CHAPTER 3

The Soviet Coal Industry

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 3

The Soviet Coal Industry

Prior to World War II, coal was the dominant source of fuel in the Soviet Union, as it was elsewhere in the world. In 1940, it supplied 75 percent of Soviet energy needs. Since then, oil and natural gas have become increasingly important and by the late 1970's, coal's share of total Soviet energy consumed had fallen to approximately 29 percent. There are incentives now to reverse this trend. Oil exports earn the Soviet Union the hard currency it needs to finance imports of Western grain and technology, and it is not surprising that Soviet energy planners have shown a strong interest in substituting other fuels for oil, particularly in electric power generation and in boiler applications.[1] Coal is such a substitute.

Unfortunately, the Soviet Union's reserves of easily obtainable high-quality coal are now seriously depleted, and the Soviet coal industry has experienced serious difficulties in simply maintaining production. The expansion of the industry which would be required for coal to be widely substituted for oil now seems extremely unlikely. The purpose of this chapter is to describe the current state and potential of the Soviet coal industry, including: 1) the characteristics of major coal deposits; 2) the technological and infrastructure problems facing the coal industry; 3) the degree of reliance of the Soviet coal industry on Western technology; and 4) the prospects for the industry in the next decade.

'See A. Troitskiy, ''Ellectric Power: Problems and Perspectives,"' *Planlo[()>c khozyaystvo*, No. 2, February 1979, p. 20.

INTRODUCTION

Soviet coal production increased steadily between 1970 and 1975, growing approximately 16 million metric tons (mmt) per year. The Tenth Five Year Plan (FYP) (1976-80) proclaimed that coal would replace oil wherever possible, and additional yearly increases averaging about 20 mmt were targeted. But the coal industry has encountered problems. Production peaked at 723.6 mmt in 1978, far short of the original goal, and has been declining since. Production in 1980 (716 mmt) was 89 mmt short of the original plan target and 29 mmt below the revised 1980 annual plan (see table 22, below.) The coal industry has consistently had difficulties meeting its output goals, and these difficulties cannot be expected to disappear in the foreseeable future.

In terms of sheer magnitude, the U.S.S.R. has substantial coal reserves. Table 19 shows the World Energy Conference Survey of Energy Resources estimates of world coal reserves. According to this survey the Soviet Union has over half of the world's resources of coal that could be successfully exploited and used within the foreseeable future, and approximately one-quarter of world explored reserves recoverable under present local economic conditions and available technology.[2] The difficulties faced by the Soviet coal industry lie not in the size of the resource base, but rather in the location of coal reserves and in the quality of the coal now being or expected to be mined in the foreseeable future.

The first coalfields to be exploited in the U.S.S.R. were located near the major population centers of the Western European part of

[2]For the purposes of this chapter, Soviet "explored" coal reserves, i.e., those relevant for present planning purposes, are roughly equivalent to proved, probable, and possible categories in Western nomenclature.

Table 19.— Estimated Coal Reserves of the World (billion tons)

	Recoverable reserves[a]	Percent world total	Total reserves[b]	Percent world total	Total resources[c]	Percent world total
U.S.S.R.	150.6	23.1 %	301.2	19.20/o	6,298.2	53.1 0/0
United States[d]	200.4	30.7	400.8	25.6	3,223.7	27.2
Canada	6.1	*0.9*	10.0	0.6	119.9	1.0
People's Republic of China	88.2	13.5	330.7	21.1	1,102,3	**9.3**
India	**12.8**	**2.0**	**25.5**	**1.6**	**91.5**	**0.8**
Rest of Asia	**6.6**	**1.0**	**19.1**	**1.2**	**27.6**	*0.2*
Federal Republic of Germany	43.6	6.7	109,7	7.0	315.4	2.7
United Kingdom	4,3	0.7	109,0	7,0	179,5	1.5
Poland	250	3.8	42.9	2,7	66.8	0.6
Rest of Europe	66.9	10.3	91.0	5.8	108,0	0.9
South Africa	11.7	1,8	26.7	1.7	48.9	0.4
Rest of Africa	5.6	0.9	6.7	0.4	16.0	0.1
Australia	26.8	4.1	81,9	5.2	218.9	1.8
Rest of Oceania	0.2	—	0.4	—.	1,2	—
Latin America	3.1	0.5	10.1	0.7	36.3	0.3
World Total	651.7	1 00,00/0	1,565.6	1 00.00/0	11,854.1	1 00,0%

[a] Amount of reserves in place that can be recovered under present local economic conditions and available technology
[b] The Portions of total resources that have been carefully measured and assessed as exploitable under local economic conditions and available technology
[c] Total amount available in the Earth which can be successfully exploited and used within the foreseeable future
[d] Estimates of U.S. coal reserves here may not agree with other domestic data
[e] Does not include additional resources for Queensland

SOURCE National Coal Association *Coal Facts*

the country. Some of these have been mined for so long that the thick, easily accessible coal seams are rapidly nearing depletion. The remaining seams are not readily susceptible to existing methods of mechanization. They are one-third thinner than the national average and lie considerably deeper in the ground. As mine depths increase, so do the costs of extraction and the risks from gas and explosions. Further problems arise because the equipment installed in these mines has become increasingly seam-specific. As seams are worked out, the equipment cannot be transferred.

As many mines have become difficult or expensive to operate, new ones have been opened. Those in the eastern part of the country, like the eastern oilfields and gasfields, are located in sparsely populated, inhospitable regions from which the cost of transporting coal to consumers is much higher. The Soviets now look increasingly to surface mining as a source of growth in coal production because surface-mined coal is cheaper to extract than underground coal—it can be mined with higher productivity equipment requiring less labor. But the relative share of surface mining in the U.S.S.R. is still low—about 37 percent in 1980 (as opposed to about 52 percent in the United States in 1978.)[3] For the present, this low level is adversely affecting overall labor productivity growth and output in the industry. For the future, the Kansk-Achinsk, Ekibastuz, Kuznetsk, and South Yakutia basins are the favored sites for expanded surface mining. But these basins are all

[3] *Ugol'*, No. 2, 1980, p. 4; U.S. Department of the Interior, Bureau of Mines Information Circular, "Coal Mine Equipment Forecast to 1985," 1976, p. 5.

located at considerable distances from the consuming centers in the European U.S.S.R. and high transportation costs would **at** least partially offset the lower costs of extraction.

Moreover, the quality of the coal in some of these new basins is very poor. Coal, which is formed as the result of millions of years of physical and chemical changes to moist vegetable matter, is a complex heterogeneous material.[1] It varies by type (depending on the kind of original plant materials from which it was formed), rank (based on the carbon and oxygen content, degree of moisture, volatile matter, etc.), and the type and amount of impurities that it contains. In general, anthracite and various grades of bituminous coal are preferable to lignite or brown coal because they have a higher heat content per unit. Large portions of Soviet coal reserves are comprised of the less desirable deposits, and the calorific value of an average ton of Soviet coal has been declining (see table 20). Between 1970 and 1978, the calorific value of Soviet coal declined from 4,853 kilocalories per kilogram (kcal/kg to 4,711 kcallkg, a drop of 3 percent. The decline could be even greater in the future. This is due, in part, to the depletion of higher grade coals and the increasing role of lignite, primarily from the Kansk-Achinsk basin. In consequence, part of any future growth in coal production will be offset by declines in the calorific content and thus in the heat value of the coal shipped to consumers.

Indeed, Soviet coal production figures must be treated warily, for they are given in terms of "run-of-mine," i.e., coal which has not yet been cleaned. This may cause output figures to be overstated by as much as 20 to 40 percent.[1] The most common impurities found in coal are sulfur, stones, and ash. Sulfur forms oxides which cause pollution; stones and ash (noncombustible material that remains after the coal has been burned) provide no heat and add to transportation costs. Coal, particularly lignite, may also contain considerable moisture which inflates its true weight.

In sum, the success of the Soviet coal industry seems to rest on the expansion of surface mining. Although the Tenth FYP sought to raise underground output, this actually fell by 23 mmt during the plan period, while surface mining production rose some 36 mmt and came closer to meeting its target. Unfortunately, however, Soviet surface-mined coal is often of poor quality. The prospects for the industry, therefore, strongly depend on the degree to which surface mining can be expanded and the success with which the coal thus mined can be treated, transported, and used. The survey of the major Soviet coal basins which follows provides the context for evaluating these two issues.

[1] See Charles Simeons, *Coal: Its Role in Tomorrow's Technology* (oxford: Pergamon Press, 1978); and Bernard Cooper, "Research Challenge: Clean Energy From Coal," *Physics Today,* January 1978.

Table 20.— Coal Production in Natural Units and in Standard Fuel
(million metric **tons,** except calorific **value)**

Year	Coal in natural units (1)	Coal in standard fuel[a] (2)	Calorific value, kcal/kg[b]
1940	165.9	140,5	5,928
1945, , , . .	1493	115,0	5,392
1950	261 1	205.7	5,515
1955 ....,	389.9	3108	5,580
1960	509.6	3731	5,125
1965	577.7	4125	4,998
1970	624.1	4327	4,853
1975	701.3	471.8	4,709
1976	711 5	479.0	4,713
1977	722.1	486,0	4,711
1978	723.6	4870	4,711
1979 ....,	718.7	483.9	4,713
1980	716.0	479.7	4,690

[a] One metric ton of standard fuel equals 278 million Btu or 7 gigacalories
[b] Column (2) divided by column (1) and multiplied by 7 ×10[1] kcal kg of standard fuel

SOURCES U S S R Central Statistical Administration, *Narodnoye khozyaystvo SSSR* v 1978 g (Moscow Izd Statistika 1979) p 144 *Ibid* (1975) p 219 and (1980) pp 170-171

[1] See Robert W. Campbell, *Soviet Energy Technologies: Planning, Policy, Research, and Development* (Bloomington, [rid.: Indiana University Press, *1980);* and V. V. Strishkov, George Markon, and Zane E. Murphy, "Soviet Coal Productivity: Clarifying the Facts and Figures, *Society of Mining Engineers Journal,* May 1973.

MAJOR SOVIET COAL-PRODUCING REGIONS

Figure 6 shows the location of the Soviet Union's major coal-producing areas. The geographic distribution of Soviet coal is unfortunate. The heavily populated and industrialized European part of the U.S.S.R. contains only 6 percent of the nation's coal reserves. The rest are located in the Arctic, Siberia, or Kazakhstan where climatic conditions make coal extraction and transportation difficult and expensive. Tables 21 and 22 summarize the extent of explored reserves and recent coal production by basin. The following survey briefly describes the chief characteristics of each of these basins.

