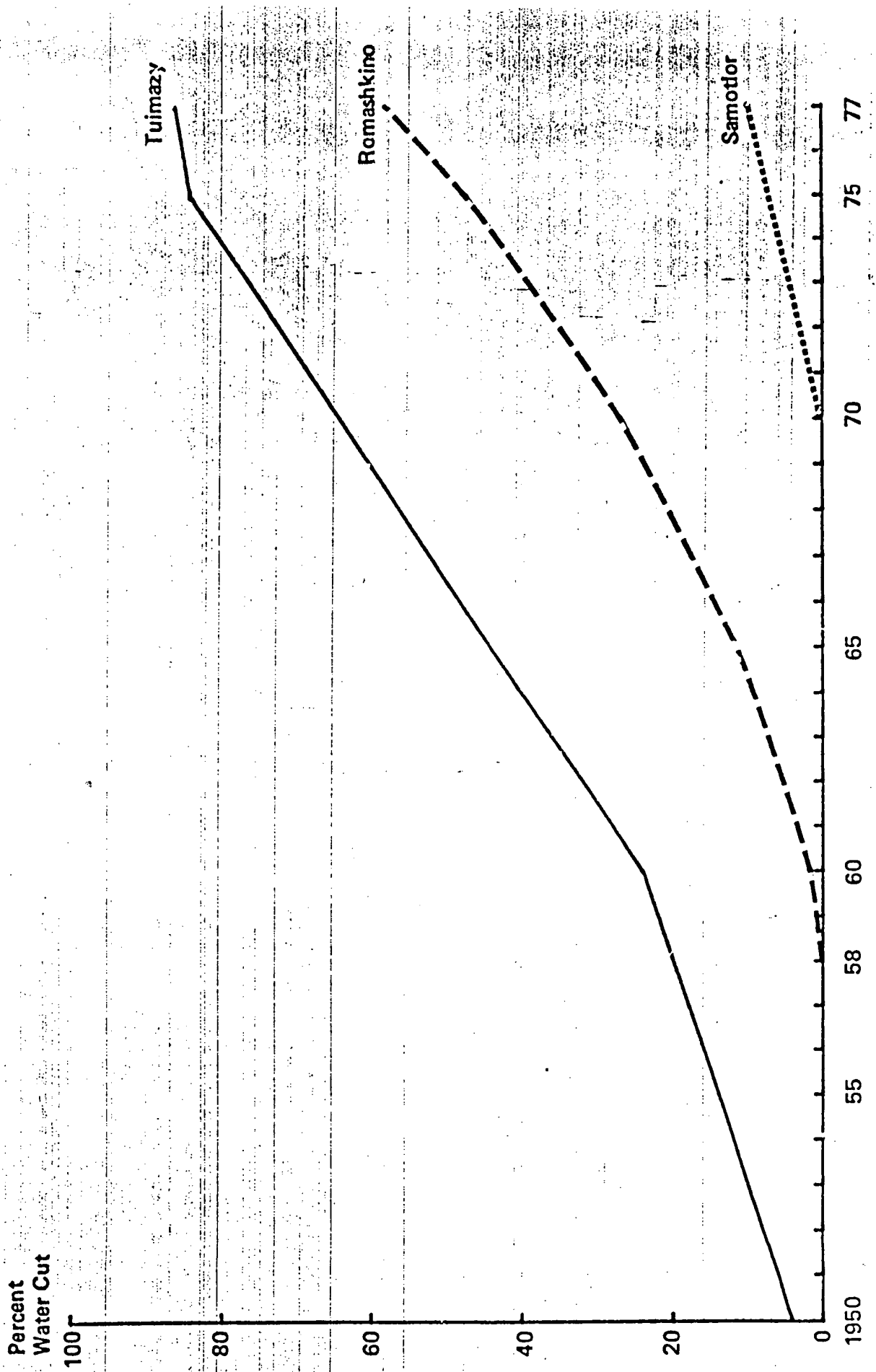
USSR: Fluid Lift Requirements

Figure 7



Water Cuts in Major Soviet Oilfields

Figure 8



REGIONAL GAS PRODUCTION

The outlook for Soviet gas is by contrast bullish. Reserves are plentiful and sustained growth through at least the mid-1980s is expected.

Output grew by 7.5% in 1978 or 26 billion cubic meters (430,000 b/d oil equivalent) and surpassed plan levels. West Siberian output is rising rapidly and now accounts for nearly all production growth; in contrast older fields in the European USSR and Central Asia will become an increasing drag on national production.

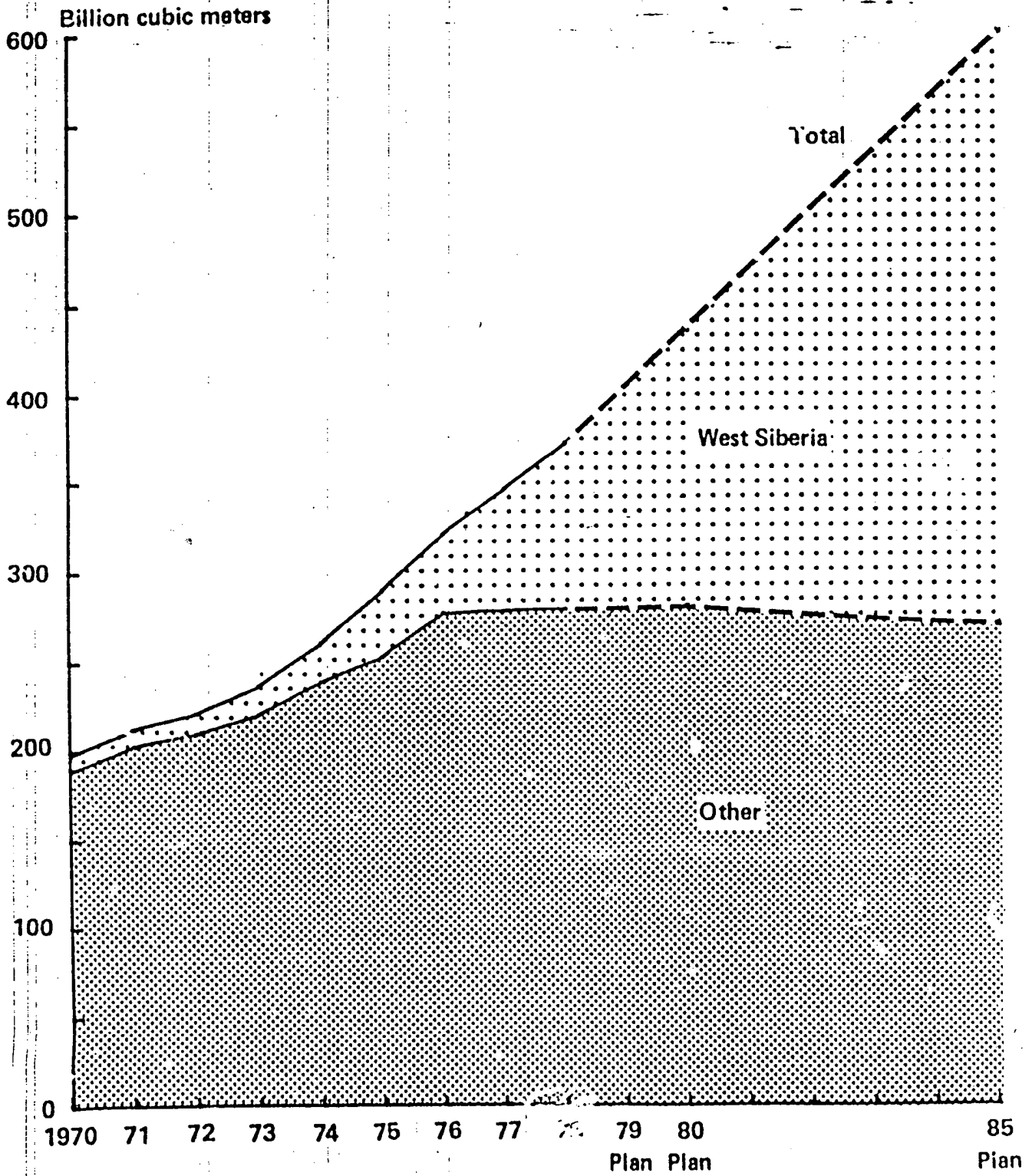
The 1979 and 1980 plans are ambitious, requiring 8% growth. Production will fall short of plan, though only slightly.

