Outlook for Soviet Oil

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Summary. Public debate about Soviet oil has become more widespread in the past 5 years, but during this period Soviet petroleum exports have ceased to be made available by volume. Soviet oil consumption has usually been estimated by deducting exports from total production. This article takes the alternative approach, using Soviet statistics from a variety of sources, to build up a sectoral pattern of Soviet oil demand and to consider this in the broader context of total Comecon energy supply and demand. From this focus future prospects for the Comecon energy balance are analyzed.

For some time it has been apparent that, despite rising production, the U.S.S.R. will eventually have to choose between its internal demand, Comecon* exports, and hard-currency exports (essentially Eastern and Western Europe, respectively). Since 1975 the growth in Soviet natural gas deliveries to Eastern Europe has exceeded the absolute growth in oil deliveries from the U.S.S.R. Soviet oil supplies to Eastern Europe are now not expected to rise above the 1980 level, although total energy supplies (gas and electricity) are scheduled to go up by 20 percent between the 10th and 11th Five-Year Plans. Oil exports to non-CMEA countries, which had doubled in the decade up to 1975, have also tended to level off.

However, in view of the disturbances in the world market, the Iranian revolution, and the cessation of IGAT pipeline gas exports to the U.S.S.R., the interruption of oil exports to CMEA in 1979 from Iran and later from Iraq, and the fact that the U.S.S.R. can now obtain its foreign currency needs with fewer barrels of oil, it would be premature to declare that recent events point to a long-term decline in U.S.S.R. oil production. The program to bring the Samotlor oil field to full production at 150 million metric tons per year was brought to a successful conclusion, despite unexpected developmental difficulties, and this ensured the lower end of the all-Union production target range of 600 million to 640 million tons (12 million barrels per day) in 1980.

In millions of barrels per day, the U.S.S.R. produces 12, consumes nine, and exports three: two to CMEA and one to non-CMEA countries. Eighty percent of the export to CMEA is to Eastern Europe.

CMEA Oil Production Prospects to 1990

Any rise in crude oil production depends totally on the U.S.S.R. Romania is the only other significant producer, at about 13 million tons per year, but its production is admitted to be in decline. Remaining reserves are equivalent to only ten more years of output at the current level. None of the other East European states has any major oil potential with which to offset this decline.

Production in the U.S.S.R. is basically from two giant regions, West Siberia and Volga-Urals, and a group of smaller areas, some new, others among the world's oldest producers. It is worth noting the trends in these areas that have occurred during the 10th Five-Year Plan and then taking a reasoned view of 1985 output by area in the light of the new plan target for all-Union production (Table 1).

Output in West Siberia rose by 600,000 barrels per day in 1980 alone. After that, however, the projected rate of increase declines. By 1985 all the known producible giant fields will have peaked unless the eastern part of the West Siberian plain can provide a major discovery in the near future. The Volga-Urals decline of 500,000 barrels per day that took place from 1975 to 1980 is expected to continue to 1985, but at a slower rate because of some increase in assisted recovery and because the area is likely to continue to add some minor new fields. Estimates for other producing areas take account of rising trends in the offshore areas of Azerbaijan and Sakhalin, and the newer production areas of Komi and Georgia.

If all areas except West Siberia only achieve the lower end of the 1985 forecast, the upper target in West Siberia would just enable the lower all-Union plan target to be met. There is also significant potential to add to total liquid hydrocarbon production from natural gas liquids (NGL's) associated with the plan target to increase gas output by over 40 percent. Improved secondary oil recovery by additional "tertiary" or enhanced oil recovery (EOR) is not likely to have much effect up to 1985. This is a question of lead time rather than potential, especially as only 3 million tons or 0.5 percent of 1980 production was achieved in this way (according to Oil Minister A. Maltsev).

Some evidence that West Siberia may indeed have to provide the entire increase in U.S.S.R. production and that additional assisted recovery in the Volga-Urals area is unlikely to intervene came from an interview in Soviet News on 27 January 1981 with the Minister of Construction of Oil and Gas Enterprises in which he is reported as stating: "Another specific feature of the eleventh [planning] period is that all our efforts will be channeled into West Siberia in general and the Tyumen region in particular. These regions will account for all the increases in oil and gas production, including those which will make up for the reduction in oil production in other regions." Mention in the plan details of a target of 390 million tons for oil and NGL's in West Siberia by 1985 is consistent with this view.