BITUMINOUS BASINS

Donets (Donbass) (No. 2 on map)

The Donets basin covers some 60,000 square kilometers (km^2) mainly in the Ukraine, and has explored reserves of over *40* billion metric tons (bmt) (see table 21). It

Table 21 .—Geographical Distribution of Soviet Recoverable Coal Reserves, 1967 (billion metric tons)

Basin/field	Proved, probable, possible		Potential	
U.S.S.R. total	255	(180)	170	(99.8)
Kansk-Achinsk	72.6	(71.1)	43.0	(35.4)
Kuznetsk	59.5	(33.0)	60.8	(25.1)
Donets	40.4	(7.7)	17.2	(1.2)
Pechora	7.9	(4.1)	6.9	(1.9)
Ekibastuz	7.4	(–)		(–)
Karaganda	7.6	(3.5)	1.8	(0.1)
Irkutsk	7.1	(7.1)	13.3	(13.2)
Turgay	6.3	(5.6)	0.4	(0.4)
Moscow	4.8	(4.8)	2.3	(2.3)
Minusinsk	2.8	(2.8)	43.0	(35.4)
Dnepr	2.6	(2.6)	–	(–)
South Yakutia	2.6	(2.5)	3.2	(3.0)
Tungus	1.9	(1.7)	3.0	(2.9)
Maykyuben	1.8	(0.9)	–	(–)
South Urals	1.3	(–)		
Lena	1.1	(0.7)	1.4	(1.4)

NOTE Column figures in parentheses ( ) denote coal down to 300 meters
(–) denotes not available.

SOURCES V A Shelest, *Regionalnyye energoekonomicheskiye problemy SSSR* (*Moscow* Izd "Nauka," 1975), pp 113-116, and *Sovetskaya geologiya* (April 1970), p 57

Table 22.—Soviet Coal Production (million metric tons)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
U.S.S.R. total[a]	624.1	640.9	655.2	667.6	684.5	701.3	711.5	722.1	723.6 (748)	719 (752)	716 (790-810)	
Minugleprom SSSR, of which	—	634.3	648.9	661.4	678.1	694.6	704.7	715.7	–	–	–	
Donets	218.0	217.5	217.4	219.4	219.5	221.5	223.7	222.0	–	208	203	(213)
Kuznetsk	113,3	115.5	119.2	123.3	128.3	134.0	138.9	141.9	(153,7)	(154.9)	(162.4)	(149)
Karaganda	38.4	39.8	41,7	43,3	45,3	46.3	47.4	48.2	–	(47)	(48.6)	(49)
Pechora	21.5	22,0	22,5	23.0	23.4	24,2	25,8	26,7		28.9	28	(29)
Ekibastuz	22.6	—	—	—	—	45,8	(49,4)	(50-53.5)	(57.0)	59.2	66.8	(72)
Kansk-Achinsk	—	—	—	—	—	27.9	29.1	31.6	—	33	34.5	(46)
Moscow	36.2	36.7	36.7	36.1	35.1	34.1	30.9	29.5	—	27	25	(23)
Degree of plan fulfillment percent	—	103.5	103.5	103.2	102.5	102.5	102.4	101.7	96.7	95.6	88.2	-90.5[b] –

NOTE Column figures in parentheses ( ) denote plan targets

[a] Total includes coal produced outside Minugleprom, the Soviet Coal Ministry. Figures taken from *Narodnoye khozyaystvo* for various years.

[b] Based on original FYP targets.

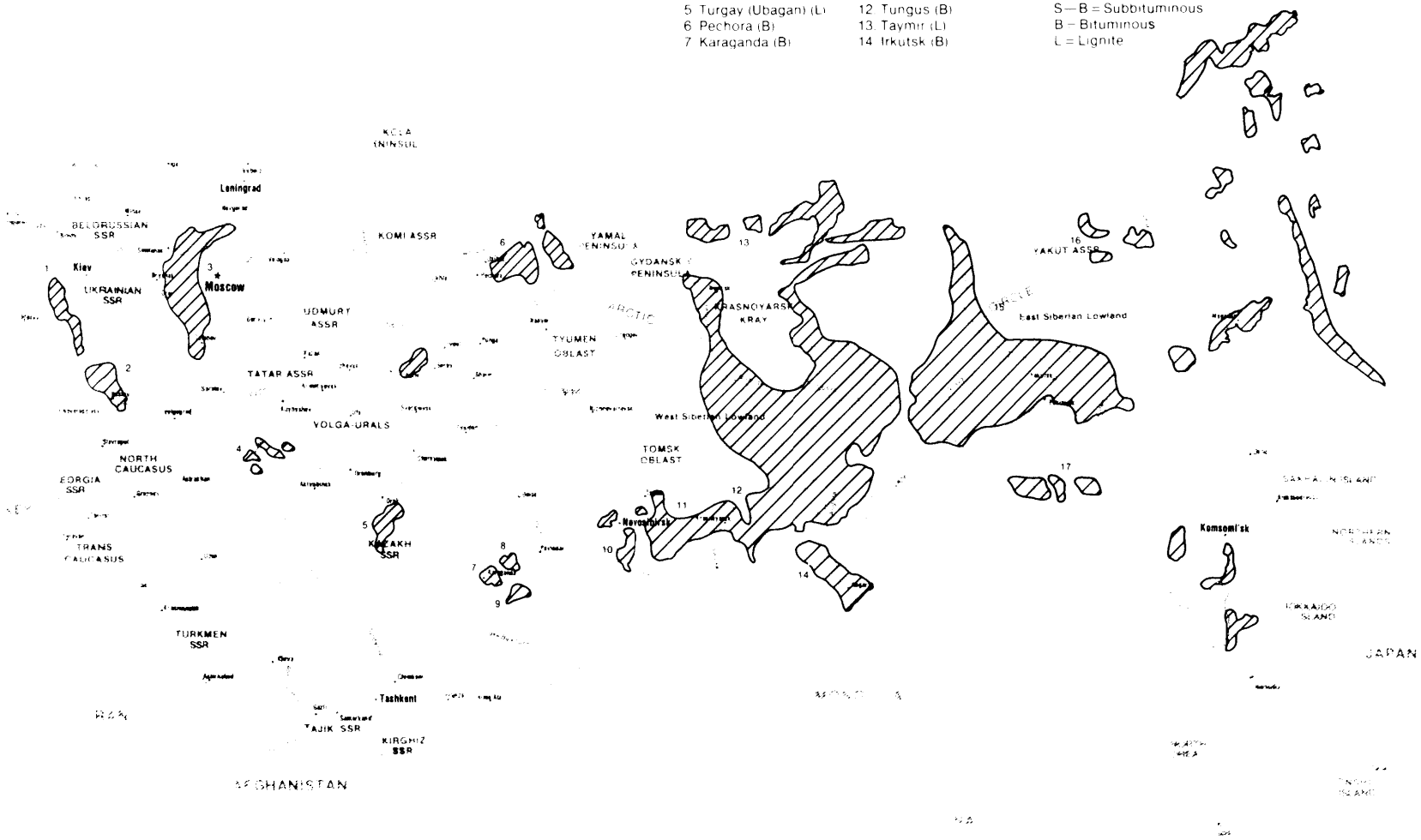
SOURCES Most production figures are from the April issues of *Ugol* for given years Other data are from the following
1979 plan figures *Ekonomicheskaya gazeta*, No 5 (February 1979), p 1
1979 total production *Pravda Ukraina*, (Jan 26, 1980), p 2
1980 plan total *Narodnoye khozyaystvo Kazakhstana*, (October 1978), pp 38-45
1977 Ekibastuz plan *Partiynaya zhizn Kazakhstana*, (January 1978), pp 34-35 [JPRS 71, 127, (May 17, 1978), p 9]
1976 and 1977 Ekibastuz plan targets *Ugol'*, (January 1978), pp 16-20
1970 production V A Shelest, *Regionalnyye energoekonomicheskiya problemy SSSR*, *(Moscow* Izd "Nauka, 1975), p 26
1975 Kansk-Achinsk and Ekibastuz production and 1980 basin plan targets A M Nekrasov and M G Pervukhin, *Energetika SSSR v 1976-1980 g., (Moscow:* Izd, "Statistika, 1977), p 146
1981 plan *Ekonomicheskaya gazeta*, No 15 (1981), p 2
See also *Soviet Geography*, April issues

Figure 6.—Soviet Coal Basins

Sizes and locations are approximate

1. Dneper (L)
2. Donets (Donbass) (B)
3. Moscow (L)
4. Southern Urals (L)
5. Turgay (Ubagan) (L)
6. Pechora (B)
7. Karaganda (B)
8. Ekibastuz (S—B)
9. Maykyubensk (L)
10. Kuznetsk (Kuzbass) (B)
11. Kansk-Achinsk (L)
12. Tungus (B)
13. Taymir (L)
14. Irkutsk (B)
15. Lena (L) and (B)
16. Zyryansk (B)
17. South Yakutia (B)

LEGEND:
S—B = Subbituminous
B = Bituminous
L = Lignite



SOURCE: Office of Technology Assessment

is one of the oldest sites of underground mining in the U. S. S. R., and, as table 22 shows, the country's leading producer. The basin contains high-grade coals, including coking coal and anthracite, and is located close to consuming industries. It is, therefore, particularly important to the Soviet coal industry.

Past mining in the Donets concentrated on thicker coal seams close to the surface. Much of this coal is now depleted, and miners must work thin seams at ever-increasing depths. In fact, the average depth of working faces in 1978 was well over 500 meters (m), and this depth was increasing at 15 m per year, nearly twice the national average. In addition over 80 percent of Donets coal lies in seams less than l-m thick (coal which would not even be counted in U.S. reserves), and many of these are steeply pitched which makes them difficult to work. Deteriorating mining conditions have also led to increasing ash and stone contents in Donets coal.[7]

It is not surprising, therefore, that production in the Donets has declined over the past decade, from 216 mmt in 1970, to 203 in 1980. The 1981 production target is 213 mmt, lower than actual 1970 output.[7]

Kuznetsk (Kuzbass) (No. 10 on map)

The Kuznetsk basin is the Soviet Union's second largest hard coal-producing region, covering some 26,000 km^2 in southwest Siberia. This basin is especially important because of its reserves of high-quality coking coal, much of which can be surface mined. Explored reserves at Kuznetsk are some 60 bmt (see table 21). Production here rose by 25 percent between 1970 and 1977, reaching 141.9 mmt. The 1980 plans called for 162.4 mmt. However, the latter were almost certainly underfulfilled (see table 22), and lately Soviet literature has been reporting production problems in the basin. These seem to be at least partly due to failure to introduce new mine capacity. Indeed, in the past 18 years, only one new mine has gone into operation. [a] There are also indications of labor shortages in the basin. The 1981 plan target was only 149 mmt.[9]

Pechora Basin (No. 6 on map)

The Pechora basin covers 120,000 to 130,000 km^2 in the extreme northeast of the European U. S. S. R., north of the Arctic Circle. Much of the coal here is located in permafrost areas, and has been only superficially studied. The basin contains explored reserves of 7.9 bmt, much of it coking coal (see table 21). A large percentage of this lies below 300 m, but in general, the coal is closer to the surface than in the Donets basin.