Lagging pipeline construction and infrastructure problems will slow the rate of growth to about 6% a year through the mid-1980s.

Despite somewhat slower growth, output will be sufficient to satisfy domestic and export needs; by 1985 gas will probably become the USSR's leading earner of hard currency.

Figure 9

USSR: Regional Gas Production



COAL PRODUCTION AND PLANS

The Soviet coal industry is in trouble. Production is lagging far behind the modest growth plans established for 1980.

Output in 1978 increased by only 2 million tons -- 22 million tons below plan.

The production plan for 1980 has since been revised downward by 25 million tons to 780. The Soviets probably will fall some 30 million tons short of the lower target.

Production will increase to 800-820 million tons by 1985 -- roughly the amount they hoped to achieve 5 years earlier.

Much of the gain in raw coal production will be offset by the steady decline in the average heat value of Soviet coal. By 1985, output -- expressed in terms of standard fuel -- will be up only 4-5% compared with 1978.

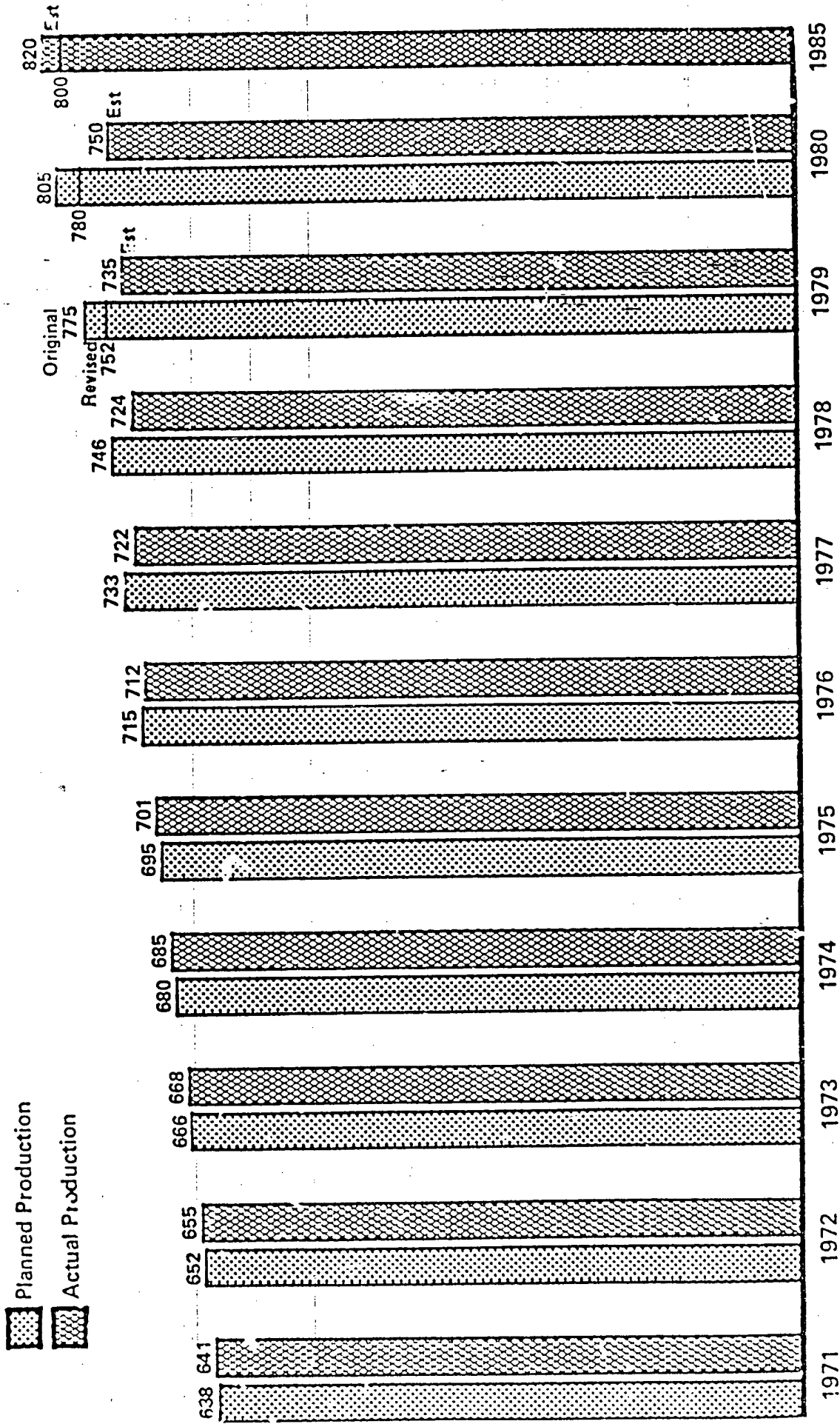
Easily exploitable deposits in the Western USSR have been largely depleted and production costs are rising. New coal basins are far from major consuming centers and the coal is of power quality.

The problems of the coal industry cannot be solved quickly. Coal can do little at least for the next decade to alleviate the impending Soviet energy crunch.

Figure 10

USSR: Coal Production and Plans

Million metric tons



INCREMENTS TO ENERGY PRODUCTION

Among the primary sources of energy, gas production is being pushed as fast as possible, but increments to energy production will decline after 1980 as the expected decrease in oil production and slow growth in coal production will increasingly offset growth in gas output.

Output of nuclear power is increasing, but its contribution to total energy production will amount to only about 2% in 1985.