Looking beyond 1985, it is worth recalling that the U.S.S.R. is the world's number one oil producer, but this inevitably involves greater drawdown of its proven reserves than in any other nation. Output of oil during this Five-Year Plan will amount to 24 billion barrels. For comparison, the recoverable reserves of Samotlor have been reported as 15 billion barrels, which places it among the top six fields ever discovered in the world. If production in the U.S.S.R. continues at this rate until 1990, the depletion of oil will be equivalent to three times Samotlor's reserves or equal to the total remaining oil reserves in the United States (as published by the American Petroleum Institute).

Therefore, while the prospect of another supergiant field in the remaining,

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eastern, part of the West Siberian plain cannot be ruled out, time is running out for such a development to make any contribution to production in this decade. It is already too late for any more remotely located Arctic or East Siberian major discovery to have any impact before 1990. Note that Samotlor itself was discovered 20 years ago but only reached full production recently.

Even if a multiplicity of fields of the average size already found in the Tyumen region are about to be discovered and developed in the eastern part of the West Siberian sedimentary basin (which has over 1 million square kilometers of potential oil-bearing area awaiting the drilling rigs), these discoveries will be necessary to maintain all-Union production after 1985. By that time, according to normal oil field time profiles, we will see production peak in Samotlor (1986) and other "first-generation" West Siberian fields beginning to decline. Without new fields by 1990 the area will resemble the current profile of the Volga-Urals. If that occurs, all-Union production will not be able to compensate for decline in its two major provinces: it too will decline.

Some indication of one high-level Soviet attitude was given in a paper presented by P. Neporozhniy, Minister of Power and Electricity, at a Moscow energy symposium in October 1979 (released with an English text). It deals with the whole spectrum of Soviet energy over the rest of the century, based on total output in 1975, and projects two "scenarios" of national income growth at 3.75 percent and up to 5 percent per year. These the paper foresees as requiring energy consumption to rise at 2.8 to 3.3 percent per year, or above 4 percent per year in the upper case—both clearly implying an improvement in the energy coefficient (ratio of energy growth to economic growth).

The 11th plan, by comparison, appears to project both national income and energy production growth at 3.7 percent per year—broadly in line with the lower scenario but without any noticeable improvement in the energy coefficient. None of the projections of total energy production explicit in Soviet texts or speeches appear to expect oil production to exceed 700 million tons at any time. This is an important pointer to Soviet attitudes to fuel substitution in the long term. I quote Minister Neporozhniy: "We should adopt a very cautious attitude towards the use of gas and especially oil as fuels. Already it is necessary to curtail to a maximum the use of these fuels at large power production plants."

U.S.S.R. Demand, 1980 to 1985

If we develop the "unique uses" concept and apply it to our limited perceptions of Soviet internal consumption, which we estimate last year was about 450 million tons of crude oil, we can broadly group consumption into (i) heat and electricity (domestic use and space heating in industry), (ii) industrial use and building construction, and (iii) transport and agriculture. The categorization is different from any in non-CMEA areas, and it happens that broadly one-third of the total consumption lies in each group. The pattern of U.S.S.R. internal oil consumption that follows is based in part on Leslie Dienes' October 1979 paper on Soviet energy policy and on papers given by Soviet energy officials and comments made at the Moscow energy symposium in the same month.

Domestic use and space heating. Apart from any oil-fired power stations in the background, or oil-fired boilers for district heating, there is little oil in the energy mix. Dienes estimated as little as 10 million tons of annual domestic oil use, which is only 2 percent of total U.S.S.R. oil consumption.

The typical new city apartment uses district heating, for which nuclear power stations are beginning to be used as well as thermal stations. Very large diameter pipes enable "waste heat" to be transmitted up to 40 kilometers despite adverse climate. Regulation of the heat received is not so effective, but the sight of windows open in Moscow in subzero temperatures to reduce room temperature, while offending the conservation-minded visitor, is not comparable to Western practice if one reflects that most of us fail to collect the heat in the first place.

The actual electric power produced is used in the apartment for lighting and appliances only; cooking is normally by gas, for which a flat service fee is charged unrelated to the amount used. The cost of electricity is related to the amount used, but a typical cost in 1979 would be 8 to 9 roubles a month—as much as the rent, but with two or more wage earners per apartment all these sums are insignificant. Electricity costs are rising, but any "market sensitivity" through price response appears to be nonexistent.