Development of the Pechora basin began in the early 1940's, using forced labor. But although the basin was able to supply coal to northern Russia during World War II, the extremely cold climate has made mine construction difficult. Pechora mines are also susceptible to gas explosions. Production here rose from 21.5 mmt in 1970 to 26.7 mmt in 1977, and was slated to reach 29.8 mmt by 1979, but in recent years the basin has failed to meet plan targets. About two-thirds of Pechora's output is high ash content coking coal, which requires cleaning before use; the rest is steam coal.

Karaganda Basin (No. 7 on map)

The Karaganda basin, covering 3,000 km^2 in northwest Kazakhstan, contains 7.6 bmt of explored reserves. Over half of this lies below 300 m. Karaganda has both coking and steam coal. Here, the steam coal is high in ash content and difficult to enrich.

---

[7] A. V. Sidorenko, *Mining Science and the Rational Utilization of Raw Mineral Resources (Moscow:* Izd. "Nauka," 1978), p. 47; Joseph K. Wilkinson (ed.), "Soviet Coal Strives for Expansion, " *Coal Age,* April 1978, p. 86; A. V. Tyzhnov, "Geological Reserves of Coal in the U. S. S.R., " *Sovetskaya geologiya, No. 4,* April 1970, p. 64; and Leslie Dienes, "Regional Dimensions of Soviet Energy Policy, " paper prepared for the American Association of Geographers, 1979, p. 38.

[7] *Soviet Geography,* April 1981, p. 276; *Ekonomicheskaya gazeta, No.* 15, 1981, p. 2.

[9] G. Shumkin, "Let's Look For and Find the Reserves, " *Trud,* Sept. 15, 1978, p. 1.

[a] *Ekonomicheskaya gazeta, No.* 15, 1981, p. 2.

Large-scale production in Karaganda began in the 1930's, when the area was first reached by railway and coal could be shipped to the iron and steel industries in the Urals. Now local iron and steel plants are major consumers. Karaganda's output grew steadily between 1970 and 1977, reaching 48.2 mmt. No production figures after 1977 have been published, but it is highly probable that growth in output has been slowing since the mid-1970's, a fact reflected in the 1981 production target of 49 mmt.[10] In March 1979, it was reported that the "Karagandaugol" mining association was producing below plan goals in January and February of that year, and that the association had also been under plan for 1978.[11] A Kazakh Party official reported in October 1978, that the "50th Anniversary of the U.S.S.R." mine, one of the basin's best, was below plan for nearly all indicators, including output, and was even producing below the 1977 level for the same months.[12] There are indications of equipment problems, shortages of labor, and inadequate new mine construction.[13] Past planning mistakes also haunt the Karaganda basin. The city of Karaganda is located over valuable reserves—1 1 beds with 1 bmt of coal. Consequently, mined-out seams here have been packed with rubble to prevent subsidence of the city, an operation which diverts needed labor away from production.

South Yakutia (No. 17 on map)

The South Yakutian basin lies in a remote area of the Soviet Far East. In 1967 explored reserves here were set at a relatively low level, 2.6 bmt, but more recent work may have significantly expanded these estimates. In any case, the contribution of South Yakutia lies in the future. Although it is now producing only very small amounts of coal, it is the site of a major Soviet-Japanese energy cooperation project that is expected to yield about 85 million tons of medium-quality coking coal for export to Japan by the year 2000. (For details of this project, see ch. 11.)

SUBBITUMINOUS AND LIGNITE BASINS

Ekibastuz (No. 8 on map)

Ekibastuz is a small—160 km^2—area in northeast Kazakhstan containing *7.4* bmt of explored reserves. Production here rose from 22.7 mmt in 1970 to 59 mmt in 1979 (6 mmt short of the plan target). Ekibastuz has abundant coal suitable for surface mining, and in 1978, it alone accounted for 22 percent of Soviet surface-mined coal.[15] Labor productivity in Ekibastuz is high, but the ease and consequent low cost of extraction is somewhat offset by the poor quality of the coal, which has a high ash content (averaging *40* percent, but reaching as high as 48 to 56 percent in some cases) and thus a low calorific value per unit. Some Ekibastuz coal is used locally as steam coal, but in 1979, over 60 percent of the basin's output was shipped outside Kazakhstan.[16]

Kansk-Achinsk (No. 11 on map)

The Kansk-Achinsk basin is located to the east of the Kuznetsk basin. Its explored reserves, the largest in the U. S. S. R., have been set at 72.6 bmt. This coal can be surface mined at low cost. Unfortunately, however, it is mostly lignite, which is characteristically low in heat value, and high in moisture content. Kansk-Achinsk coal also tends to self-ignite when dried. For these reasons, its transportation is difficult, and demand for it is low. In 1975, about 90 percent of the basin's output was used 1ocally. This coal is difficult to use even locally, however, and

[10] I bid,; Leslie Dienes and Theodore Shabad, *The Soviet Energy System. Resource Use and Policies* (Washington, D.C.: V. H. Winston & Sons, 1 979), p. 114.

[11] B. Glotov, "In Hope of a Sunday Assault, " *Sotsialisticheskaya industriya*, Mar. 15, 1979, p. 2.

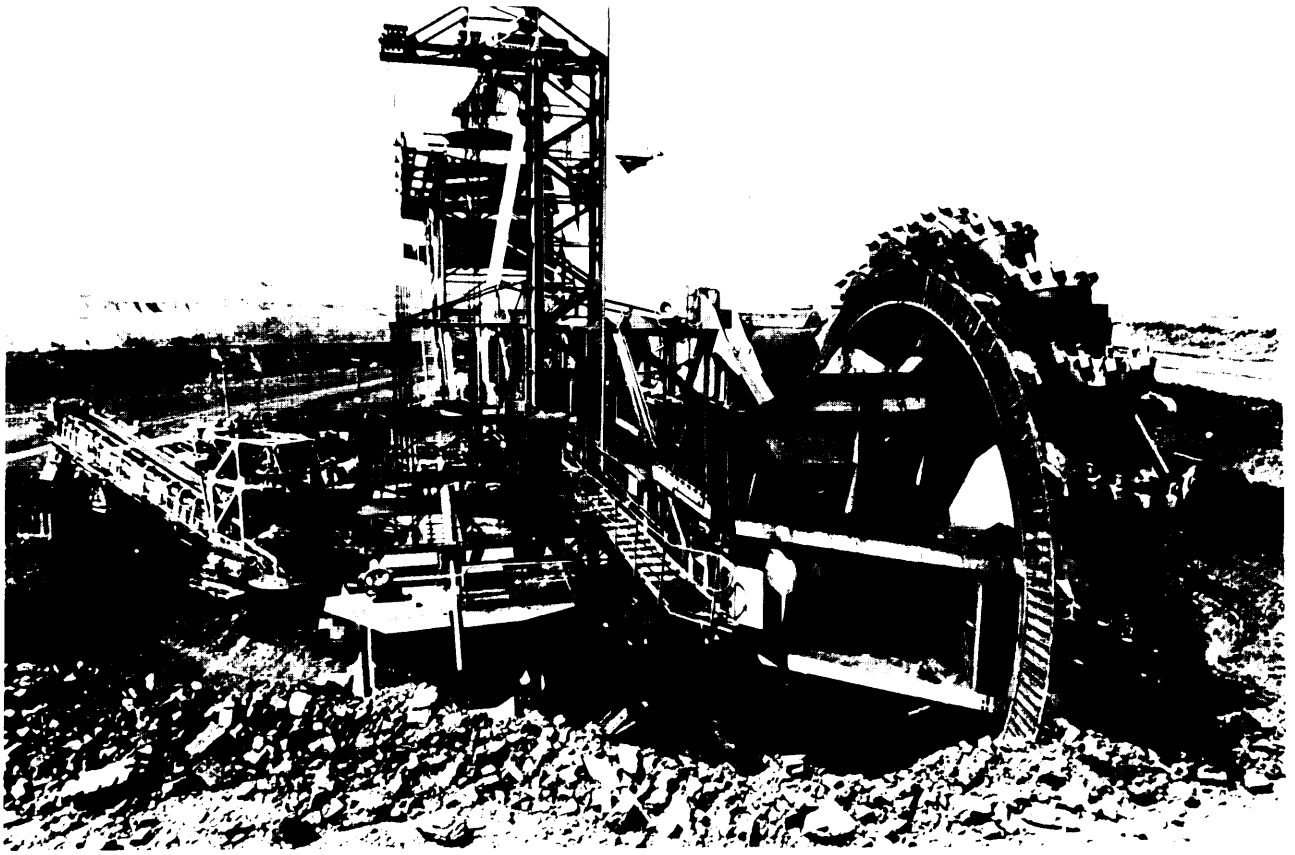
[12] O. Mulkibayev, "Why Are the Mines G iving Up the Positions They 've Won" *Narodnoye k h ozyaystvo Kazakhstana*, *No.* 10, October 1978, pp. 38-45 in JPRS 72,902, Mar. 1, 1979, p. 98.

[13] I bid., p. 98; Glotov, op. cit., p. 2.

[14] B. Glotov, "Arguments Instead of Action, " *Sotsialisticheskaya in dustriya*, J u ne 6, 1980, p. 2, in J P RS 76,242, Aug. 18, 1 980, p. 43.

[15] Dienes and Shabad, op. cit., p. 116.

[16] *Soviet Geography*, March 1980.



power stations refuse shipment whenever possible. Kansk-Achinsk lignite cakes onto boilers and has highly variable ash melting points.[17]

About 32 mmt of coal were extracted here in 1977, and the 1981 target is 36 mmt (see table 22). This basin is considered by many Soviets to be the best hope for expanded coal production (production that has been forecast as high as 1 bmt/yr nationwide[18]), and there are plans for a large fuel, energy, and industrial complex to be built in the area. However, the feasibility of this venture will rest importantly on the development of boilers suitable for the coal (see ch. 5.)

