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Economics of the Siberia-to-Europe Gas Pipeline

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Key Judgments

The Siberia-to-Europe natural gas pipeline is of great importance to the Soviet economy, even though it would be a marginal project at best if evaluated in terms of Western profitability accounting. The likely softening in West European gas demand in the 1980s will probably force the pipeline's gas to sell at nearly the same price as residual fuel oil, roughly $4.00 per 1,000 cubic feet (cf). At that price, the Soviets would not earn a profit unless they accepted a fairly low rate of return on their capital. Algerian gas, in contrast, could easily be profitable at the $4.00 price. If the Soviets expected a higher rate of return on capital—comparable to those rates considered reasonable by Western standards—the Siberian project probably would earn a profit only if the gas were priced at parity with crude oil, roughly $6.00 per 1,000 cf.

These calculations, however, do not reflect important considerations that make the pipeline profitable as well as important to the Soviet economy:

- Moscow cannot find alternative uses for most of the gas to be shipped to Western Europe until the Soviet domestic gas distribution network is expanded—a costly and time-consumming undertaking.
- The Western goods Moscow can buy with the gas project's annual earnings of about $4 billion are worth a great deal more to the Soviet economy than are the domestic goods that could be produced with the Soviet resources used to build and operate the pipeline. Western goods incorporate better technology than do Soviet goods and fill important gaps in supplies.
- Alternative sources of hard currency exports on the scale of those the pipeline will generate are either unavailable or would cost a good deal more in Soviet labor and capital goods.
- With the likelihood that Soviet oil exports to the West will nearly disappear over the next few years, and with few prospects for a large expansion of alternative exports, construction of the pipeline is necessary to prevent a severe decline in Moscow's capacity to import from the West.

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Economics of the Siberia-to-Europe Gas Pipeline

Introduction

This paper evaluates the economic costs and benefits to the Soviet Union of the proposed Siberia-to-Europe gas pipeline. The project's viability is first judged in Western terms, with the application in some instances of costs that might occur for similar projects undertaken in the West. After calculating a range of gas prices that would enable the project to break even, the pipeline's potential profitability is estimated using the strictly Western criterion of netback—or rent—at the wellhead and our assumptions about a likely selling price for Soviet gas in Western Europe. The project's viability is then examined from a Soviet national perspective, which requires consideration of broader criteria.

A summary of our estimates and assumptions regarding the costs of the Siberian project and probable gas prices is presented in table 1. Subsequent sections will provide more detail. This paper updates our earlier assessment, *USSR–Western Europe: Implications of the Siberia-to-Europe Gas Pipeline*, ER 81-10085/PA 81-10107, March 1981.

Table 1

Soviet Pipeline Costing [a]

Hard currency costs	$8 billion
Construction costs	$3.75 billion per year, 1982-85
Gas cost at wellhead	50 cents per 1,000 cubic feet
Gas processing costs	12 cents per 1,000 cubic feet
Input into pipeline	3.3 billion cubic feet per day
Operation and maintenance	70 cents per 1,000 cubic feet
Czechoslovak transit fee	80 cents per 1,000 cubic feet
Initial selling price	$4.00 per 1,000 cubic feet
Gas deliveries [b]	2.9 billion cubic feet per day
Nominal inflation rate	10 percent per year
Alternative assumptions	
Return on equity [c]	12, 15, and 20 percent per year
Cost overruns [c]	0, 25, and 50 percent

[a] All construction and operating costs in 1980 prices, except for hard currency costs.
[b] Gas deliveries begin January 1986 and run for 20 years.
[c] On Soviet construction expenditures only. Return on equity is in nominal terms.

Western Evaluation

Hard Currency Costs

We derived the estimate of $8 billion in Soviet purchases of Western pipe, equipment, and services by adjusting our March 1981 estimate of hard currency costs for a twin-line system with the same operating pressure.[1] A simple halving of the $12-14 billion estimated for the two-line project was not practical, since several costs could be almost constant whether one or two lines were built. As in the twin-line cost estimate, two modifications of prices are made:

- Because the Soviets are seeking concessionary financing at interest rates below current market rates and EC guidelines, Western suppliers of equipment and services will adjust their final sales prices upwards to provide the same yield as could be earned in the West. Our estimates assume a 15-percent price markup to reflect this action.
- A 10-percent annual rate of price inflation has been included to reflect increased prices at the time of equipment delivery.

[1] For the earlier estimate, see the Intelligence Assessment, appendix B.