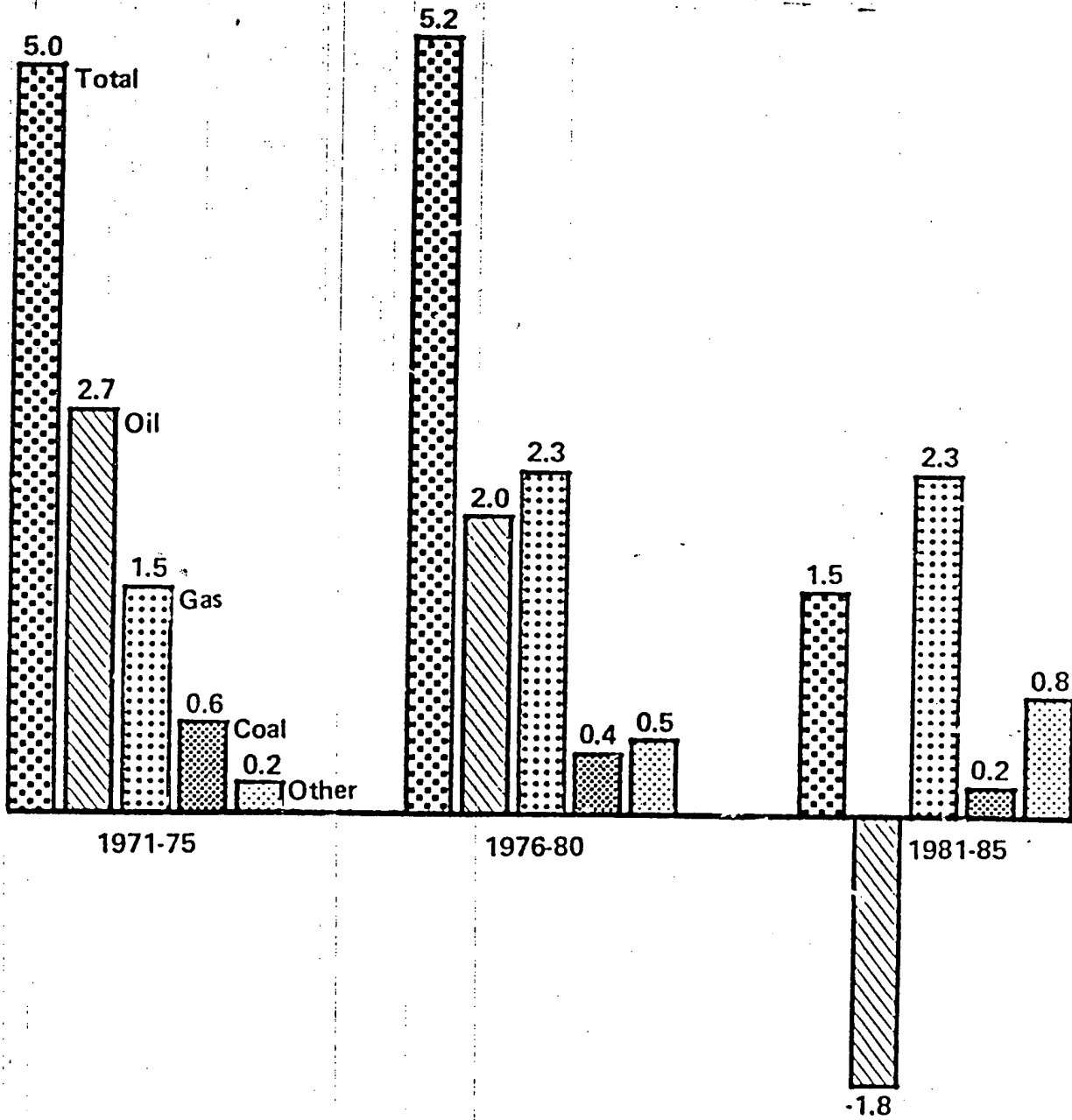
The shares of oil and gas in energy production will shift sharply in 1985 compared with 1978, as shown below:

	<u>% of Total Energy Production</u>	
	<u>1978</u>	<u>1985</u>
Oil	42	33
Natural gas	24	31
Coal	25	24

USSR: Increments to Energy Production

Figure 11

Million b/d oil equivalent



CONSERVATION

The pattern of energy consumption in the USSR is substantially different from that in Western industrial countries and makes large energy savings more difficult. It is unlikely that the Soviets will be able to make a substantial reduction in growth of energy consumption without a severe impact on industry.

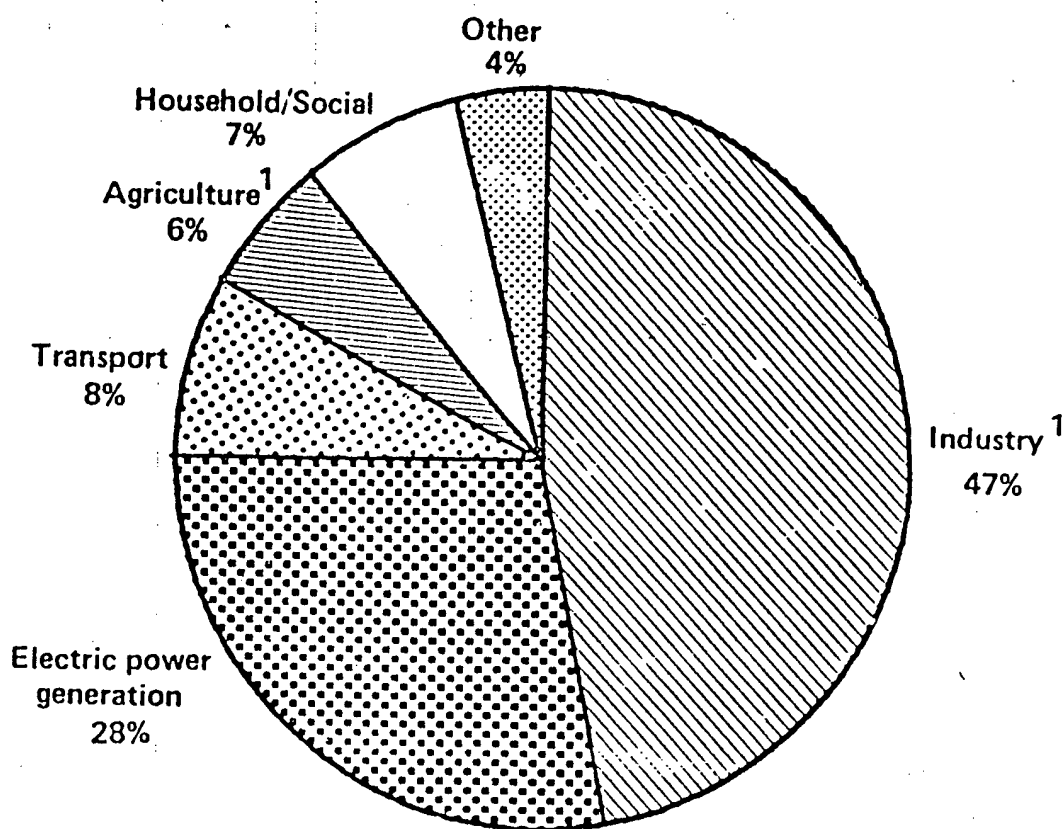
In 1977, about 65 percent of Soviet electricity was used by industry. This proportion is dropping slowly as rural and municipal-communal consumption rises.

The highly energy-intensive iron and steel industry alone accounts for nearly 13% of Soviet energy consumption compared with only about 3 percent in the US.

Ferrous and non-ferrous metallurgy, chemicals, construction materials, paper, food, machine building, and electro technology use 82% of industrial fuel, 60% of industrial heat, and 67% of industrial electricity. The Soviets are concentrating conservation measures in these energy-intensive industries.

Major energy savings will have to be obtained largely by upgrading industrial technology or by a major shift in output away from heavy industry toward light industry and services. Neither would be easy.