[17] *Ugol'*, No. 12, December 1975, p. 62; Dienes and Shabad, op. cit., p. 251; Campbell, op. cit., pp. 175-6.

[18] L. Sizov, "Fuel Base of Siberia: How to Develop Kansk-Achinsk Fuel-17 nergy Complex" *Trud*, June 27, 1980, p. 2.

Moscow Basin (No. 3 on map)

This basin, covering 120,000 km^2 south of Moscow, contains some 4.8 bmt of low-quality coal, having high ash and sulfur contents and low calorific value. Production peaked in 1958 when new underground mine construction stopped,[19] and has been declining since 1971. Output fell from 36.2 mmt in 1970 to 29.5 mmt in 1977, and plan targets envisage a further reduction in 1981 to 23 mmt. Given the high cost of this coal, underground production probably would have ceased altogether were it not for the proximity to consumers. (In addition, there is relatively cheap coal suitable for surface mining in the

[19] A. D. Breyterman, *The Economic Geography of Heavy Industry* (Moscow: Izd. "Vysshaya shkola," 1969), in JPRS 49,321, Nov. 26, 1969, p. 66.

southern part of the basin.) The Moscow basin's output is largely of local importance, serving the industrial regions around Moscow primarily as boiler fuel.

SUMMARY

Although the U.S.S.R. has large coal reserves, their geographic distribution is unfavorable, with most of the coal lying in little-studied basins in remote areas with adverse climates. Not only has coal production declined over the past several years, but the calorific value of a ton of Soviet coal has decreased and probably will continue to do so.

Major characteristics of the primary coal basins are summarized in table 23. Important features to note include the fact that the Donets basin, the major coal producer in the U. S. S. R., has an unfortunate geological structure. More than 80 percent of the remaining coal is in seams less than 1 m thick and only 19 percent of this coal is between ground level and 300 m. Coal from Ekibastuz is very high in ash content, which means that Soviet output figures for the basin overstate its contribution to the production of energy. Kansk-Achinsk coal is low in heat value and cannot be transported economically to the central industrial region in untreated form.

In short, despite large reserves, coal output has been falling and the outlook for the future is not as bright as one might expect. Increasingly, the unfavorable geographical distribution of unexploited coal reserves will have its effect on the costs of production and utilization, especially in view of continuing depletion of the Donets reserves. Most of the major underground mining basins are having difficulty meeting output goals. Soviet hopes therefore rest on coal which can be surface mined.

Table 23.—Characteristics of Major Soviet Coal Deposits

Type of mining	Explored reserves (billion metric tons)	Average thickness of seam (meters)	Average depth of mine (meters)	Average caloriflc value (Btu per pound)	Moisture content (percent)	Ash content (percent)	Share of production in 1980 (percent)
Donets . . . . . Underground	40	0.9	566	10,900	6.50/o	19.20/.	280/o
Kuznetsk . . . . . Underground and surface	60	25	262	9,990	10.2	19.0	22
Pechora. ., , ... Underground	8	2.4	454	9,390	8.3	25.1	4
Karaganda . . . . . Underground	8	2.5	384	9,250	7.5	28,8	7
Ekibastuz . . . . . Surface	4	10-40	—	7,250	7.7	39.1	10
Kansk-Achinsk . . . Surface	72	—	—	6,490	33,0	10,7	6
Moscow . . . . . Underground	5	2.5	135	4,550	32.3	35.5	4

SOURCE Off Ice of Technology Assessment CIA USSR Coal Industry Problems and Prospects, "ER 80-10154 (March 1980)

SOVIET COAL INDUSTRY TECHNOLOGY –PROBLEMS AND PROSPECTS

The technological level of Soviet-designed and produced coal mining equipment is uneven. At its best, the Soviet coal mining equipment industry has produced sturdy and well-designed equipment. But the technological level of equipment in place varies. Major basins can be expected to command the better equipment, while some mines must make do with old, deteriorated machincry.

Soviet coal mining equipment stocks are large, greater in fact than American stocks, yet the U.S.S.R. produces less coal than the

84-389 0 - 81 - 7

United States. Despite the large inventory of equipment, the level of mechanization is often low, including the main extraction operations in some basins. This is due in part to failure to produce needed quantities of equipment of proper quality; failure to maintain equipment properly; lack of sufficient parts or repair crews; and neglect of maintenance schedules. Anomalies abound. In underground mines, coal may be extracted and the mine roof supported with sophisticated pieces of equipment—which operate along roadways prepared by hand. In the country's open-pit or surface mines, large capacity excavators may be teamed with trucks mismatched in size and strength. Such examples are not isolated extremes; technological inconsistencies of this type are widespread and chronic. In short, despite a seemingly abundant stock of equipment, the failure to produce an appropriate mix of machinery models for the special conditions imposed by different coal seams has led to shortages in some basins.

Production of coal mining equipment has, in the past, been of secondary priority to Soviet planners, subordinate to oil and gas development. The quality of Soviet machinery reflects this. The older equipment that makes up the bulk of the stocks is equivalent to models produced in the United States 10 to 20 years ago, smaller and less productive, although apparently mechanically reliable. This has been due in part to Soviet reluctance to adopt new technologies in coal mining, even technologies that would be readily available outside the U.S.S.R. Plants continue to produce equipment that is no longer in great demand, while production of new equipment, to mine thin seams for example, is lagging seriously.

The failure to change products has two major causes. Perhaps most important is the pervasive reluctance of plant managers to jeopardize output plan fulfillment by interrupting production to retool for a new product. A change in the product line not only means risking bonuses given for plan fulfillment, but also requires new supply arrangements, possible changes in profitability, and risk associated with new production technology and new products. Soviet managers have little incentive to incur such risks and so prefer to continue to use and produce established models, even if they are outmoded or unwanted.

An additional problem stems from the fact that the Ministry of the Coal Industry has been in a relatively weak position vis-a-vis its equipment suppliers. Responsibility for producing coal mining and transport equipment was scattered among many factories, all of which also produce a variety of other machines for other customers. Nor can the ministry participate in the research, design, and testing of new mining equipment—as does the Ministry of the Power Industry, for instance, with respect to power generation.

The current renewed interest in coal has led to some attempts to alleviate these problems. In the early 1970's an effort was made to make both manufacturers of some mining equipment and coal mine construction organizations more responsive to the needs of the industry, and administrative responsibility for these activities was transferred to the Ministry of the Coal Industry, known as Minugleprom. (Underground equipment is handled by Minugleprom, but the production of surface mining equipment is under the Ministry of Heavy and Transport Machine Building.) This has produced some improvement: production of modern equipment has increased in recent years and the quality of output has reportedly risen. For instance, between 1973 and 1977, the number of mining equipment models awarded the State Seal of Quality, the U.S.S.R.'s highest category of product quality, increased 2.4 times.[20] However, demand is still not being satisfied.

Nor does it seem that investment in productive capacity in underground coal mining machine building is sufficient to support in-

[20] "Make Decisions of the 25th Congress of the CPSU a Reality," *Ugol'*, No. 4, April 1978, pp. 3-7 in JPRS 71,340, June 22, 1978, pp. 3-7.

creased output. It was hoped that transferring coal machinery plants to Minugleprom would eliminate administrative barriers frustrating the satisfaction of demand for equipment. Minugleprom, already responsible for the fulfillment of coal output targets, would itself set the production programs of the equipment plants and oversee their fulfillment. Instead, it appears that Minugleprom may be diverting capital away from the machinery plants in an attempt to assist the fulfillment of short-term coal mining targets.

Inability to produce appropriate mining equipment in the required quantities and of required reliability is only one aspect of the equipment problem facing the industry. Perhaps even more serious in the long term is the seeming inability of miners themselves to use and maintain equipment properly. In large part, the difficulty stems from the inattention to maintenance and repair schedules, lack of spare parts, improper operations, and use of equipment inappropriate to geological conditions. As a result of poor maintenance, downtime on machinery is seriously in excess of established norms.[21] Several examples may be cited. Equipment failures in the Karaganda basin have increased by 27 percent in recent years.[22] In 1978, one Soviet journal reported that coal mining equipment idleness had reached 25 percent,[23] while another reported 350 work stoppages due to equipment failure in one Donets mine alone." Poorly maintained equipment is also leading to an increased rate of accidents in the labor force. Soviet fatalities per million tons of coal mined were several times greater than the U.S. rate in the mid-1 970's.[25]

[21]G lotov, op. ('it., p. 2.
[22]M ulkibayev, op cit.
[23]G. Dorofeyev, "Lost Perspective " *Sotsialisticheskaya industriya*, 1 Dec. 3, 197H, p. 2
[24]A. Zharkikh, " Far Behind," *Pravda Ukrainy*, Dec. 16, 1978, p. 2.
[25]"More Coal for the Country," *Ugol' Ukrainy*, No. 1, January 1979, pp. 1-4, in JPRS L 8370, Apr. 3, 1979, p, 54; Joseph J. Yancik, "Some Impressions and Observations of Soviet Coal 111 ining," *Society of Mining Engineers Journal*, July 1974, p. 65.

The following sections briefly describe the most important technology and equipment in both surface and underground extraction of coal, summarizing the state of the Soviet industry, and identifying the major difficulties it is encountering.

SURFACE MINING

Surface or strip mining in 1980 accounted for 37 percent of Soviet coal production. In surface mining, the rock and earth above the coal seam, called overburden, is removed to expose the coal, which is then broken up, loaded onto transport, and hauled away. Surface mining equipment ranges from construction bulldozers or front-end loaders, to enormous draglines, the largest moving land machines in the world. Large shovels and draglines remove the overburden so the coal can be picked up by smaller shovels and front-end loaders, although the latter are relatively little used in the U.S.S.R. Large power shovels work from the floor of the coal pit, taking bits of earth from one wall of the pit, pivoting and dropping the load on the other side. Larger draglines work from the surface at the edge of the pit. Buckets are dropped from the ends of long booms and are filled by dragging them back toward the machine. Draglines then turn, reach across the pit, and drop their loads. Shovels and draglines are generally preceded by vertical or horizontal drills that bore holes for explosives that can shatter the earth and rock for easier digging.