How typical is this picture? One answer lies in the figures issued by the Central Statistical Bureau in Moscow. Flats and apartments are being built at an annual rate of over 2 million, but the increase in the number with gas facilities has been rising at nearly 4 million annually, so that whereas 10 million apartments had gas in 1965, by 1978 the figure was over 50 million and by the end of last year could be approaching 60 million. The number of apartments built between 1950 and 1980 is also about 60 million. Records of the number of citizens who receive new flats annually show a consistent average of just below four people per apartment. In addition, about 3 million people annually receive fresh accommodation in renovated buildings. The "gross" list of 300 million people rehoused from 1950 to 1980 (and the figures on gas retrofitting and new apartments) is nearly double the total urban population of 165 million, which is nearly two-thirds of the total U.S.S.R. population. With life expectancy of 60 years, changes in marital status, and so forth, the entire urban population will have gone through at least one turnover since 1950. Add to this the statement, in a symposium paper by V. P. Korytnikov and V. E. Arakelov of the Ministry of Power and Electrification, that 170 million people use gas for domestic purposes, and the comprehensiveness of the penetration of gas becomes clearer. Gas Minister Orudzhev, over Moscow home service on 28 February 1981, estimated the number of people who used gas "in the household" as nearly 200 million.

No equivalent data were given for district heating, although it is clear (from the paper by Korytnikov and Arakelov) that nuclear power use for this purpose is just beginning, for instance, at Odessa and in Gorky. It is also clear that gas penetration is intended to take over district heating from oil wherever a supply is available and that in both electricity generation and other thermal boiler outlets natural gas is about to surpass oil as the primary source of supply. The oil demand for 1980 that results is 190 to 200 million metric tons of standard fuel (MMTSF). This at once accounts for electricity and the entire area of domestic use (except transport).

Industry. Again, the symposium paper of Korytnikov and Arakelov is enlightening: "More than 55 percent of all energy is consumed by industry. Approximately 52 percent of the total energy consumed in industry goes to three branches which are conspicuous by their high energy consumption—oil refining, chemicals, and steel. Approximately 22 percent of energy consumption is in building materials, nonferrous metals, food, paper, and pulp. The remaining 26 percent are the low-energy consuming branches of industry."

They go on to claim a 15 percent energy saving in oil refining and chemi-

Table 1. U.S.S.R. oil production by region.

Region	Production (million metric tons)	
	1980	1985
West Siberia	312	350–390
Volga-Urals	190	140–160
Baku and offshore Caspian	15	25–15
Kazakhstan–East Caspian	25	35–25
North Caucasus	21	20–17
Georgia	3	4–3
Ukraine, White Russia, and Baltic offshore	11	10–6
Komi	23	30–26
Far East	3	6–3
Total	603	620–645

cal plants since 1970 by saving electricity through new processes and more efficient use of recycling process heat at intermediate stages. The high level of electricity used in steel does not give them any overall hope of economies, although they are more hopeful about nonferrous metals such as aluminum (10 to 15 percent target savings during the 10th plan). New processes in cement manufacture and in papermaking show only marginal savings in the targets for the same period. Secondary energy use in industry generally is expected to show up to 20 percent more harnessing of available waste heat between 1975 and 1985.

But in general one cannot expect much practical energy saving from this list. Good housekeeping practices in industry are subordinate to production requirements. Recycling in a variety of processes to improve the use of waste heat in other industries is again largely a matter of skilled and consistent practice on the site. The technical improvements in oil refining will in part be offset as the U.S.S.R. phases out the use of mazut (residual fuel oil) by power stations and aims to lighten the barrel; more complex refining processes require more fuel.

Again, it is substitution by gas that is significant. According to Korytnikov and Arakelov, "Today 80 percent of steel, 85 percent of cast iron, 40 percent of rolled steel, 20 percent of nonferrous metal, and 60 percent of cement is produced with natural gas." They expect a doubling of the use of gas in industry in the "current" (10th) plan period and this trend is expected to continue. Even higher figures were given by Orudzhev on 28 February 1981: 93 percent of iron and steel, 60 percent of cement, and 95 percent of mineral fertilizers. Dienes estimates 50 MMTSF for use of oil in industry in 1976 and 55 MMTSF for gas, and estimates in aggregate 170 MMTSF in 1980. In addition, he shows various figures for oil for chemical manufacture, oil refining, pipeline losses, fuel, and other uses which the Soviet classification includes in the industrial category. These additions double the totals of both oil and gas required in 1976 and raise the combined oil and gas figure for 1980 to about 420 MMTSF. Oil use in industry in 1980 (including the oil industry itself) would on this progression have amounted to 200 MMTSF or 140 million tons of oil. In industry, as in space heating and electricity generation, oil is being phased out of the energy-intensive sectors, not by price but by allocation.