Pipe

Line pipe costs of $2.5 billion assume a pipeline of roughly 5,000 kilometers—rather than the 4,500- to 5,500-km range assumed in March—as the result of better information about the pipeline's probable route. Pipe deliveries are assumed to occur in three equal shipments during 1982-84.

Compressors

Compressor and turbine equipment, exclusive of related engineering services, represents the greatest variation in costs. Our estimate of $3 billion, which represents a midpoint among possible costs, assumes 42 compressor stations. The total cost will depend primarily on how Soviet purchases are divided between industrial compressor units and the less expensive, light-weight aircraft designs. Although the Soviets probably want complete delivery by 1983, we assume some slippage.

Other Costs

Although our estimate of $2.5 billion for this category is not much firmer than in March because of spotty information, these costs are probably the least likely to differ substantially between a one- and two-line system. Although such items as pipeline ball valves will be needed in reduced quantity, purchases of other items such as pipelayers, earth movers, some communications equipment, and engineering services and ancillary equipment for the compressor stations could resemble those for a larger project. Imports of Arctic-design gas-extraction equipment for the Urengoy field may also be included in the deal.[3]

Debt Service

We are assuming that Moscow will use the Western credits needed to cover most of the hard currency costs in four equal drawings (see table 2). Although final financing agreements have not been made, we are assuming a three-year grace period—during which time interest accrues—and an eight-year repayment period. We assume a 10 percent interest rate to account for a probable combination of rates that will be agreed upon, ranging from below 8 percent to near market levels.

Table 2 *Billion US $*

USSR: Debt Service on Siberia-to-Europe Pipeline

Year	Uncapitalized Drawings	Principal	Interest *	Debt Service	Debt
1982	2.0	0	0.2	0.2	2.0
1983	2.0	0	0.4	0.4	4.0
1984	2.0	0	0.6	0.6	6.0
1985	2.0	0.4	0.8	1.2	7.6
1986	0	0.8	0.8	1.6	6.8
1987	0	1.2	0.7	1.9	5.6
1988	0	1.6	0.6	2.2	4.0
1989	0	1.6	0.4	2.0	2.4
1990	0	1.2	0.2	1.4	1.2
1991	0	0.8	0.1	0.9	0.4
1992	0	0.4	0	0.4	0

* At 10 percent per year.

Soviet Construction Costs

Equity of $15 billion in the Siberian project (in 1980 prices) is represented by Soviet internal costs in constructing the pipeline and compressor stations. We are assuming for lack of better information that this investment will be made in equal portions over a four-year construction period. To estimate the construction costs we applied a Western analogue based on the proposed Alaskan Natural Gas Transportation System (ANGTS).[4] The two pipeline projects will carry a roughly similar amount of gas over similar terrain. Construction cost estimates (in 1980 prices) were obtained for the portion of ANGTS ending at the US-Canadian border in Montana—a length slightly

[3] A Western processing plant may be installed at Urengoy to remove liquids and impurities from the gas before transport by pipeline. Moscow has purchased such plants for some of its other Siberian gas lines. No specific purchase appears related to the export pipeline, however, so we are excluding it from our hard currency estimate and including it under Soviet internal costs

[4] Soviet ruble cost data were not used, since (1) they are far less detailed and (2) converting them into dollars would have involved an arbitrary and probably inflated ruble-dollar exchange rate. Given these problems, Western data probably provide a cost analogue that is at least as useful

shorter than that of the Siberian pipeline built to the Czechoslovak border. The cost of items to be provided by hard currency imports in the Soviet project—primarily pipe, compressors, pipelaying equipment, and some engineering services—was netted out, and a per-kilometer construction cost was derived. That cost was then applied to the Siberian line's length. The 1980 cost of an Alaskan gas processing plant was added to the construction figure. Although the Alaskan plant's capacity is slightly less than that required for the Siberian project, it provides a rough cost analogue.

Cost Overruns

As in evaluating Western pipeline projects, our analysis includes possible cost overruns—increased costs exclusive of nominal inflation. Given frequent Soviet failures in the past to complete gas lines on schedule, even when using more resources than planned, an overrun is not inconceivable. Overruns of 25 and 50 percent are considered.

Capital Costs

We have considered three nominal rates of return on Soviet investment in evaluating the pipeline project. Some Western analysts believe that a 12-percent return represents capital's productivity in the Soviet economy. Rates of 15 and 20 percent have also been included to represent a range of after-tax rates of return expected for ANGTS. Because we are assuming an annual inflation rate of 10 percent over the project's lifetime, real rates of return would amount to 2, 5, and 10 percent.