From an engineering standpoint, the Soviet Union is generally capable of fulfilling its surface mining needs. (The exception to this rule is equipment for operating in extremely cold temperatures, as in the Yakutsk basin. Such equipment has yet to be developed anywhere in the world.) But equipment is slow in reaching production and supplies are chronically short. In 1980, draglines accounted for about 33 percent of stripping work, but there have been production shortages and the demand for draglines is not being met.[26] Lack of haulage capacity is a

[26]*Ugol'*, No. 1, 1 9/+1, p. 5.

serious problem, and there is also a need for excavators of greater bucket capacity and cutting force. With the development and introduction of 120- to 180-ton trucks, the importance of large bucket capacities increases, because of the need to match equipment productivities and achieve more efficient (i.e., uninterrupted) operations. Although some giant (5,000 m^3/hr) rotary excavators exist—two are in operation at the Bogatyr Mine in Ekibastuz and one is operating at the Irsha-Borodino pit in Kansk-Achinsk—there remains a general deficit in their supply and capacity.

Climate plays a special role in contributing to downtime and constraining the efficiency of Soviet equipment. Cold climates require special design features. Electrical systems are adversely affected by the cold, and when the temperature drops below -40 °, the conveyer belts on rotary excavators become virtually inoperable. These effects are very serious in Siberia where much of the U.S.S.R. surface mining is carried on. For example, around 70 percent of the coal in the Kansk-Achinsk basin is produced through these methods.[27]

As in other energy industries, part of the problem of supply relates to the inadequacy of facilities to produce large pieces of equipment. In an effort to alleviate this problem, work has begun on the development of a machine building industry in Siberia. Construction of the Krasnoyarsk Heavy Excavator Plant is now underway and is scheduled to be completed by 1984.[28] The plant is to produce mechanical shovels with bucket capacities of 12.5 m^3, walking excavators with 40 m^3 buckets, and rotary bucket equipment with capacities of 5,000 to 12,500 m^3/hr.

The success of these and other attempts to improve the quality and quantity of surface mining equipment are crucial to the coal industry as a whole. As mentioned above, Soviet plans to increase coal output rest ultimately on the expansion of surface mining. To a large degree, therefore, the fate of the Eleventh FYP for coal will depend on the availability of sufficient and appropriate surface mining equipment with adequate capacities to deal with increased output.

UNDERGROUND MINING

The most common technique for mining coal underground in the U.S.S.R. is by continuous mining machines built into longwall systems.[29] Longwall mining utilizes a steel plow or rotating cutting drum that moves back and forth across a coal face several hundred feet long. As the machinery moves, it cuts the coal, which falls onto a conveyer. Broad steel beams set a few feet apart provide ceiling support. These supports are moved by self-advancing hydraulic jacks that change their position during or after each pass of the cutting machine along the coal face. This change in position is accomplished by releasing the pressure exerted on the roof and moving the machinery forward one beam at a time. The unsupported portion of the roof then collapses. A continuous mining machine tears the coal from the face and loads it for transportation in one operation.

Only about 4 percent of U.S. underground production comes from longwall mining. In contrast, it is the predominant method in the U.S.S.R. (as in Western Europe), accounting in 1979 for over 65 percent of total Soviet underground output.[30] In some basins, this percentage is even higher, (reaching 96 percent in Moscow, 90 percent in Pechora, and 86 percent in Karaganda), the national average being held down by a relatively low level of longwall mining in the Donets basin. This

---

[27] B. Pichugin, "Coal Made Ready During the Summer," *Sotsialisticheskaya industriya*, July 17, 1980, p. 2.

[28] V. Lisin, "A Second 'Uralmash' on the Banks of the Yenisey River," *Trud*, Feb. 25, 1979, p. 1.

[29] See Simeons, op. cit., pp. 94-95; Environmental and Natural Resources Policy Division, Congressional Research Service, Library of Congress, *The Coal Industry: Problems and Prospects*, a background study prepared for the Permanent Subcommittee on Investigations of the Senate Committee on Governmental Affairs, 1978, p. 26.

[30] "Make Decisions of the 25th Congress . . . . ," op. cit., pp. 12-20.

is probably due to the lack of longwall miners designed for work on thin seams.

The Soviet equipment stock in underground mining is large and increasing, but its quality is declining. Although the number of mechanized complexes in use over the 4 years from 1975 to 1978 (inclusive) went up by 24.4 percent, the amount of equipment recorded as nonoperational went up by 73.7 percent.[31] This can be explained by the age of the equipment in use, the use of equipment unsuited to worsened geological conditions, and equipment repair and servicing practices.

Soviet sources point repeatedly to underground equipment requirements that are not being met. In particular, miners in the Donets basin are faced with the increasingly pressing need for equipment suited to new geological conditions. Sixty percent of Donets coal is being mined from thin seams less than 1.2 m thick, 50.7 percent of which are gently sloping, and 9.3 percent of which are steep.[32] At the beginning of 1978 thin seams already constituted 83 percent of the commercially recoverable coal reserves. Yet of a total of 50 working faces at one Donets mine, only 12 were being worked with appropriate equipment. Shortfalls in production by the machine building industry are blamed for this problem. Past emphasis on production of machinery for excavation of thicker and more productive seams had relegated thin seam equipment to a secondary, nonpriority role. Despite official recognition now of the need for thin seam excavators, equipment for thicker seams has continued to be developed. "

In addition to not meeting the present equipment needs of the coal mining industry, machine builders are criticized for a lack of attention to quality, reliability, and ease of repair.[35] Their seemingly slow response to changing needs in the industry is a function of a mix of operational constraints: a shortage of labor, insufficient production space in factories, pressures of shortrun production targets, and the fact that the coal industry is not the sole (nor even, in some cases, the primary) customer for their products.

Other deficiencies that continue to be cited include a shortage of equipment for the transport of support materials and personnel, drills of insufficient power and productivity, highly labor-intensive timbering techniques, low mechanization of tunneling operations, and ventilating systems of inadequate power and efficiency. The claim is made that while technical solutions for these problems have been developed, the necessary equipment for implementing change is not yet being produced.[36]

[31] Ye. N. Rozhchenko, "on Some Problems of the Development of Underground Coal Mining," *Ugol'*, No. 8, August 1979, p. 6.

[32] A. I. Bashov, "Dongiprouglemash's Developers Are Working for Donbass Miners," *Ugol'*, No. 10, October 1979, pp. 41-46, in JPRS 75,145, Feb. 15, 1978, p. 25.

[33] V. Deshko, "Equipment for Thin Seams," *Rabochaya gazeta*, Dec. 14, 1979, p. 1.

[34] *Rabochaya gazeta*, May 27, 1980, p. 1.

[35] Rozchenko, op. cit., p. 7.

[36] Ibid., p. 9.

SOVIET COAL INDUSTRY INFRASTRUCTURE AND RELATED AREAS: PROBLEMS AND PROSPECTS

Aside from the quantity and quality of mining equipment, the major problems facing the Soviet coal industry lie in labor supply and productivity; in the construction of new mines; in the transport of coal; and in the amount of capital investment available to the industry. The following sections deal with these issues.

LABOR

The labor force employed in the Soviet coal industry is enormous. It has been estimated that in the early 1970's there were more than 1 million workers involved in the production of coal.[37] In comparison, the U.S. coal mining industry required only 159,000 people in 1972.[38] And despite the high absolute level of employment, Soviet labor shortages in the coal industry are becoming increasingly serious.

The major reason for the coal industry's voracious requirements is the low level of mechanization. Over 50 percent of those employed are still engaged in manual labor. Even in the more highly mechanized longwall mines, one-third of the work performed is manual. Much of this labor relates to auxiliary operations. Mine repair, roof control, and even some coal and rock loading is done manually .39

Labor shortages affect both coal extraction and coal mining machine building. *Pravda* noted in 1979 that in the Kuznetzk basin, the work force was 5,000 short in the underground mines alone. Labor shortages are also reported for the Karaganda basin. The director of the Gorlovka Machine Building Plant, a major coal mining equipment producer, recently complained that production targets cannot be met because the plant lacks workers. In October 1978, M. I. Shchadov, a deputy minister of Minugleprom, indicated that the industry as a whole was facing labor shortages and that the shortages were impeding output.[40]

These shortages may be exacerbated by the progressive reductions in the length of the workweek. Before 1956, mines operated 7 days a week. Between 1956 and 1958, extraction and development work began to shut down 1 day a week and the workday was reduced to 6 hours for some workers. In 1967, a 2-day weekend was introduced and miners doing heavy labor underground were given a 30-hour workweek. These reductions have created a demand for additional labor that is not likely to be met in the next few years, for the industry is experiencing difficulty in recruiting and keeping workers. At one time, coal miners were among the highest paid workers in the U. S. S. R., but now the difference between coal miners' wages and those of the average industrial worker is decreasing. Housing for coal miners is in short supply and this does little to attract workers. Shortages of labor are especially acute in the eastern regions of the country[41] and are affecting mine construction as well as coal output there. Labor turnover is also a substantial problem. In early 1980, turnover ran at about 20 percent of the total work force per year.[42]

Problems of this kind are not unique to the coal sector; they pervade all Soviet industries and the situation is likely to grow worse in the years ahead. The probability that the coal industry will have sufficient labor to solve its problems without other reforms is low. Thus, in coming years solution to the labor problem will rest on increases in labor productivity.

Table 24 gives official Soviet productivity figures for 1971 to 1977, the last year for which they are available. The amounts shown here are inflated by the fact that, like output data, Soviet productivity statistics are in terms of "raw" (i.e., uncleaned) coal mined per "production" worker, a category that excludes workers who would be counted in the West. Nevertheless, several trends are clear. Labor productivity for the industry as

---

[37] Stephen Rapawy, "Estimates and Projections of the labor Force and Civilian Employment in the U. S. S. R., 1950 to 1990, (Washington, D. C.: U.S. Department of Commerce, Bureau of Economic Affairs, September 1976), p. 31: Strishkov, Markon, and Murphy, "Soviet Coal Productivity . . .," op. cit., p. 48.

[38] "Campbell, op. cit., p. 132.

[39] V. P. Podgurskiy and A. S. Minevich, "Reserves of Labor Productivity Growth," *Ugol'*, No. 7, July 1980, p. 43.

[40] Bogachuk. op. cit.; Mulkibayev, op. cit., p. 99; V. Vylgin, "In Every Column-A Minus," *Rabochaya gazeta*, May 27, 1980, p. 1; M. 1. Shchadov, "Coal: Increase Extraction, Accelerate Deliveries," *Gudok*, Oct. 12, 1978, pp. 1-2 in JPRS 72,821, Feb. 14, 1979, p. 66.

[41] Kurnosov, op. cit.

[42] Podgurskiy, op. cit.