Transport (including the agricultural sector). Here, dependence on oil is much more difficult to limit, and this may be why the price mechanism has been involved in the recent doubling of gasoline prices. Current Soviet estimates indicate that about 150 MMTSF of oil is used in transport and a further 50 in agriculture, about 140 million tons of oil in total.

Railways, in terms of freight ton-miles, are over 50 percent electrified; the rest are all diesel, including passenger trains. In terms of direct use of oil, railway diesel is only 2 to 3 percent of total oil use. Aircraft, vital in the largest country, are more significant as a growth factor and may be expected to grow at least double the rate of growth of national income in terms of freight and passenger miles. Introduction of wide-bodied jets will help to economize on fuel, but the older aircraft they displace will tend to swell the secondary routes. Road transport and tractors showed the following average annual increase in numbers in recent years: trucks, 800,000; passenger cars, 1,300,000; trolleybuses, 2,000,000; other buses, 100,000; and tractors and so on, 600,000.

The extent to which these production figures represent net increases in vehicular use is difficult to judge, but in the case of passenger cars and tractors they largely represent an increase in the total vehicle population. At this level another 20 million to 25 million tons of oil for vehicles of one type or another could be needed by 1985. Air, marine, river, and rail increases might add another 15 million to 20 million tons. This would raise total transport demand from 140 million tons in 1980 to 175 million to 185 million tons in 1985, after which the net incease in new vehicles may start to slow down (offset by obsolescence). And one must not overlook the fact that transport by tramcar and trolleybus dominates urban commuting, as the scale of trolleybus construction implies. Increasing urbanization will also see more cities passing the level of 1 million citizens, at which point they can, apparently, press for a subway to be built—a further depressant to the increased use of oil.

Table 2. Internal U.S.S.R. oil use in 1980.

Use	Million metric tons	
	Standard fuel	Oil
Heating and electricity	200	140
Industry	200	140
Transport and agriculture	200	140
Nonenergy uses (bitumen, lubricants, and so on)	30	20
Total	630	440

To summarize, U.S.S.R. total 1980 oil requirements amount to about 440 million tons, broken down as shown in Table 2. Adding a factor of 2 percent of the total for losses and the first stockfilling of new pipelines and storage tanks gives an adjusted total of nearly 450 million tons of oil as the level of U.S.S.R. domestic consumption in 1980. The figures, of course, are not that precise (a major uncertainty is military use), but there is a large degree of confluence of the assessments from different Soviet statements.

What does this imply for 1985, even at depressed economic growth rates? The minimum value would be obtained by taking the 1980 estimate of 450 million tons; adding on the whole increment for transport at 35 million to 40 million tons; adding on the increase in chemicals and other nonenergy uses (fertilizers, lubricants), all sectors that are largely unsubstitutable, at 10 million tons; and assuming that conservation and substitution take care of potential oil growth in all other sectors. That puts a minimum value on 1985 demand of 485 million to 500 million tons of oil, depending on what is added for losses in transit and storage. The maximum value is obtained by assuming that oil demand increases at the same rate as national income. If that were to occur, 1985 oil demand could be as high as 540 million tons.

The higher projection is unlikely. The continuing phasing-out of oil in power stations and energy-intensive industries, mainly by gas, will continue, and there will be curbs on the use of passenger cars (such as the recent doubling of gasoline prices). There will also be increases in efficiency in transport and industry. It is equally unlikely, however, that the U.S.S.R. will be able to reduce demand for oil below the bottom of the lower range, which will require an average annual increase in the supply of crude oil

of 9 million to 18 million tons, throughout the 11th plan, compared with an increase of 3 million to 8 million tons in annual crude oil production. Taking the mean of both sets of figures, oil demand will tend to grow at about twice the annual growth in oil supply if the economy meets its plan targets.