USSR: Primary Energy Consumption, 1977



Total 20.6 million b/d oil equivalent

1. Excluding a rigorous analysis of the use of trucks for transport in these sectors.

Upgrading technology is a very time-consuming, capital-intensive process. A shift away from heavy industry such as iron and steel would be contrary to the view of the dominant Soviet interest groups.

In Western countries transportation and residential energy use is large, and the potential for energy savings is great. In the USSR many of the techniques now discussed in the West to save energy are already in use on a wide scale. For example, most urban space heating in the USSR as well as large amounts of industrial process heat are provided through cogeneration.

Soviet preoccupation with thermal efficiency is revealed by fifty years experience with cogeneration. Their scale of effort dwarfs other nations. Over 1100 combined heat-and-power plants serve 800 cities, accounting for over 60% of heat in urban areas and about 40% of the Soviet total. The Soviets claim a 20-30% gain in efficiency by using steam to heat industrial and apartment buildings after it has been used to produce electricity.

The Soviets have long stressed cutting fuel input in terms of electrical output. They have published tables indicating they surpassed Britain and Germany in energy efficiency in electricity production in the early 1970s--only France, by their computations, excel them in efficiency. But technical limits have now been reached.

Only incremented improvements can be realized by updating generating equipment.

The Soviet transportation sector is the most energy efficient in the world, thus large savings are unlikely.

There are few passenger cars and most intercity traffic is handled on electrified rail lines rather than truck.

Soviet use of trucks for freight hauling is roughly half that of Western Europe.

Based on reported passenger-kilometers, Soviet automobiles use just over 2% of Soviet oil products. Allowing for the gasoline black market, this figure could rise to 3%.

In contrast, American automobiles account for 25-30% of US oil consumption.

Based on reported passenger-or-freight -- kilometers, estimated percentages of Soviet gasoline consumption are:

<u>non-agricultural trucks</u>	<u>buses</u>	<u>cars</u>	<u>motorcycles</u>	<u>agriculture</u>
50%	15%	13.5%	13.5%	30%

SOVIET OIL CONSUMPTION LATE '70s

or Oil Volume
Consumption

% of Fuel Consumed by Sector

Gasoline
22%

Transportation
70%

Agriculture
30%

Kerosene
8%

Domestic
up to 5%

Aeroflot
60% up

Military
30-35%

Diesel Fuel
26%

Misc.
4%

Construction
10%

Industry
22%

Transport
28%

Agriculture
36%

Lubricants
4%

Residuals
40%

Misc.
15%

Chemicals
& Other
7.5%

Iron &
Steel
12.5%

Communal
Housing
13%

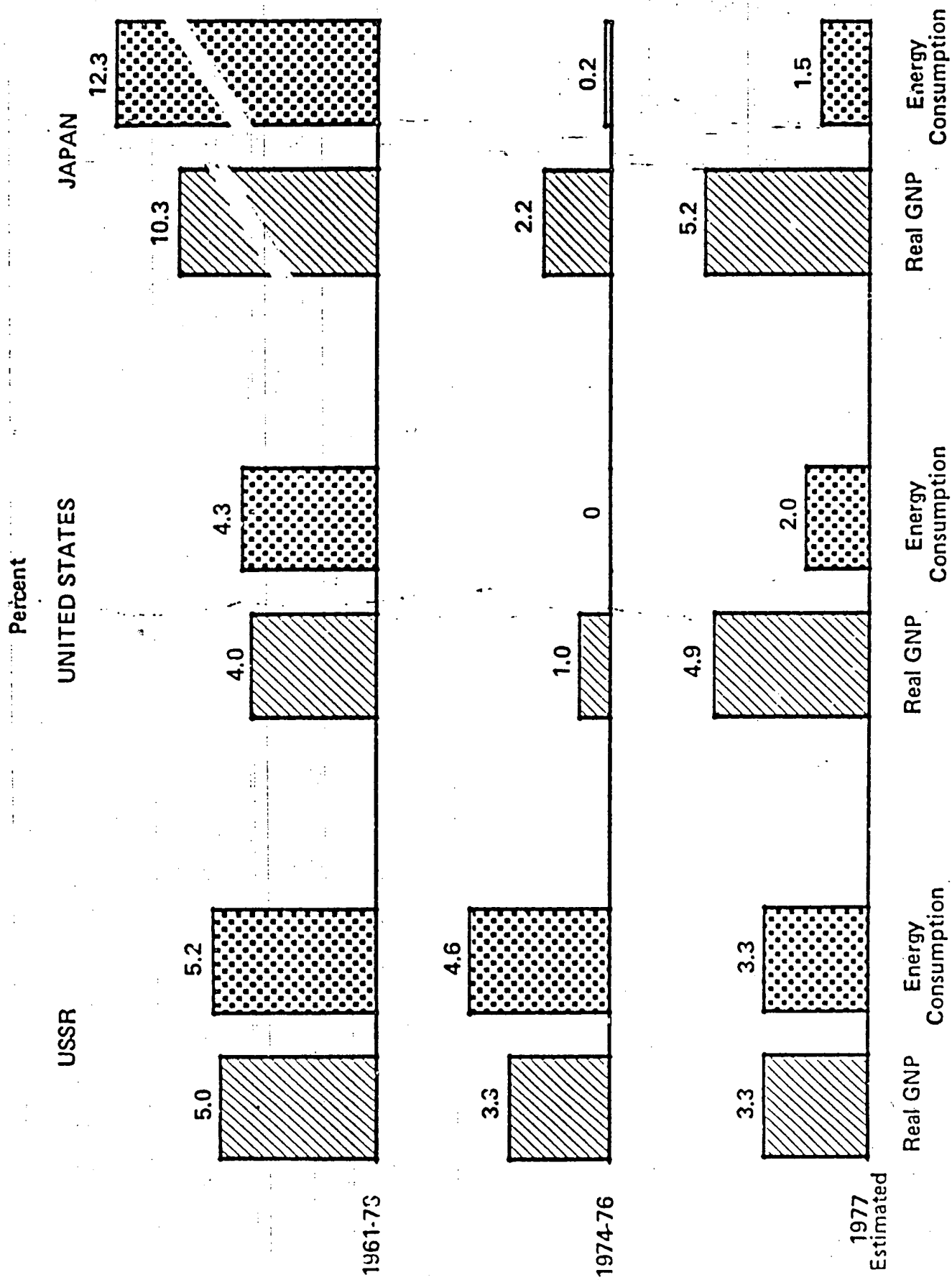
Boilers
12%

Electricity
& Heat
40%

Agriculture 3%
Military 3%
Trans. 3%
Industrial 3%
Feedstock
Gas Pipelines 2%
Oil Refining 2%
Construction 1%

Trends in Economic Growth and Energy Consumption

Figure 13



USSR: TRENDS IN OIL PRODUCTION AND END USE

BASIC ASSUMPTIONS

1. Soviets achieve energy savings of about 2.5%/year through 1985; all in the form of oil.
2. GNP growth during 1981-85 assumed to be 3-3.5%/year.
3. Rise in energy consumption assumed to be at or average annual rate of 3.2% during 1981-85.
4. Soviets will continue to export oil to other Communist countries at a constant level of 1.9 million b/d during 1981-85.
5. Domestic oil production is assumed to 11.8 million b/d in 1980 and falls to 10 million b/d in 1985.