Table 24.— Labor Productivity in Soviet Coal Mining
(metric tons mined per person per month)

	1971	1972	1973	1974	1975	1976	1977	1979
Minugleprom	62.3	66.3	69.7	73.1	75.4	75.1	75.3	70.2
Underground mining	48.0	40.5	52.6	54.3	55.2	54.6	53.7	48.6
Surface mining	310.0	335.1	362.5	391.2	428.3	435.5	454.0	448.0
By basin.								
Donetsk (underground)	39.9	41.7	43.3	43.9	43.7	42.5	41.4	
Kuznetsk	74.1	78.6	82.7	87.0	92.8	95.1	96.3	
Underground	—			70.4	74.2	75.7	75.9	—
Surface		—	—	231.3	253.5	260.0	271.9	
Karaganda	73.5	79.4	84.5	91.2	96.2	98.6	98.9	—
Underground	—		—	86.7	91.3	93.7	93.9	—
Surface	—	—		295.1	316.4	328.2	338.4	
Moscow	74.0	78.4	82.7	87.2	*90.5*	87.4	86.0	
Underground	—		—	80.2	*83.4*	80.4	78.8	—
Surface				306.5	*303.4*	283.6	272.2	
Pechora (underground)	61.0	64.4	67.5	70.6	*75.0*	77.8	79.1	—
Kansk-Achinsk (surface)			—			929.9	909.3	

SOURCES April issues of Ugol

a whole rose through 1975, but since then appears to have stalled at around 75 mt per person month. Labor productivity in underground mining has decreased since 1975, although this decline has been offset by gains in surface mining, where productivity is 8.5 times higher. Continued gains in surface labor productivity must be counted upon to offset underground declines such as those apparent in the Donets and Moscow basins. Labor productivity in Donets is not even one-half as great as in the other major basins, due largely to a relatively low level of mechanization of mining operations. Since the Donets basin employs about 55 percent of the industry's labor force,[43] improvements in labor productivity here are particularly important.

MINE CONSTRUCTION

Coal mine construction organizations, like underground mining equipment manufacturers, were transferred to the administration of Minugleprom in the early 1970's, But here too, there have been complaints that no improvements have resulted. Instead, the construction firms have been cut off from their old ministries and suppliers, and do not have production capacities of their own.[44] They are inhibited by lack of resources and labor shortages. In addition they must still contend with all the traditional impediments to the conduct of business in the Soviet economy: lack of cooperation from other organizations, poor plan development, shortages of labor and funds, and improper work practices.

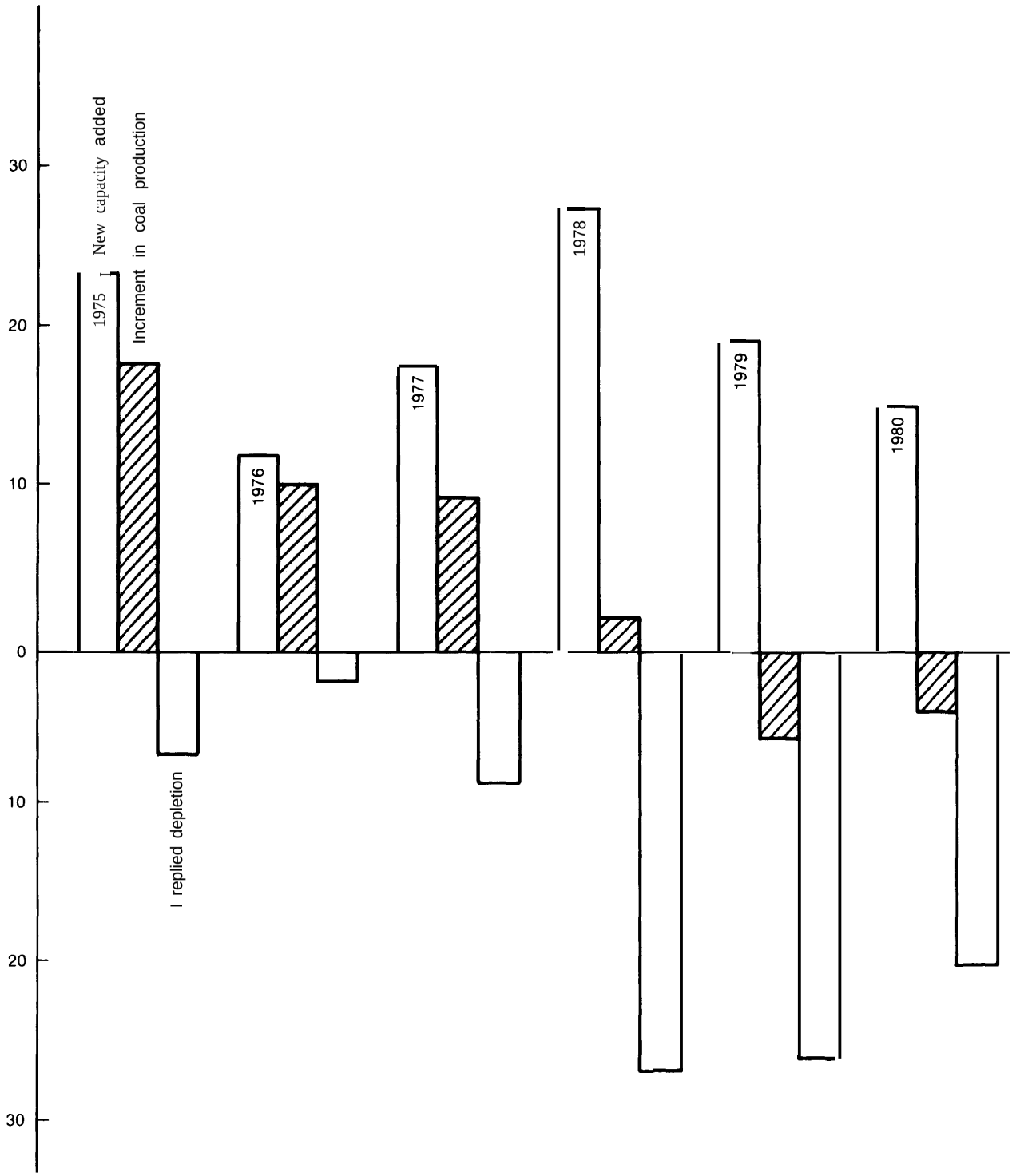
The Central Intelligence Agency (CIA) has reported that additions of new coal mining capacity between 1976 and 1979 fell to the lowest level in nearly a decade. At the same time the rate of mine depletion has risen, and it has been estimated that over three-quarters of new mine capacity now merely offsets mine depletion .45 Estimates of recent yearly mine depletions are given in figure 7. The depletions shown for 1978 through 1980 are substantial and may pose a serious impediment to coal output growth in the next 5 years. Since new Soviet mine capacity is taking 10 to 11 years to introduce, the Soviets will be largely dependent, for many years to come, on assimilating mines currently under construction.

[43] Central Intelligence Agency, "U.S.S.R: Coal Industry Problems and Prospects," ER H0-10151, March 1980, p. 8.

[44] N. Klunduk, "Is This Really Economic?" *Pravda*, Dec. 11, 1978, p. 2.

[45] CIA, "USSR: Coal Industry," op. cit., p. 3.

Figure —Estimated Mine Depletion, 1975-80
(million metric tons)



SOURCE: Methodology taken from CIA, "U.S.S.R.: Coal Industry. . .," op. cit. Data for 1975-1979: *Narodnoye khozyaystvo, op. cit.* various years. 1980: *Trud* (December 21, 1980), p. 2.

Mine reconstruction is also lagging, According to Soviet norms, a mine with a capacity of up to 3 mmt per year should require 5 to 7 years for reconstruction. In practice, reconstruction of many mines takes three times longer.[46] Due to shortages of appropriate new capacity, mine operators who must fulfill their output plan targets mine whatever coal is available, often damaging longrun development plans in the process. In their attempts to maintain output, they push mining into ill-studied coal seams and use machines in conditions for which they were not designed.

The severity of the problem may be suggested by the following example from Kuznetsk. In this leading Soviet coal region only one new mine has gone into operation in the past 18 years in two of the biggest production units–the Kuzbassugol and Leninskugol mining associations. At present, not one mine is under construction in the province that includes much of the basin.[47]

TRANSPORT

The bulk of growth in coal production is coming from Siberian basins. The limitations posed by transport conditions were officially recognized by the November 1979 Plenum of the Communist Party Central Committee in the emphasis it placed on solving transport problems associated with the growing flow and volume of freight. Basically, there are three choices open to the U.S.S.R. for the transport of coal from remote regions: rail, slurry pipeline, and the conversion to electricity at source and transmission by wire. This latter option is discussed in chapter 5.

Rail

At present, coal is transported almost entirely by rail and a number of factors hinder its delivery. These include losses of coal during shipment, and more important, the inefficient management and insufficient capacity of the rail system.

First, some Soviet coal is difficult to transport economically. Ekibastuz and Kuznetsk coals, for instance, can be transported in run-of-mine form, but Kansk-Achinsk coal, which tends to self-ignite when dried, can be shipped only 1,500 to 2,000 km in untreated form. Longer distances will not be practical until beneficiation technologies have been developed and put in place. This is not likely to occur until the latter part of the 1980's.

Second, loss of coal from rail cars is a major problem. Some rail cars leaving the Donets basin arrive at the power station with only one-half their cargo remaining, and about 4 percent of the coal shipped from the Karaganda basin is lost during transport. Aside from theft, coal is lost in two ways. It either leaks out of the bottoms and sides of the cars or it is blown out of the open cars by the wind. The introduction of continuous mining machinery has led to shipments containing finer coal than was the case previously. Consequently, during transport in open rail cars 1 ton of coal may be blown away in each car for every 1,000 km traveled. The

[46] S. Zayga O\, et al., ' 'on Mining Technology, *Pravda*, Oct. 14, I 979, p. 2.

[47] Shumkin, **op. cit., p, 1, "**

[48] V. Sonin, "The Tracks Are Sown Wit h ('ml, " *Pravda*, Nov. 1, 1979, p. 3; "Russians Plan Surface Mine Complex for Power (generation, *Coal Age*, October 19'7H, p 47.

Photo credit TASS from SOVFOTO

Coal-loaded trains leave Karaganda

Ninth FYP (1971-75), called for Minugleprom to construct eight facilities in the Donets basin to coal the coal in the rail cars with a protective film, but as of late 1979 none had been built.[49]

Third, there is substantial evidence of mismanagement in the rail transport of coal. While there is a shortage of rail cars in Siberia to transport coal to the Urals, rail cars are standing idle on sidings in other regions. In 1978, the Soviet paper *Izvestiya* reported that coal from Uzbekistan was being shipped to electric power stations in Kirgiziya, while coal from Kirgiziya was being shipped to electric power stations in Uzbekistan. This was because coal had to be shipped to the Angren electric power station to maintain operations during the peakload period. When the station returned to normal operation the coal shipments continued (and this despite the fact that the coal had already damaged station equipment). Coal continued to arrive from Kirgiziya for the next 2 years and piled up at the station.[50] Again, such anecdotes are not isolated instances. They reflect deep systemic problems.