East-West Comparisons

A straightforward application of Western costs to Soviet construction practices, of course, will not reflect precisely the actual costs to Moscow of building the pipeline. Besides the immediate difficulty of translating prices of goods and services provided in a command economy into dollar equivalents, the Soviets' simultaneous development of Siberian gas for domestic use will affect the cost of building the Siberian gas pipeline. We believe, however, that such differences from Western costs may cancel themselves out sufficiently to make the Western cost analogue a useful first cut at estimating Soviet investment in the Siberian export project. Two key examples are infrastructure and labor.

Infrastructure. The export pipeline's construction probably will benefit from some infrastructure created for gas lines already laid along its route. Moreover, since all new major domestic trunklines will also run from the Urengoy field—some of them along the same route as the export pipeline—Moscow may not have to create as much additional infrastructure and provide as many temporary support facilities for constructing each line as will the builders of ANGTS. On the other hand, the export pipeline will increase the strain on labor and equipment already stretched thin by the Soviets' ambitious 1981-85 domestic pipelaying effort.

Labor. Generally inferior Soviet equipment and substandard construction practices usually require Moscow to use more men than the West in building both pipelines and compressor stations. The real cost of that labor, however, may not be higher than for ANGTS. Although the Soviets, like the West, pay premium, though lower, wages for Siberian work, the total Soviet expenditure on labor in the form of housing and related services and amenities is much lower.

Operation and Maintenance

Much of this cost for both ANGTS and the Siberian project will result from the use of natural gas in the pipeline to run compressor stations and related equipment. Although in this use both Soviet and Western efficiencies are similar—particularly when the Soviets employ Western compressors—Soviet gas losses on trunklines are usually higher due to pipeline ruptures, compressor station failures and substandard Soviet operation and maintenance procedures. We accordingly have raised slightly the operating costs of the Siberian line above that for ANGTS.

Gas consumption and losses during transport are costed in our analysis at the assumed selling price for gas (f.o.b. West German border) of $4.00 per 1,000 cubic feet. The gas could also be costed at its wellhead price, however. We have opted to reflect the hard currency revenue foregone as a result of online gas consumption, although we recognize that the opportunity cost of gas at the wellhead is much lower. There is no universally accepted approach to this problem. If

gas were costed at its wellhead price, our estimate of operation and maintenance costs would be reduced considerably.

Other Costs

As in pipeline construction, the Soviets use far more labor in operating and maintaining a Siberian trunkline than will ANGTS. We again are assuming, however, that the real costs of Siberian labor will not exceed that for ANGTS, due to lower real expenditures on wages, housing, and related services. Taxes, which constitute roughly 25 percent of the projected cost of transporting gas via ANGTS, are not imposed on Soviet pipelines and thus are not included in our estimates

Czechoslovakian Transit

We are unsure how the Soviets will pay for the expansion of Czechoslovakian trunkline capacity to West Germany and for subsequent Czechoslovak operating costs. A payment in gas from the Siberian pipeline seems unlikely under the single-line export project, since the Soviets probably want to sell the line's entire capacity to Western Europe. Moscow may instead pay Prague—either in gas from another line or in goods or currency—an amount equivalent to 20 percent of the pipeline's throughput. This was a share reportedly being considered previously by Moscow as payment under a twin-line deal. If costed at the assumed selling price for gas of $4.00 per 1,000 cubic feet, the transit fee would approximate 80 cents per 1,000 cubic feet

Project Profitability

The Siberian pipeline would probably be a marginal project at best under our costing and price assumptions, with positive netbacks at the wellhead achieved in only a few of the cases that we have considered. We are assuming a selling price for gas (f.o.b. West Germany) in 1980 prices of approximately $4.00 per 1,000 cubic feet—a price roughly at parity with residual fuel oil rather than with crude. Possible breakeven prices for the project are those that under the various rates of return would equate the project's discounted 20-year streams of revenues and costs (see table 3). Only a return on equity of 12 percent with cost overruns of either 0 or 25 percent would thus permit positive netbacks. Several other cases would result in only small losses. Half the possible breakeven prices, however, would result in substantial negative netbacks.

Table 3 *1980 US $ per 1,000 Cubic Feet*

USSR: Pipeline Project Breakeven Price *

Cost Overrun (Percent)	Discount Rate		
	12 Percent	15 Percent	20 Percent
0	3.64	4.01	4.76
25	3.85	4.30	5.21
50	4.07	4.59	5.66

* Assuming inflation rate of 10 percent and 1980 gas selling price (f.o.b. West Germany) of $4.00 per 1,000 cubic feet.