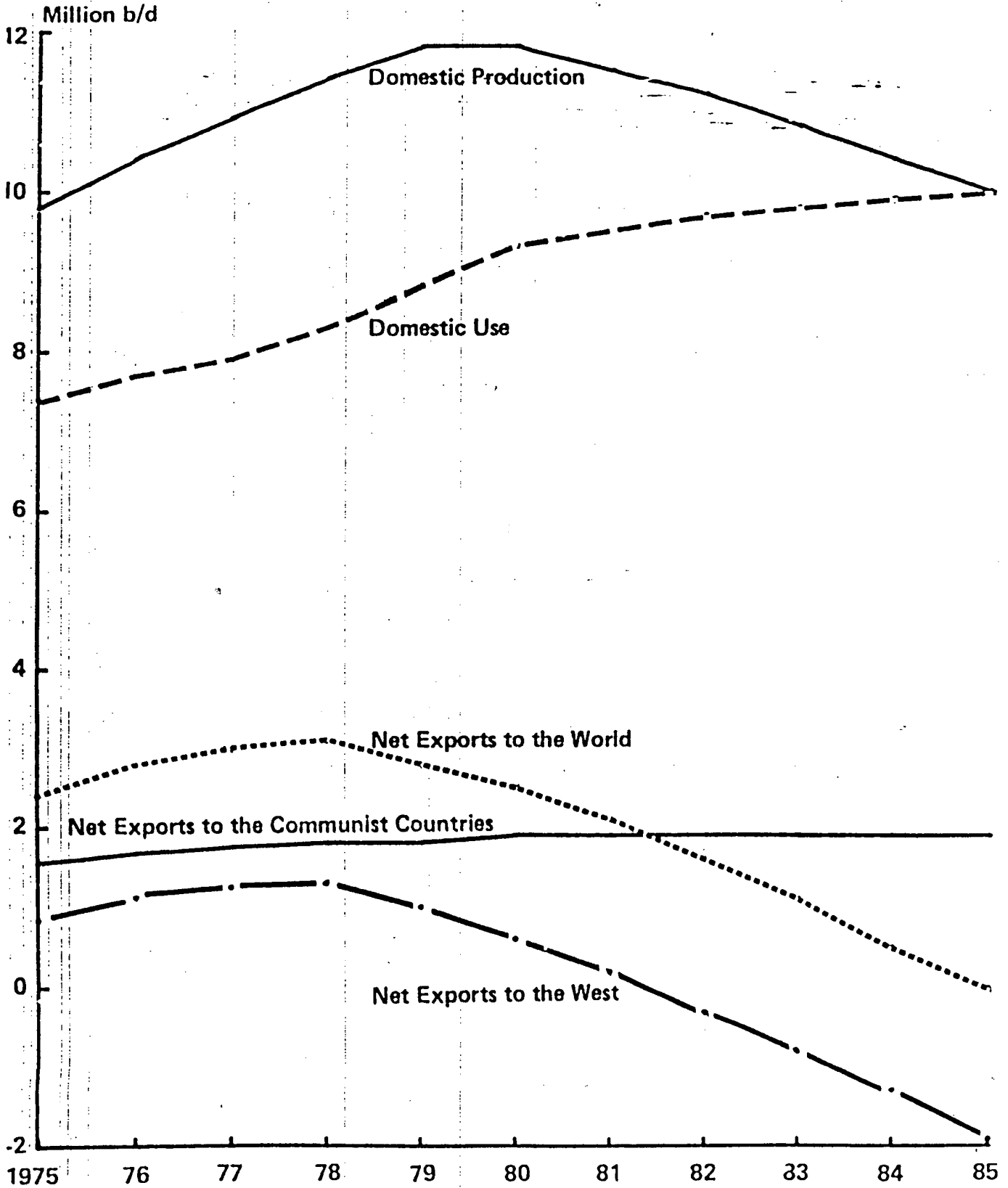
KEY POINTS

USSR ceases to be a net oil exporter to the world after 1981.

In 1985 the Soviets can supply all domestic oil needs from indigenous production.

Oil exported to other Communist countries in 1985 -- 1.9 million b/d -- must be procured from OPEC countries for barter and/or hard currency.

USSR: Trends in Oil Production and End Use¹ 1975-85



SCENARIO -- TRENDS IN HARD CURRENCY TRADE

Basic Assumptions

1. Grain imports will have top priority claim on hard currency through 1985 as the Soviets strive to reach targets for increased meat consumption.
2. The Soviets do not have total flexibility with regard to non-oil non-grain imports from the West. In some cases raw materials and semi-manufacturers are needed to support current production; in other cases equipment imports are needed in 1980-1985 to sustain certain investment programs needed for the late eighties and beyond. We assume the USSR cannot tolerate a cutback in non-oil non-grain imports from the West in excess of 50% of the current proportion between these imports and Soviet GNP. In addition, when this floor is reached, we assume that the USSR will adjust by either increasing oil exports or decreasing oil imports from the West.
3. The Soviets will likely increase their dependence on Western credits for equipment imports and, as total import capacity falls, equipment imports will climb to a larger share of a smaller pie. We assume the USSR obtains a 90% long-term financing for equipment imports by 1985. We also assume the equipment as a share of total non-oil non-grain imports rises by 50% by 1985.
4. Moscow will be loath to rely heavily on general purpose financing. Its shorter length and higher interest cost mean only a short relief from a long term problem. We therefore assume negligible general purpose financing through 1985.

Key Points

- Non-oil non-grain imports fall to floor in 1983 and later as grain, debt service, and then oil soak up available hard currency.
- Commodity exports (no gold or arms) bottom out in 1981-82 as oil trade shifts from export to import position. Later growth reflects gas and coal exports and underlying assumptions regarding exports of non-fuels. All figures are in current dollars so they reflect both price and volume movements.