The most important constraints in the ability of the existing rail system to handle coal shipments, however, lie in factors related to rail management and engineering. These difficulties are not grounded in the Soviet Union's capability to solve technical problems in rail transport. The technology for electrification, double-tracking, and locomotive and freight car design and construction is well-established. The real constraint lies in a past heritage of mismanagement and in the inadequacy of capital investment funds allotted to the rail system, manifest in the railroad's poor economic performance in recent years.[51]

The engineering and technical improvements needed to increase coal's share of total rail freight would include:[52]

- increasing the length of jointless track on improved roadbeds;
- increasing track capacity at arrival and departure points;
- increasing the share of eight-axle rail cars in the rolling stock fleet in combination with locomotives of increased power;
- continuation of ongoing and planned double-tracking and electrification; and
- improvements in freight car and track repair and maintenance practices to curb coal losses en route.

The Eleventh FYP calls for construction of only 3,500 km of new mainline and 5,000 km of secondary rail line." Much of this relates to the Baikal-Amur Mainline (BAM) railroad in the Far East, and will contribute little to facilitating the transport of Siberian coal to the European U.S.S.R. Thus, while marginal improvements in the system may continue, the improvements necessary to support an increased flow of Siberian coal are not likely to be met in the near future. Expansion of the rail system to allow for greater coal freight may be hindered by a reluctance on the part of the Soviet leadership to commit itself to Siberian coal development (see ch. 8).

Slurry Pipelines

Coal slurry pipelines are a possible solution to the transport problem posed by the substantial distance separating primary sites of energy consumption and the country's largest fuel reserves. Although the initial capital investment for such pipelines is high, operational costs relative to rail trans-

[49] Sonin, op. cit., p. 3.

[50] G. Dimov, "Why Take Coal to Coal?" *Izvestiya*, Sept. 5, 1978, p. 2.

"Central Intelligence Agency, "The Soviet Economy in 1978-79 and Prospects for 1980," June 1980, p. 8.

[52] T. M. Borisenko and V. P. Vodyanitskiy, "Evaluation of Possible Ways of Increasing the Economic Effectiveness of Systems of Long-Distance Hydraulic Transport of Coal, " *Izvestiya an SSSR: Energetika i transport, No. 4,* April 1979, p. 44.

[53] *Izvestiya*, Dec. 2, 1980, p. 5.

port are low.[54] Pipeline transport of coal would also circumvent the problem of stepping-up use rates on an already intensively operated rail system.

While underground slurry pipelines hold certain advantages over rail for long-distance coal transport (no loss of transported material en route; reduction in noise and pollution; increase in land made available for alternative uses; and greater process automation) several problems remain to be resolved. There has been little study of the physical-technical processes of pumping coal slurry through the large diameter pipes required for efficient pipeline transport over long distances. 55 Moreover, the Soviet Union does not now produce the basic equipment needed for slurry preparation plants, pumping stations, and end-of-line installations for preparation of the coal for burning. These include high-capacity slurry pumping units, centrifugal pumps capable of handling large amounts of slurry, and dependable wear-resistant fittings (flush ball cocks, reflux valves, etc.).[56]

Two industrial coal slurry pipelines have been built and are in operation in the Kuznetsk basin. The large particle size of the coal being pumped through these lines (up to 50 mm) has led to significant wear in the pipes and has required that they be periodically turned and replaced.[57] These pipelines are short (not over 10 to 11 km) and lie above ground, facts that facilitate maintenance. Nevertheless, pipeline erosion of this type would have significant impact on the cost of operating coal slurry pipelines of greater lengths.

Construction of a 250-km pipeline, connecting the hydraulic underground mine Inskaya in the Kuznetsk basin to a thermal electric power and heat station in Krasnsyarsk, was scheduled to begin in 1982, but there are now indications that the project will be delayed until 1984.[58] This line is to serve as the prototype for 2,000- to 4,000-km pipelines connecting the Kuznetsk basin to the western U.S.S.R. The earliest date given for creation of long-distance coal slurry pipelines is 1990. Additional constraints *on* development of long-distance coal slurry pipelines arise from the need to prevent the slurry from freezing in cold weather, and the high-volume water requirements associated with hydrotransport. These caveats are particularly important for pipelines originating in Siberia.

In short, there is a disparity between Soviet progress in slurry theory and practice. On the one hand, the Soviet Union has led the world in development of hydrotransport theory. "Soviet insight into the structure of fine coal slurries is of the highest order, "[59] even in the absence of a long-distance pipeline of a length comparable to the U.S. Black Mesa coal slurry pipeline. Yet Soviet domestic capabilities for construction of pumping equipment remain undeveloped.

CAPITAL INVESTMENT

Annual investment in the coal industry rose from 1.4 billion rubles in 1965 to 2.0 billion rubles in 1979 (see table 25), but coal's share in total investment in industry fell from 6.9 to 4.5 percent. In comparison, investment in the petroleum industry rose from 10.0 percent of all industry investment in 1965 to 12.9 percent in 1979, while investment in the gas industry rose from 3.0 to 4.5 percent. The coal industry has thus failed to keep pace with the other fuel sectors, and the current state of the industry reflects this fact. Its recent poor performance supports the judgment that past investment has been too small and too irregular to maintain, let

[54] "Development of New Types of Transport," *Stroitelstvo truboprovodov*, No. 11, November 1978, pp. 36-37.

[55] Borisenko and Vodyanetskiy, op. cit., p. 37.

[56] Ye. Olofinskiy, *Planovoye khozyaystvo*, No. 8, August 1980, p. 95, in JPRS 76,585, Aug. 8, 1980, p. 36.

[57] Ibid.

[58] Kuzbass-Novosibirsk Coal Pipeline, *Sotsialisticheskaya industriya* Sept, 12, 1980, p, 2 in JPRS 76,654, Oct 20, 1980, p. 50; *Planovoe khozyaystvo*, N(), 5, May 19/+1, p. 25.

[59] John W. Kiser, III, " Report on the Potential for Technology Transfer from the Soviet Union to the United States, " (Santa Monica, Calif.: Rand, August 1974), p. 40.

Table 25.— Capital Investment in Leading Fuel Industries

Year	Coal	Oil	Gas
	(million rubles, constant prices)		
1965, ...	**1,426**	2,070	615
1970	1,541	2,527	1,041
1975	1,759	3,853	1,798
1976	1,747	4,066	1,835
1977	1,848	4,503	2,031
1978	2,035	5,270	2,210
1979	2,020	5,860	2,020
	(percent of total investment in Industry)		
1965	6.9%	1 0.0%	3.0%
1970	5.3	8.8	3.6
1975	4.4	9.7	4.5
1976	4.3	10.0	4.5
1977 ...,.	4.5	10.6	4.8
1978	4,5	11.6	4.9
1979	4,5	12.9	4.5

SOURCE *Narodnoye* khozyaystvo, various years

alone expand, productive capacity. The situation is aggravated by constantly rising costs of mining and mine construction in the European basins.

Evidence of insufficient investment in the coal industry can be seen in a number of areas: 1) the extremely low level of introduction of new mine capacity at many basins; 2) the insufficient productive capacity at plants producing mining equipment; 3) the lack of repair facilities at many basins and the attendent rise in machinery downtimes; 4) the shortage of enrichment facilities; 5) the ill-repair of rail cars; 6) the shortages of locomotives and rail cars; 7) the short supplies of spare parts; 8) the lack of equipment suitable for working thin or pitching seams; 9) the low level of mechanization of many basins, including the Donets; and 10) the lack of large capacity trucks and rail cars at surface mines. Probably the two most important of these areas are mine capacity and transport.

Mine Capacity

One of the most serious effects of the present low level of investment in the coal industry has been the failure to prevent a decline in productive mine capacity. The Soviets hope to achieve greater increases in productive capacity per ruble of investment by switching from underground to surface mining. At present, the share of surface mining in total mining is substantially lower for coal production than for the mining of ferrous and nonferrous metal ores, and for chemicals. Soviet industry officials believe that a l-percent increase in the share of surface mining in total output (accompanied by a l-percent decrease in underground mining) could save 80 million rubles per year, lower the capital intensity of the industry by 1 percent, and raise labor productivity by 1.4 percent.[60] It must be noted that increases in surface" mining would have to be substantial before such an effect would result in decreased expenditures by the industry, but increases here would help the Soviets to achieve greater increases in capacity per ruble spent.

The differences between surface and underground mining have an important geographic dimension. Coal production from the underground mines in the European U.S.S.R. is stagnating or falling. At the same time, production is becoming increasingly costly as mines go deeper and the quality of mined coal falls, and as thin or steep seams account for greater shares of output . The cost of coal mined in these basins is now as much as several times higher than the cost of coal mined at Kansk-Achinsk and Ekibastuz, even when compared on a calorific basis.

In the mid-1970's, the required capital investment for introducing new mine capacity in the Donets basin was 64.3 rubles/ret of new capacity and in the Moscow basin, 89.7 rubles/ret. By comparison, the required capital investments in the Ekibastuz and Kansk-Achinsk basins were 8.2 rubles/ret and 9.6 rubles/ret, respectively. The cost per ton of coal mined from new capacity was correspondingly high in the Donets and Moscow

[60] M. I. Shchadov, "Improving Equipment and Technology for Surface Mining of Coal Deposits," *Ugol'*, No.1, Januar, 1981, p. 1.

basins (17.0 rubles/ret and 24.1 rubles/ret, respectively), and low in the Ekibastuz and Kansk-Achinsk basins (2.5 rubles/ret and 2.4 rubles/ret). Extraction of Kansk-Achinsk and Ekibastuz coal is thus economically more attractive than extraction of any other coal in the U. S. S.R.[61]

The relatively large investments that would be required to maintain Donets and Moscow basin production are a serious deterrent to production there. This fact is largely responsible for the turn to eastern coal in Soviet economic planning.