Algerian gas, the largest alternative natural gas source for Western Europe during the 1980s, is probably deliverable—either by pipeline or LNG projects—more cheaply (exclusive of West European costs) than Siberian gas (see table 4). At $4.00 per 1,000 cubic feet, either Algerian project would earn a profit. Moscow, on the other hand, has been seeking a price (f.o.b. West Germany) near parity with the price of crude oil, roughly $6.00 per 1,000 cubic feet. Only at that price, by our estimates, would the Siberian project almost certainly earn a positive netback.

The Soviet Perspective

The export pipeline project would be attractive to Moscow even if it appeared marginal in terms of Western profitability accounting.* Increased gas exports will be vital to Soviet hard currency earnings by

* This also has been true for other Soviet exports, such as tin and copper, indicating that the Soviet need for hard currency, as described in the text, is of overriding concern

Table 4

1989 US $ per 1,000 Cubic Feet

Algeria–Western Europe: Comparative Costs for Pipeline Gas and LNG

	Pipeline	LNG
Total Algerian costs	1.26	2.25
Investment costs [a]	0.71	1.40
Field facilities	0.18	0.18
Pipeline to coast		0.12
LNG plant		1.10
Algeria-Italy pipeline [b]	0.53	
Operating cost	0.55	0.85
Production costs	0.45	0.55
Fuel and losses	0.10	0.30
Delivery costs to Western Europe [c]	0.32	1.01
Transport		0.50
Tunisia pipeline (transit fee)	0.16	
Regasification fuel and losses		0.10
LNG receiving terminal investment cost		0.41
Algeria-Italy pipeline investment cost [d]	0.16	
Total delivered cost to Western Europe	1.58	3.26
Netback at wellhead for Algeria with gas priced at $4.00 per 1,000 cubic foot (f.o.b.) [e]	2.74	1.75

[a] Amortization assuming three years to build, 20 years operation, and 14-percent rate of return on investment.
[b] Portion of costs Algeria pays.
[c] Excluding cost of West European internal distribution network.
[d] Portion of costs Italy pays.
[e] F.o.b. refers to prices at Algerian terminals or the Algerian border.

the mid-1980s, and Western investment in the pipeline could help ease a tight supply of Soviet capital for Siberian energy development. It would take many years, moreover, to expand the Soviet gas distribution network sufficiently to use domestically all the gas that the pipeline can carry.

Financial Benefits

The pipeline is the Soviets' largest prospective source of stable hard currency earnings, and some alternative exports, even if feasible, would be far more costly:

- Combined earnings from exports of gold, nickel, and platinum group metals could approximate those from the single-line project if existing world market prices held firm. The Soviets' already large share of those metals markets, however, would probably cause increased Soviet supply to depress prices substantially, reducing revenues further for each increment in exports. The West European gas market, on the other hand, is probably large enough to absorb the single line's deliveries at a price roughly equivalent to that of residual fuel oil.

- Increased Soviet exports of other raw materials and of manufactured goods—including weapons—would encounter more rapidly rising costs than would gas exports and would achieve a smaller net growth in revenue. Returns on investment in many Soviet extractive industries are falling faster than for gas. In manufactures, an improvement in the quality of export-oriented goods necessary to achieve an increase in hard currency revenues equal to that from the pipeline project would probably require more investment than the pipeline itself.

Conversely, the costs to Moscow of not concluding a pipeline deal are high. Although hard currency earnings from a one-line project probably would be about 60 percent of that from a twin-line deal, they would still be substantial (see tables 5 and 6). Moreover, since the pipeline's hard currency costs alone could be repaid within two to three years after start-up (see table 7), most of the project's revenue stream would represent discretionary income for imports. With oil exports to the West probably disappearing by the mid-1980s, lack of a pipeline deal would mean a substantial drop in Soviet import capacity. By the late 1980s, total gas hard currency earnings with the pipeline in operation would equal one-half of the 1980 revenues from oil; without the pipeline they would equal only one-fourth (see table 8). The revenues foregone, moreover, would most likely have purchased machinery and other manufactured goods, whose marginal productivity exceeds that of similar items produced domestically.

Table 5 *Billion 1980 US $* [a]

USSR: Hard Currency Earnings From Gas Exports

	1980	1985 [b]	1990 [c]	
			One Line	Twin Line
Total earnings	3.0	3.5	7.7	10.2
Project earnings alone	0	0	4.2	6.7

[a] At $4.00 per 1,000 cubic feet.
[b] Assumes only deliveries under existing contracts.
[c] Full deliveries from a single-line project assumed to begin in 1986; deliveries under a twin-line project probably would start only by 1987-88.