Of course, a slower rate of economic growth may alleviate the pressure on oil, as it has done elsewhere. But the short-term economic results (3.8 percent national income advance in 1980 compared with 4.0 percent planned) do not presage a dramatic slowdown beyond that which occurred during the past decade compared with advances in the 1950's and 1960's. Against this is the fact that the rate of substitution of oil by gas is unlikely to be perfectly on schedule, nor are the production targets for coal and nuclear power guaranteed.

Eastern European Demand, 1980 to 1985

There are three key features of oil use in the Eastern European countries ("the Six"). Perhaps the most notable is the low percentage of oil in the energy balance. The three northern countries, Poland, Czechoslovakia, and East Germany, averaged a mere 20 percent of oil in their energy mix, while the three more southerly countries, Hungary, Romania, and Bulgaria, averaged 33 to 40 percent—similar to the U.S.S.R. The OECD (Organization for Economic Cooperation and Development) average is 50 percent of oil in the total energy mix. The decline in oil production in Romania has resulted in plans for all six nations to increase the use of Soviet gas imports, raise the production of solid fuels, and embark on ambitious nuclear programs. The combined production of solid fuels is impressive by any standard and in 1980 was in excess of 700 million tons in natural units (that is, in tons weight as produced, not in "standard" calorific tons according to heat value) compared with oil production of 20 million tons. For comparison, the U.S.S.R., with 2.5 times the population, produced the same quantity of coal but 30 times as much oil.

This is a key difference between the Six and the U.S.S.R. While the U.S.S.R. has sufficient flexibility in its primary energy mix to substitute for oil, Eastern Europe (except Romania) has little or no flexibility. For example, the ability to reduce the use of oil in electricity generation is almost nonexistent: solid fuels provide 80 percent of total generating capacity in Bulgaria and East Germany and 90 percent or more in Czechoslovakia and Poland.

Table 3. Potential energy and oil growth rates, 1981 to 1985.

Country	Plan target national increase* (percent per year)	Oil coefficient potential	Implied oil increment (percent)
Bulgaria	5	0.7	19
Romania	7	0.5	19
Hungary	3	0.7	10
East Germany	5	1.0	22
Czechoslovakia	3	1.0	15
Poland	0.5	1.0	5

*Information from National Westminster Bank Ltd. in September 1981.

The second feature is the high use of energy per capita, especially in East Germany, Czechoslovakia, and Poland. On an adjusted standard of living basis (relative to East Germany), Poland emerges as the highest user per capita with Romania second—the two nations with, until recently, a significant energy export potential.

Third, the group are heavily import-dependent, with over 75 percent of their oil coming from the U.S.S.R. and a rising share coming from non-CMEA sources—from 5 million tons in 1975 to 20 million tons by 1978–1979, when both price and volume were abruptly upset by the events in Iran and later Iraq. The effect on growth of the disruption to non-CMEA imports has been masked by the economic recession. The level of consumption, expected to be 105 million to 110 million tons in 1980, was probably only 103 million tons. The Adria line appears hardly to have been used by the full CMEA members, and supplies from the U.S.S.R. have now reached a plateau. Prices of both external sources of supply have doubled. Romania, until recently the only exception to import dependence, is admitting production decline and has purchased oil and gas from the U.S.S.R. Growth of national income, although lower than planned everywhere except Bulgaria, was reasonably close to planned targets, but these are only a shadow of growth rates in recent past.

The Hungarian (6th) Five-Year Plan is an example: national income is to rise 14 to 17 percent by 1985 and industrial output 19 to 22 percent, but energy is due to grow at a maximum of 10 to 11 percent with a 4 to 8 percent fall in hydrocarbons. Production of crude oil is to be "maintained" and oil imports, it is clear, are not expected to increase.

That the U.S.S.R. has placed a limit on oil exports has also been acknowledged by East Germany, Czechoslovakia, and Poland. How rigorously the 1980 level of supply will be maintained as a ceiling remains to be seen, but extra quantities will apparently be priced at full world parity and that could prove as effective as a volume constraint.

The apparent improvement in the energy coefficient (0.7 unit of energy growth for each unit increase in the economy) is a realistic target, given the high degree of energy use in Eastern Europe. Hungary emerged from a recent analysis as the most efficient per capita energy user of the Six, so that short-term energy coefficients as large as perhaps 0.5 to 1.0 could be achieved in the Romanian, Polish, and East German economies, which have a higher use of energy per capita.