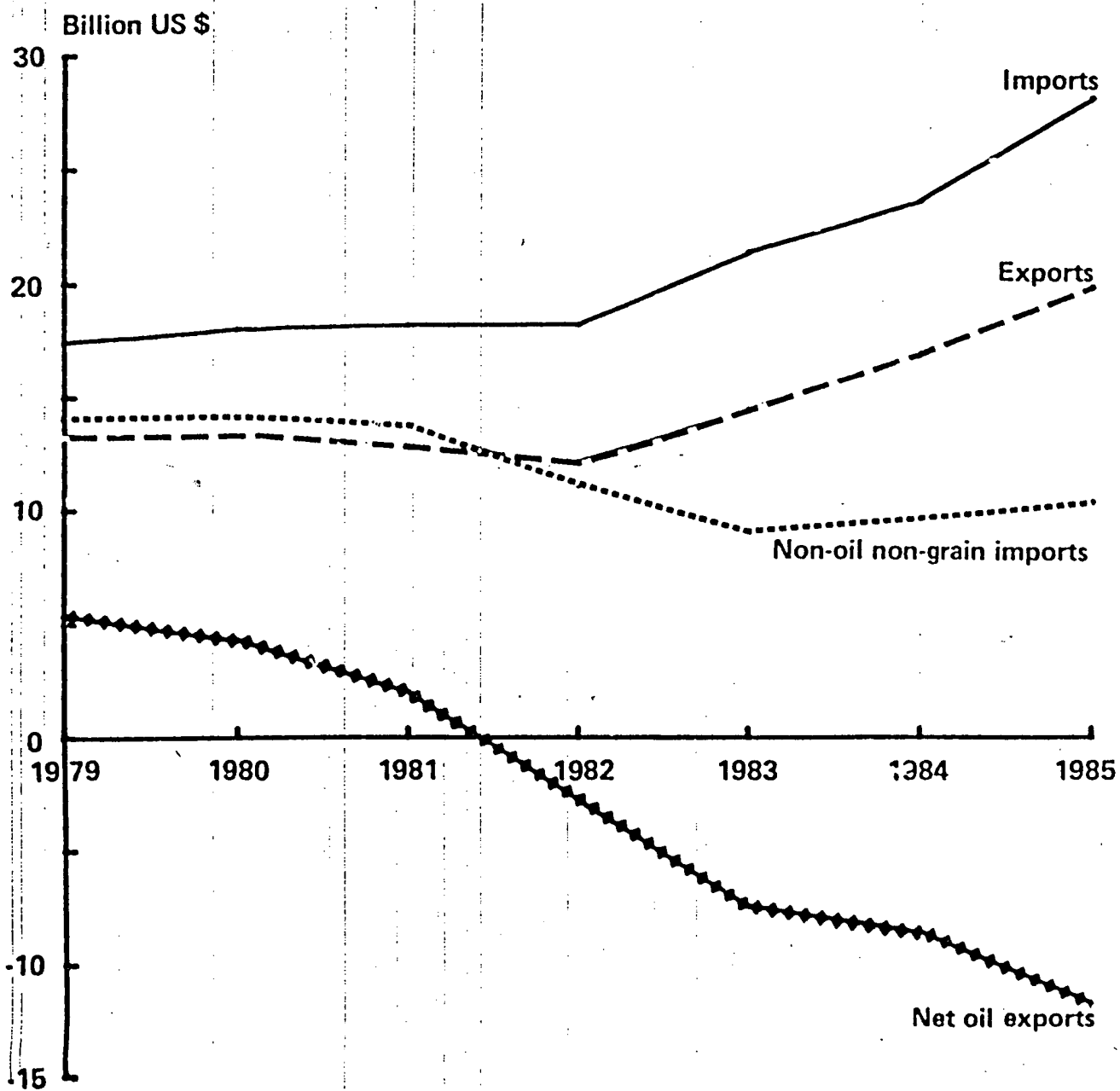
- Hard currency trade deficit -- exports minus imports -- rises over time. This implies increased need for gold and arms sales and Western credits.
- Debt-service Ratios based on total foreign exchange earnings.

<u>1980</u>	<u>1982</u>	<u>1985</u>
21%	26%	22%

This looks like some balance of payments financing would be no problem. Remember calculations assume negligible general purpose credits.

Figure 15

USSR: Hard Currency Exports and Imports



IMPACT OF DIFFERENT ASSUMPTIONS ON

GROWTH RATES OF GNP

Key Points

Case A shows effects of capital and labor constraints if energy is no problem. GNP growth falls from 3.8% in 1980 to 3.0% in 1985 due purely to slower growth in the labor force and in the productive capital stock. Cases B and E define a "growth rate envelope" based on the conditions we examined. Any combination of (1) domestic production between 400 million metric tons and 500 million metric tons in 1985 and (2) oil exports to Eastern Europe between flat and halved by 1985 would give growth within the envelope.

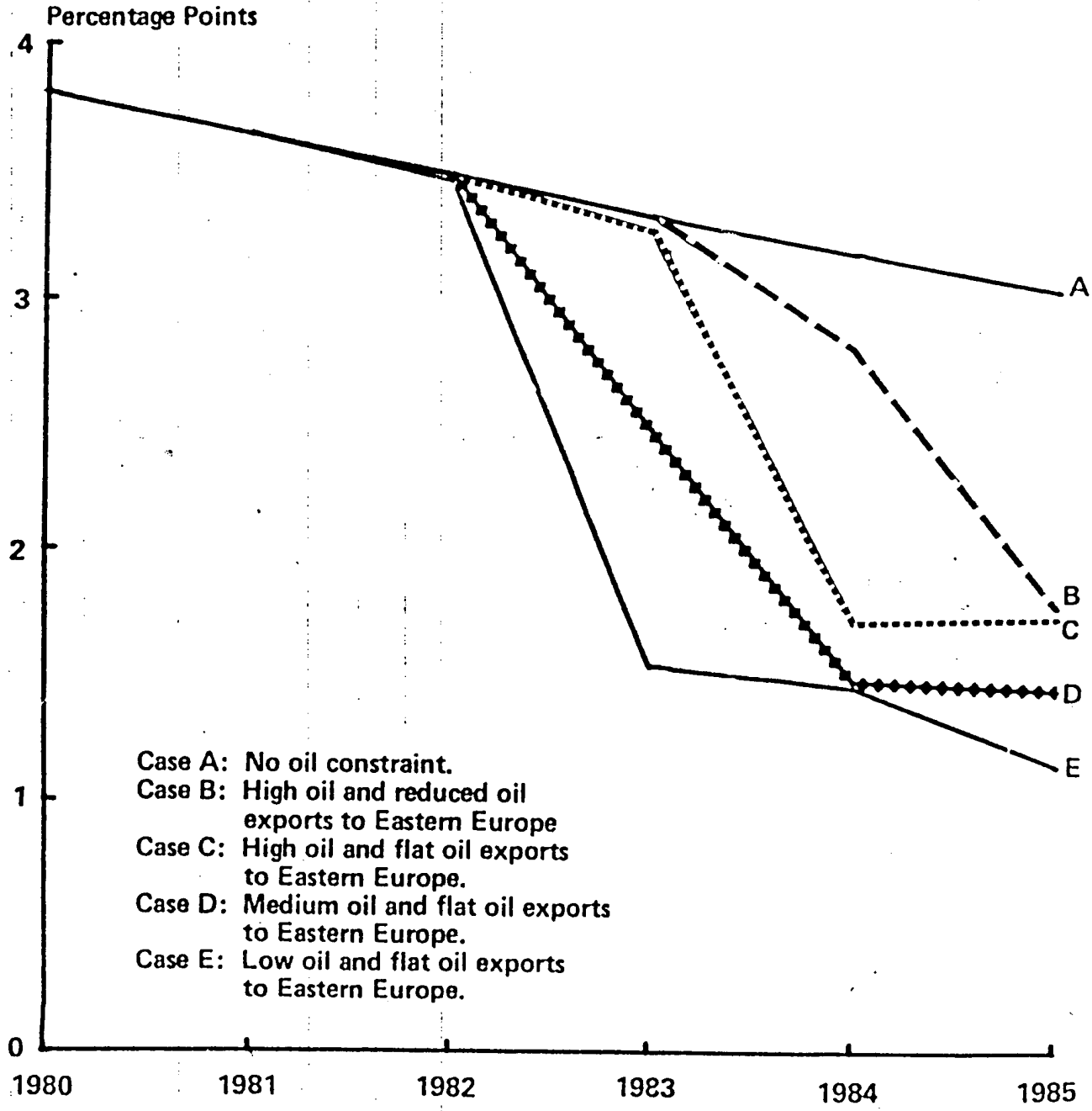
No energy constraint through 1982. Energy constraint in years after, depending on domestic oil production assumption.

Growth loss due to energy constraint is 1-2 percentage points by 1985, depending on degree of shortfalls assumed.

Halving oil exports to Eastern Europe by 1985 increases the annual GNP growth rate by 1.0 percentage point in 1984 but only 0.2 percentage point in 1985, assuming high oil production.