Table 6

USSR: Natural Gas Exports to Western Europe [a]

	1980	1985 [b]	1990	
			One Line [c]	Twin Line [d]
Billion cubic feet per day	2.1	2.4	5.3	7.0
Million b/d oil equivalent	0.4	0.4	0.9	1.2

[a] Excluding Finland.
[b] Existing contracts only.
[c] Assumes 2.9 billion cubic feet per day under one-line project.
[d] Assumes 4.6 billion cubic feet per day under twin-line project.

Table 7 *Billion US $* [a]

USSR: Hard Currency Cash Flow for the Siberian Pipeline [b]

	1982-85	1986-87	1988-93	1994 [c]
Debt service [d]	−2.4	−3.5	−6.9	0
Revenues [e]	0	15.8	70.0	16.0
Cash flow	−2.4	12.3	63.1	16.0

[a] In current prices, assuming 10-percent annual rate of inflation.
[b] Cumulative flows for each of the multiyear periods shown.
[c] Project will continue through the year 2005.
[d] Interest payments begin in 1982; repayment of principal starts in 1985.
[e] Assumes gas deliveries begin in 1986 at full capacity of 2.9 billion cubic feet per day.

Table 8 *Percent*

USSR: Hard Currency Gas Exports as a Share of the Value of 1980 Oil Exports [a]

1980	1985 [b]	1990 [c]	
		One Line	Twin Line
21	24	53	70

[a] Soviet oil exports for hard currency only, which totaled $14.5 billion. Gas hard currency revenues in constant 1980 dollars, at $4.00 per 1,000 cubic feet.
[b] Assumes only deliveries under existing contracts.
[c] Existing contracts plus deliveries under Siberian pipeline project.

The pipeline project would also involve Western Europe more heavily in Siberian development. Aside from potential political benefits, analyzed in our March assessment, the Soviets could increase the amount of capital available for investment in Siberian energy at a time when Soviet resources are being stretched thin between the massive Siberian oil drilling program and the unprecedented domestic gas pipeline construction effort.

Low Gas Cost

The gas destined for export under a single-line deal could not be used domestically for some years. An inadequate grid of gas distribution lines will prevent a vast number of oil-consuming industries and homes from switching to gas and thus absorbing the entire planned increase in gas output.[1] Canceling the export line's construction would not free enough resources to accelerate greatly the expansion of the distribution grid. Moreover, without building a domestic trunkline of almost equal length in the export line's place, Moscow could not provide any more gas for domestic use than if the Siberian deal went through.

[1] Gas-for-oil substitution will also be constrained by the substantially increased use of internal combustion engines—notably in automotive transport and in agriculture—in which gas cannot replace oil.

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Appendix

West European Dependence on Soviet Gas

The Soviets have recently decided not to construct two gas pipelines simultaneously, as they had planned in early 1981, but instead to build only one line now with construction of a second line reserved for future negotiations. The six West European countries participating in the project thus would not be as reliant on Soviet gas deliveries toward the late 1980s as earlier expected, particularly if a second line were not built. The share of Soviet gas in those countries' total combined energy use by 1990 would be roughly 6 percent (see table 9). Total Soviet gas deliveries—existing contracts plus exports from the Siberian project—would cover one-third of the six countries' projected combined gas needs by 1990 under a twin-line project; under a one-line project total deliveries would cover one-fourth of gas consumption. Individual countries' dependence under a single-line deal, however, would still be fairly high. In the important case of West Germany, dependence could exceed 30 percent, the level currently seen as critical by Bonn.

Table 9

Percent of Total Consumption

Western Europe: Dependence on Soviet Gas Supplies [a]

	1979		1990			
	Gas	Energy	Gas		Energy	
			One Line [b]	Twin Line [c]	One Line	Twin Line [c]
West Germany [d]	19	3	29-34	30-35	6	6
France	0	0	24	27	4	4
Italy	28	5	28	31	5	5
Netherlands	0	0	7	13	3	4
Belgium	0	0	35	51	5	8
Austria	43	8	82	82 [e]	13	18

[a] Based on 1980 IEA submissions and French Energy Plan.
[b] Assumes that the 2.9 billion cubic feet per day is allocated among countries in same proportions as under twin-line system.
[c] Includes only 3.9 billion cubic feet per day to Western Europe, rather than the 4.6 billion cubic feet per day possible, since allocations under the 3.9-billion-cubic-feet-per-day scenario were the only ones ever published. Other countries probably would have received much of the remainder.
[d] Lower estimates for 1990 for dependency based on a higher estimate by Ruhrgas of gas demand.
[e] Same dependency under twin-line project due to assuming the same Soviet gas deliveries in both cases.