There are also some spectacular, once-for-all, energy saving adjustments possible in the scope of total CMEA trade. One example is the potential for East Germany to switch from bauxite to alumina imports from the U.S.S.R., thus removing at a stroke the entire energy-intensive process from Germany. Of course, the U.S.S.R. will incur the burden, but it may use hydropower, not fossil fuels. If the accounting procedures for energy saving in East Germany also credit nuclear power stations with "saving" fossil fuels and if importing electricity "saves" indigenous consumption of primary energy, we could hear dramatic claims that economic advance is being achieved with negligible increases in the use of energy. But there are two problems with this type of accounting: (i) it cannot last into the long term once the main once-for-all measures have been effected, and (ii) due to the structure of oil use which is limited to unique purposes, substitution is ruled out. Romania is the exception, with plans to virtually eliminate oil burning in power stations (use of oil and gas, now 30 percent of the total, to be reduced to 4 percent combined by 1990).

The oil position in this regard is different from that in energy. Limiting use in Hungary, where more than one-third of national energy is oil-based, is going to be considerably easier than in East Germany, Czechoslovakia, or Poland. If the Five-Year Plans are fulfilled, the oil pattern shown in Table 3 is projected. On this basis, 1985 demand would be 120 million to 125 million tons. However, if the position in Poland remains as it is and conditions deteriorate elsewhere, oil demand for all six countries may not exceed 115 million tons by 1985. It is difficult to see the unique uses of oil allowing the total to go much lower.

On the other hand, better efficiency in energy use could result in further improvements in the energy coefficient, partly due to special effects already men-

Table 4. Potential oil demand and supply in CMEA, 1985.

Region	Million metric tons		
	Production	Domestic demand	Export surplus (net)
U.S.S.R.	620–645	490–540	+155/+80
Eastern Europe	15–20	115–130	−95/−115
Total	635–665	605–670	+60/−35

tioned but mainly because of the high intensity of use. It does not seem technically impossible for the energy coefficient to increase in the short term to 0.5 to 1.0, reducing 1985 demand to little more than 500 million tons compared with previous estimates of 530 million tons (oil equivalent).

These are not forecasts but perspectives. The achievement of such a sustained improvement in energy efficiency is a formidable task but is practical. The problem with the oil targets, however, is that the end uses for all the new growth are technically inflexible—another aircraft, another road vehicle, another chemical feedstock plant.

Outlook for Total 1985 CMEA Oil Balance

The estimates from the preceding sections are summarized in Table 4. The export surplus is expected to decline. Eastern European demand will have to allow for gross imports sufficient to provide reexport products to non-CMEA markets at about 10 million tons per year, mainly Romanian trade. If the U.S.S.R. continues to limit exports to Eastern Europe to 80 million tons (approximately the 1980 level), some 30 million tons of non-CMEA crude would have to be imported annually by Eastern Europe, even at the lower level of 1985 demand. If demand within the U.S.S.R. is also held at the lower level and 80 million tons of oil continues to be exported to Eastern Europe, only 50 million tons would be left for export to both non-Communist and Communist areas (other than Eastern Europe). Since deliveries to Vietnam, North Korea, and so on cannot easily be reduced (as yet, none of these countries is a producer), the ultimate quantity available to sell for hard currency may be only half the 1980 level despite the "freeze" on Eastern Europe. This loss of volume would be compensated by higher dollar prices and by gas exports. The key, of course, is higher production success in West Siberia to alleviate the total oil balance.

Prospects for 1986 to 1990

Supply. The pattern after 1985 will put tremendous reliance on increasing production in West Siberia. For example, a senior economist with the Soviet Academy of Sciences, Abel Aganbegyan, was quoted by Reuters as having said in Moscow on 21 March 1981 that a 50 percent increase from 1980 to 1990 is anticipated. However, he expected this regional target to be 70 percent of all-Union production, that is, 475 out of 670 million tons. This would mean all other areas combined would produce less than 200 million tons. Allowing for some continuing successes in minor producing areas, the implication for the Volga-Urals could be that production is expected to be only half the level of recent years.

If the forecast of Aganbegyan is realized, West Siberia will be producing more crude oil than the entire United States does today, and by 1990 the comparison could be even more noteworthy. It would also mean that for 20 years, 1970 to 1990, the world's number one oil producer would depend on this one region for its production growth.