High oil output would delay the onset of oil shortages by only one year.

USSR: Impacts of Different Assumptions on GNP Growth Rates



- Case A: No oil constraint.
- Case B: High oil and reduced oil exports to Eastern Europe
- Case C: High oil and flat oil exports to Eastern Europe.
- Case D: Medium oil and flat oil exports to Eastern Europe.
- Case E: Low oil and flat oil exports to Eastern Europe.

FACTOR PRODUCTIVITY

Productivity gains continue to elude the Soviet economy.

Efforts to increase the quality and quantity of output and make better use of available resources continue to be frustrated by a backward technological base, rising resource costs, a tightening labor supply, and a cumbersome and inefficient system of planning and management.

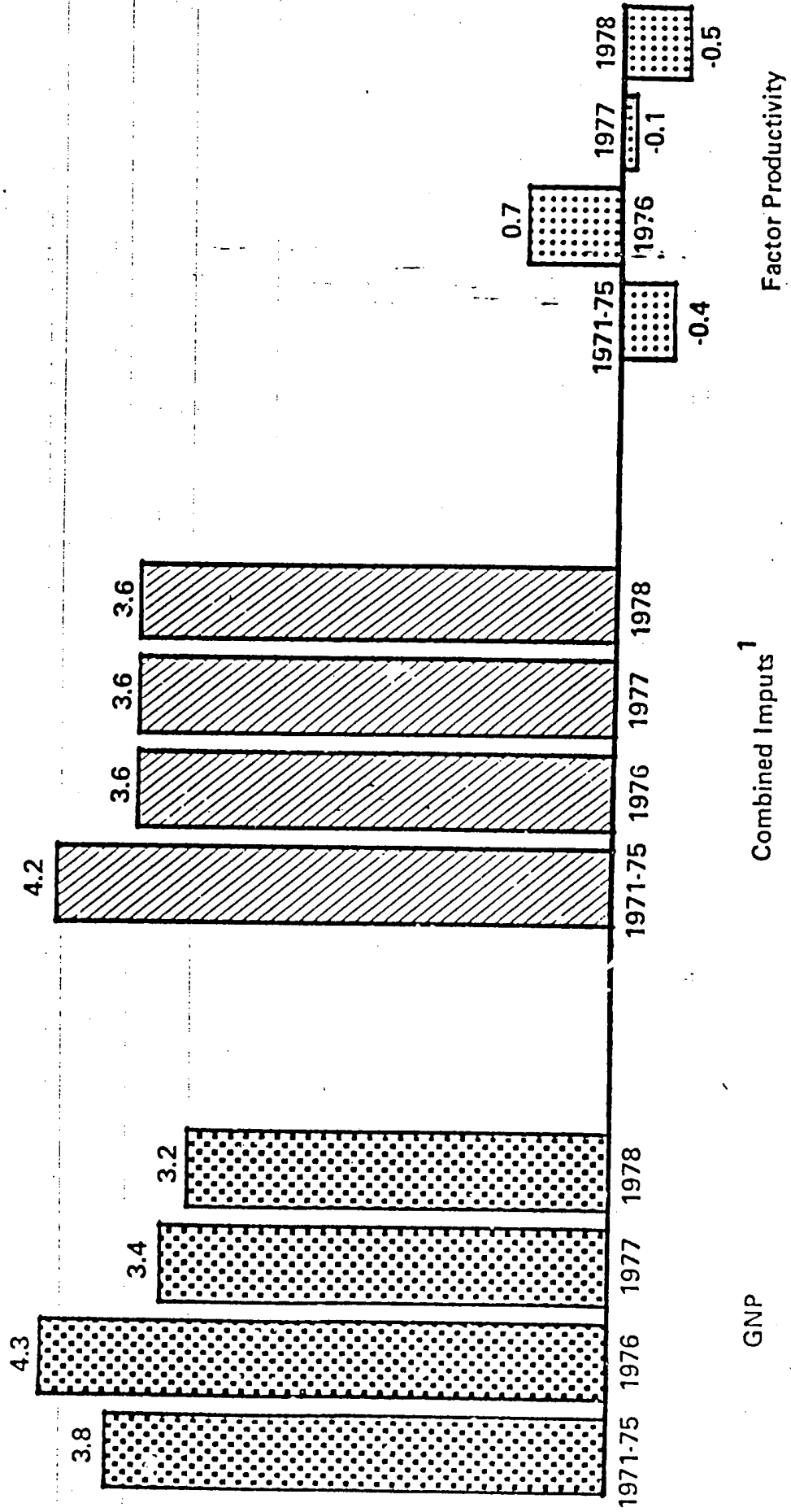
These frustrations will intensify and multiply as the economy moves into the 1980s when the pinch on human and natural resources will be most severe.

Capital formation, too, is slowing and the performance of the capital goods industries since 1975 does not bode well for a major acceleration in investment.

The practice of offsetting shortfalls in productivity by overfullfillment of employment plans is much less viable than in the past and will become even more limited in the 1980s.

USSR: Growth in GNP, Inputs, and Productivity

Percent



1. Land, labor, and capital.

LABOR CONSTRAINTS

The slowdown in growth of the working age population -- first visible in 1977 -- was even more dramatic in 1978. Industrial employment increased by only 1%, the lowest rate in at least 25 years.

Labor shortages will be a central part of the Soviet economic environment through the 1980s. Their impact will be exacerbated by the USSR's chronically poor record for introducing labor-saving innovations and by the dim prospects for an acceleration in the growth of labor and capital productivity.