Is this feasible? The potential resources of this vast sedimentary basin could have this sort of potential, but unless some giant oil fields emerge that are easy to develop, the time scale is barely adequate. Of the known giant fields, there are technical extraction problems at Salim. The U.S.S.R. does not expect production from Salim until 1986, when this highly viscous field is expected to yield 5 million tons per year. As geophysicist Arthur Meyerhoff has noted on several occasions, the Bazhenov shale formation underlies Salim at a depth of 3000 meters, which is perhaps sufficient comment on the prospects for this location.

The essential perspective on West Siberia at this point is that without substantial new developments or discoveries U.S.S.R. production could decline by 2 million barrels per day in 1990 because of decreases in other regions and because Samotlor, currently accounting for 25 percent of U.S.S.R. production, will be past its peak. Enhanced recovery techniques and deep drilling may not be as important as the intention to treble the amount of exploration and development drilling in West Siberia and elsewhere. Of course, accelerated effort and higher quality equipment are always useful, and better drilling techniques may save as much as a year in drilling below 15,000 feet. Soviet technicians claim to have achieved this depth off Baku, and most of the oil in the Volga-Urals and West Siberia is at half this depth.

Table 5. Projected CMEA oil balance, 1990.

Region	Million metric tons		
	Production	Consumption	Export surplus
U.S.S.R.	600–675	525–570	+150/+30
Eastern Europe	10–15	125–140	−110/−130
Total	610–690	650–710	+40/−100

Enhanced oil recovery simply refers to another set of methods to stimulate the "energizing" of the flow of crude oil from a reservoir by increasing pressure or improving viscosity. It is used at a mature stage to maintain production profiles and arrest decline and may not increase production flow rates significantly above the level of the mature profile. The limits to the effectiveness of EOR in raising daily production (as distinct from preventing decline and increasing total recoverable reserves over time) are slowly being realized all over the world. It is not a panacea outside CMEA and it will not overturn the oil outlook within CMEA, although its long-term effects in extending the useful life of oil fields are fully appreciated.

The increase in drilling is partly a response to public complaints by the oil producers that too little exploration drilling took place in the past few years. Exploration appears to have taken second place to development priorities at Samotlor and elsewhere, and the gap is now being felt. But footage drilled is not a guarantee of major discoveries.

Demand. After 1985 opportunities to substitute gas for oil will become much more limited. The major energy-consuming industries such as steel and cement, electricity generation, and CHP (combined heat and power) for the main urban centers will already have been converted. All that will be left will be smaller outlets in areas where the gas grid is remote and oil is more accessible.

The logistics also require the phasing out of older refineries. Data produced by the CDPD (Comité d'Information des Pêtroles) in Paris show about 470 million tons of refinery capacity in units over 2 million tons. There is a great preponderance of refining at this size, and the average size of plant is less than 4 million tons per year. The plants are spread widely throughout the Soviet republics and the yield of 50 percent of the average barrel refined has been left as residual fuel oil, mazut, no doubt for local power stations and so on. Now that gas is taking over this role, the mazut is not required and its heavy molecules need to be cracked to lighter products for trans-

port and chemical feedstock. To do this effectively larger refineries with wider distribution networks are essential. The CDPD figures show an impressive total of 200 million tons of much larger plant, averaging 8 million tons per year, under construction, mainly in European city areas, Central European U.S.S.R., and Ukraine, and also in West Siberia where there are several urban centers with 1 million or more inhabitants. The plan details are flimsy, apart from calling for a better refinery yield of higher quality products, but they do include a sixfold increase in product pipelines (12,000 kilometers).

A great deal will depend on the logistics and timing of further penetration by other fuels. Long-distance high-voltage electricity from Ekibastuz to the cities of the Urals and Central Asia is due before 1985, so that its effectiveness (and thereby a major key to the use of coal and lignite from Kazakhstan and Kansk-Achinsk) will have been tested before the 12th plan commences. The use of nuclear power for district heating will also have been tested, and for European U.S.S.R. this is a vital development for the 1990's.

In the same way the pace of development in the nuclear industry in Eastern Europe will be of prime concern, as the limits to lignite production, in East Germany for example, are already of some concern. In the Asiatic U.S.S.R. the degree of success in producing oil from Kansk-Achinsk lignite at Krasnoyarsk will be establishing its potential as a major long-term oil source. It would be interesting to compare the future costs of this source of liquid fuel with exploration and development costs offshore in the Arctic basins. Both are likely to be extraordinarily high and neither can have any impact before 1990, but they do serve as a reminder of the impressive long-term potential of Soviet energy resources. Nevertheless, from 1985 to 1990 it appears inevitable that the U.S.S.R. will be dependent on the same areas of production as in the first part of the decade.

Economic growth in 1986 to 1990 is likely to be planned at a similar level to that in 1981 to 1985—about 3 percent per year or perhaps a little lower—but with many of the easier options for substituting other fuels for petroleum already exhausted, annual growth in oil demand in unlikely to be much below that in 1981 to 1985. Extensive road networks complementing the BAM (Baikul-Amur railway) and other TPK's (industrial development projects) are mentioned in the current plan and the rail network in other areas is likely to remain saturated, requiring more road (diesel) haulage. Air transport will continue to be an expanding sector. The oil situation in Eastern Europe is likely to be unchanged in all major respects, except that Romanian crude output will be lower.

A possible 1990 oil balance is shown in Table 5. Because of the potential supply constraints and other depressants to general economic growth, the upper end of the demand range is unlikely to emerge. However, there are also doubts about the upper end of the supply range. Even taking the most comfortable combination, the trend toward elimination of any export surplus (including the problem of supply for non-European CMEA) is clear. But unless, for example, Vietnam discovers oil, Eastern Europe is unlikely to take complete priority in CMEA, and that implies that 1 million barrels per day of Eastern European demand will have to come from non-CMEA sources. The ability to pay for this is one of the major uncertainties in the entire CMEA energy balance.

However, if the costs of producing oil are rising steeply (some recent Soviet commentators have suggested a 20-fold marginal cost increase), then the Eastern European nations may consider the real economic cost of acquiring crude from world markets to be no worse than that of investing in or paying for marginal Soviet production. The Soviet Union is now increasingly closing the gap between the price of its crude (and natural gas) to the Six and world price levels—with quantities above planned supply levels at full market price.

So, if the incentive exists, the trade necessary to achieve imports of crude from non-CMEA sources will almost inevitably be attempted under the aegis of existing or new trade deals. Once the Iran-Iraq conflict is over, the decline in oil demand in OECD will ease the problems of access. How the trade will evolve is difficult to predict. But the demand potential exists in Eastern Europe, and although the U.S.S.R. itself is unlikely to need oil imports, the burden on incremental U.S.S.R. domestic production will be eased if Eastern Europe develops alternative sources of supply on the lines already achieved between 1975 and 1979. One way or another, their trade balances will have to respond to the higher cost of oil imports.

Conclusion

It is not very productive to attempt to reach a numerical evaluation of the success or failure of energy policy in such a large region of the world over 10 years. In any case, we are dealing with perspectives and not with definitive forecasts. There is no 20-year plan in this decade in the background to hint at the direction of the next Five-Year Plan before it is revealed. However, certain pointers to Soviet attitudes appear to emerge repeatedly:

1) The U.S.S.R. intends to remain self-sufficient in energy and in each major type of primary energy.

2) The continued upward movement of all-Union oil production is intended to depend primarily on the further development of West Siberia.

3) A major rationalization of the role of oil, and in the longer term of gas also, is under way. No more power stations will be developed to use oil; gas is taking over the role of oil in a number of locations in the domestic and industrial areas. Natural gas has already assumed a dominant role in incremental supplies to the rest of European CMEA and this will escalate. Similarly, gas will take a major incremental role in world exports.

4) Electricity will maintain its key role but with a major shift toward nuclear power in Eastern Europe and the European U.S.S.R. as coal production in the latter begins to level off. In the Asiatic U.S.S.R. the linking of the last two major electricity grids with the all-Union grid, subject to success in high-voltage transmission, will enable this vast area to be based on coal and indeed will enable the distant coalfields to be brought into effective use.

5) Conservation is a lively issue, accentuated by the need for greater overall industrial efficiency. However, it runs second in the Soviet Union to primary fuel allocation to the various economic sectors. In Eastern Europe, with its noticeably low oil mix, substitution is not available to nearly the same degree and great emphasis has to be placed on conservation.

6) Higher energy prices are having an effect throughout CMEA, but whereas they add to the Russian bargaining position within CMEA, the reverse is true in Eastern Europe. Therefore, faced with an absolute oil problem and not just an energy problem, the Eastern European states face a need to balance their terms of trade with all their oil suppliers. Given their state of development and their appetite for oil, this must in the long term point them toward an expansion in international trade, while at the same time they will continue to depend on the U.S.S.R. for the great bulk of their hydrocarbon supplies.