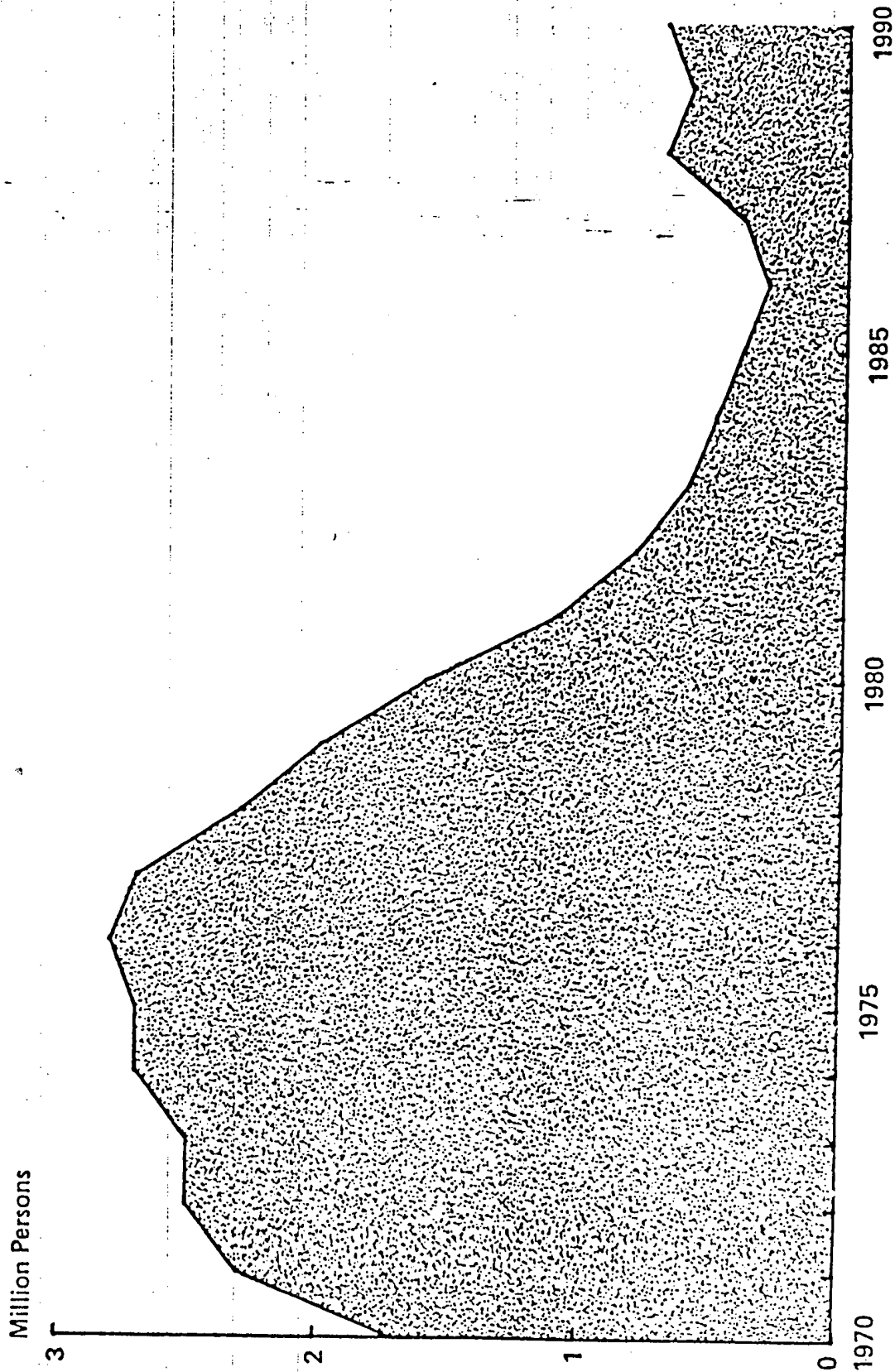
Most of the policy options available to ease the labor force constraint directly would have only a one-time impact; e.g., retaining older workers longer in the labor force, shortening secondary education, or reducing military manpower.

The reservoir of redundant farm labor -- Moscow's historic stimulus to industrial labor growth -- already has been siphoned off to develop other sectors.

Nearly all of the increase in the labor force in the 1980s will be among non-Slavic minority populations, who have consistently avoided migrating from Central Asia to labor-short industrial areas in the European and Siberian USSR.

USSR: Population of Working Age

(Annual Increment)



USSR: ENERGY BALANCE

	Million b/d Oil Equivalent											
	1970 ¹	1971 ¹	1972 ¹	1973 ¹	1974 ¹	1975 ¹	1976 ¹	1977	1978	1980 (Plan)	1980 (Estimated)	1985 (Estimated)
Supply	18.5	19.4	20.4	21.5	22.4	23.8	24.8	26.0	27.4	30.9	29.1	32.5 ²
Production	18.2	19.1	19.9	20.9	22.0	23.3	24.4	25.5	26.9	30.3	28.4	29.9 ²
Crude oil & condensate	7.1	7.6	8.0	8.6	9.2	9.8	10.4	10.9 ³	11.4 ³	12.8 ⁴	11.8	10.0 ²
Natural gas	3.3	3.5	3.7	3.9	4.4	4.8	5.3	5.7 ³	6.4 ³	7.3 ⁴	7.1	9.4
Coal	6.0	6.2	6.3	6.4	6.5	6.6	6.7	6.8 ³	6.8 ³	7.5 ⁴	7.0	7.2
Peat, shale & fuelwood	0.7	0.7	0.8	0.8	0.7	0.8	0.7	0.7 ⁵	0.7 ⁵	0.8 ⁵	0.7	0.8
Hydro ⁶	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7 ³	0.8 ³	0.9 ⁴	0.9	1.2
Nuclear ⁶	0	0	0	0.1	0.1	0.1	0.1	0.1 ³	0.2 ³	0.4 ⁴	0.3	0.7
Other sources	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6 ⁵	0.6 ⁵	0.6 ⁵	0.6	0.6
Imports	0.3	0.3	0.5	0.6	0.4	0.5	0.4	0.5	0.5	0.6	0.7	2.6
Crude oil & petroleum products	0.1	0.1	0.2	0.3	0.1	0.2	0.1	0.2 ⁵	0.2 ⁵	0.3 ⁵	0.3	1.9
Natural gas	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2 ⁵	0.2 ⁵	0.2 ⁵	0.2	0.5
Coal and coke	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1 ⁵	0.1 ⁵	0.1 ⁵	0.2	0.2
Requirements	18.5	19.4	20.4	21.5	22.4	23.8	24.8	26.0	27.4	30.9	29.1	32.5
Consumption	16.1	16.8	17.7	18.5	19.4	20.3	21.2	21.9	23.1	25.7	25.0	28.9
Crude oil & condensate	5.2	5.5	6.0	6.4	7.0	7.4	7.7	7.9 ⁵	8.3 ⁵	9.3 ⁵	9.3	10.0
Natural gas	3.3	3.6	3.8	4.0	4.3	4.5	5.0	5.4 ⁵	6.0 ⁵	6.6 ⁵	6.4	8.6
Coal	5.7	5.9	6.0	6.1	6.2	6.3	6.5	6.5 ⁵	6.5 ⁵	7.2 ⁵	6.8	7.0
Other	1.9	1.9	1.9	2.0	1.9	2.1	2.0	2.1 ⁵	2.3 ⁵	2.6 ⁵	2.5	3.3
Exports	2.4	2.6	2.7	2.9	3.0	3.3	3.8	4.1	4.3	5.2	4.1	3.6
Crude oil & petroleum products	1.9	2.1	2.2	2.4	2.3	2.6	3.0	3.2 ⁵	3.3 ⁵	3.8 ⁵	2.8	1.9
Natural gas	0.1	0.1	0.1	0.1	0.3	0.3	0.4	0.5 ⁵	0.6 ⁵	1.0 ⁵	0.9	1.3
Coal and coke	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4 ⁵	0.4 ⁵	0.4 ⁵	0.4	0.4
Additions to stocks	0	0	0	0.1	0	0.2	-0.2	0 ⁵	0 ⁵	0 ⁵	0	0
Exports	2.1	2.2	2.2	2.3	2.6	2.8	3.3	3.6	3.8	4.5	3.4	1.0
Crude oil & petroleum products	1.8	2.0	2.0	2.1	2.2	2.4	2.8	3.0	3.1	3.5	2.5	0
Natural gas	0	-0.1	-0.1	-0.1	0.1	0.1	0.2	0.3	0.4	0.7	0.7	0.8
Coal and coke	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2

Derived from official Soviet statistical yearbooks.

In computing this indicated energy balance for 1985, we have assumed oil production at the high end of the range of likely outcome -- 8.0 to 10.0 million b/d. In the event that oil production drops sooner and falls short of 10 million b/d, the USSR will probably be forced to reduce economic growth.

From Soviet statistical reports.

From official Soviet plans.

Estimated.

Converted at factors corresponding to the average amount of fuel required to produce electricity in thermal power plants