Coal Transport

A recent Soviet source has given rough cost estimates for various options for transporting coal from Siberia to the Urals or farther west. These options include: 1) rail transport of coal not requiring beneficiation before transport (presumably Kuznetsk coal); 2) transport of coal requiring beneficiation, i.e., Kansk-Achinsk coal; and 3) transport of coal as electricity. This assumes a volume of traffic on the order of 250 to 300 mmt of coal per year. [62]

Rail transport of Kuznetsk coal to the Urals or the European U.S.S.R. is an attractive option. Coke from Kuznetsk is significantly less expensive to produce than coke from Donets, and is competitive with the latter anywhere in the U.S.S.R. However, expansion of rail traffic from the Kuznetsk basin would call for substantial investments in the rail system, and would increase the rail sector's demand for heavy-duty steel rails, labor, and improved freight cars and locomotives. This would place additional stresses on the already strained steel and machine building industries, and on an increasingly tight labor market.

Building a railroad, even in the more favorable terrain of the area, might cost up to 1 million rubles/km.[63] (It probably would not be necessary to build completely new rail lines, since junction with existing railroads would be possible at certain points.) Increased traffic on the railroads will also lead to faster depreciation of the track. Present rails handling 100 to 120 mmt of traffic a year wear out in 4 to 5 years. Their life would decrease to 2 to 3 years if 320 to 350 mmt of traffic were carried,[64] and steel rail demand would therefore remain high after construction of the initial rail line was completed.

Transport of 250 to 300 mmt of coal per year from Kansk-Achinsk would entail not only upgrading or expansion of the rail system, but also the expenditure of huge sums on coal beneficiation facilities. Since the coal is of such low quality, about 600 to 700 mmt would have to be mined in order to obtain 250 to 350 mmt of upgraded coal. No less than 25 treatment plants would have to be built at a total cost of 10 billion to 12 billion rubles. The investment in the treatment plants alone is enormous and is on a level with the required investment for the proposed Siberian natural gas pipeline to Western Europe.[65]

[61] These costs are termed *privedennyye zatraty*, a cost that includes direct costs, plus a capital charge at an interest rate appropriate for the given industry. Ya. Mazover, " Perspectives of the Kansk-Achinsk Coal Basin, " *Planovoye khozyaystvo*, No. 5, May 1976, p. 66.

[62] V. E. Popov (ed.), *Siberian Fuel-Energy Complexes*, (Novosibirsk: Izd. "Nauka " 1978), p. 207; See also A. Probst, "Ways of Developing the Fuel Economy of the U. S. S.R.," *Voprosy ekonomiki, No. 6*, June 1971, p. 57; Ya. Gantman, "Structural Changes in the Fuel Balance of the U. S. S.R.," *Planovoye khozyaystvo*, No. 11, November 1971, pp. 88-91.

[63] B. S. Filippov, "The Effectiveness of Transporting Kuznetsk Coals and Coke to the Center of the European U. S. S.R.," *Koks i khimiya, No. 3*, March 1977, p. 51.

[64] Popov, op. cit., p. 207.

[65] David Brand, "Soviet Slip-Up, " *Wall Street Journal*, Jan. 23, 1981, p. 1.

WESTERN TECHNOLOGY IN THE SOVIET COAL INDUSTRY

As the above analysis has indicated, the Soviet coal mining machinery industry is capable of producing—and does produce—equipment of sufficient quality to meet the needs of the industry. The power and capacity of this machinery often tends to be below the best Western models, but the Soviets are improving in this respect. For all the shortcomings described above, the production of many types of machinery increased at substantial rates between 1970 and 1979. Continuous miner production was up 5 percent; heading machines were up 78 percent; and loaders were up 28 percent. In addition, the U.S.S.R. actually exports mining equipment, and the share of annual production of mining machinery exported has risen. For example, the export of continuous miners rose from 5 percent of production in 1970 to 9 percent in 1979. Overall, in 1979, the Soviets imported about 74 million rubles worth of mining equipment (all types), while they exported about 211 million rubles worth.[66] This reinforces the impression that the Soviets suffer not so much from an overall equipment shortage as from the lack of capacity to produce specific models. These areas of need—in which thin-seam miners and surface mining equipment (power shovels, draglines, drilling equipment, bucket excavators, trucks, and rail cars) figure prominently—have been supported by modest imports.

Table 26 shows official Soviet foreign trade statistics for imports of all types of mining machinery. These statistics should be treated with some caution. First, they are certainly incomplete. For instance, Japan is not listed as a source of imported machinery, but significant amounts of Japanese equipment are known to be in use in the South Yakutian basin. Second, the figures are highly aggregated; they do not break out coal from other mining equipment.

The volume of Soviet mining equipment imports rose dramatically during the 1970's, peaking at about 92.6 million rubles in 1978. In 1979, 38.3 percent of these were from the West (8 percent of total imports were from the United States); 47.5 percent were from Eastern Europe; and 14.2 percent were unidentified. It would appear, therefore, that purchases from the United States are neg-

[66] U.S.S.R. Ministry of Foreign Trade, *Vneshnyavatorgovlya SSSR v 1979 g.* (Moscow: Izd. "Statistika," 1980), pp. 21, 34.

Table 26.—Soviet Imports of Equipment for Underground and Surface Mining of Minerals
(thousand rubles)

Year	Source							Total
	U.S.A.	Poland	G.D. R.	F.R.G.	France	Sweden	Czechoslovakia	
1970	*2,045*	—	*7,987*	*556*	969	*1,515*	6,394	19,857
1971	*338*	—	*3,383*	1,792	1,868	1,925	1,343	10,768
1972	*353*	—	*2,026*	**1,552**	2,250	404	1,033	7,623
1973	*377*	—	*2,606*	**2,022**	2,370	2,117	2,687	12,356
1974	*438*	—	*3,449*	**10,344**	1,068	7,432	—	26,719
1975	*7,858*	—	*4,017*	**20,515**	3,973	10,108	—	58,181
1976	*7,287*	—	*5,461*	**6,964**	9,999	7,961	—	49,976
1977	*674*	—	*8,826*	**8,676**	851	1,419	—	36,303
1978	*2,836*	*11,426*	*33,098*	**20,710**	1,898	9,923	—	92,636
1979	*9,984*	*10,624*	*24,504*	**14,104**	449	3,798		73,935

SOURCE U S S R Ministry of Foreign Trade Vneshnyaya forgovlya SSSR (Moscow Izd "Statistika") for various years

ligible and that Eastern Europe figures more prominently as a supplier of Soviet mining equipment than does the West. Poland, for instance, is an important producer of underground equipment. The U.S.S.R. has also purchased excavators from East Germany.

Western trade statistics and trade journals provide more information on the precise nature of imports from the West, The two major areas here are equipment purchased from Japan for development of South Yakutian coal, and trucks for use in surface mining operations. (Meanwhile, the U.S.S.R. is attempting to increase its own capacity for the production of large–up to 180 tons—dump trucks.) In general, compared to the oil and gas industries, the Soviet coal industry shows little reliance on Western technology and equipment. The Soviets have opted largely for domestic development and production of equipment, despite the fact that superior models may be available in the West.

Nor is there evidence of much use of Western computers in the Soviet coal industry. Underground and surface mining are not particularly amenable to the application of computers. The Soviets would only be likely to turn to the West in these areas if they could acquire breakthroughs in automated mining. Given the low level of mechanization in the industry and its secondary priority after petroleum and nuclear power, such a development is unlikely. Computerization in Soviet coal mines is, therefore, not expected to be important in the next 10 years, although it could contribute to the rationalization and management of the industry. Given the pervasive systemic problems described above, the coal industry would at best benefit slowly and indirectly from transfers of software. It has not sought such technology itself, and is not likely to do so in the near future.

PROSPECTS FOR THE SOVIET COAL INDUSTRY

The Eleventh FYP calls for the production of 770 to 800 mmt of coal per year by 1985. Achievement of output in this range, which is lower than the original 1980 goal (790 to 810 mmt), would represent the reversal of previous trends of declining production and restore a modest rate of growth for the industry as a whole. Most of this growth would be achieved by expanding surface mining. The FYP targets envisage surface mining constituting 39 to 40 percent of total output (300 to 320 mmt), leaving 470 to 480 mmt of underground production. 1980 underground output was 451 mmt. Thus, the intention is to at least hold underground production stable.

Soviet targets for the Twelfth FYP (1986 - 90), if they exist, have not been published. However, the literature does support the qualitative judgment that the Eleventh FYP period is intended to be a time of preparation for a period of more intense growth to follow. The 1981-85 respite will hopefully allow time to permit the expansion and upgrading of surface mine capacity, coal processing capacity, the stock of surface mining equipment, and the rail transport system.

In this section, OTA has attempted to evaluate these goals and to provide estimates of plausible levels of production in 1985 and 1990. As with all of the projections in this report, the figures provided here are not predictions. Rather, they are projections based on OTA's judgments of likely outcomes, given explicit accompanying assumptions. These estimates, together with 1980 production figures, are given in table 27.

1981-85

OTA believes that the production range for the Soviet coal industry specified in the plan is unrealistically high, and that the best

Table 27.—Estimated Soviet Coal Production (million metric tons)

	Years			
	1980	1985 (plan)	1985 (best case projection)	Percentage change
U.S.S.R. total	716	(770-800)	765	+ 7
Major basin a:				
Donets	203		195	- 3
Kuznetsk	154	(167)	160	+ 4
Ekibastuz	67	(85)	85	+ 20
Kansk-Achinsk	40		50	+ 25
Karaganda	*49*	*(49)*	*49*	*0*
Pechora	30		26	– 13
MOSCOW	26		25	– 4
South Yakutia	3			+ 267
By surface mining	264	(300-320)	320	+ 21

[a]Estimates

SOURCE Off Ice of Technology Assessment, Soviet Geography, April 1981, p. 280

that could be expected is production of 765 mmt. This growth of roughly 7 percent is short of the low end of the range specified in the plan, but even this figure should be regarded as a highly optimistic best case, which might be possible if the U.S.S.R. could fulfill announced plan targets for surface mining and halt the decline in underground output. Some experts believe that the latter is impossible and that a more realistic projection would be some 20 mmt lower.

OTA's most optimistic scenario corresponds closely to recent CIA projections,[67] and is based on the following assumptions:

- No dramatic changes in the present organization of the economic system as it affects coal production.
- No dramatic change in the priority to be accorded to the coal industry; i.e., OTA assumes that coal will retain its "second-class" status, at least for the next 5 years, while attention is concentrated on nuclear power and gas development. This subject is discussed in more detail in chapter 8.
- No major labor shortages. Growth in coal output will come almost exclusively from Siberian surface mines that have a labor productivity nearly nine times as great as underground mines. The shift to surface mining, coupled with continued mechanization and automation of underground operations, should, therefore, help to alleviate labor shortages.
- Few, if any, new measures taken to provide greater protection of the environment. OTA assumes that despite official rhetoric affirming the need for greater environmental protection, only those measures that would not lead to significant sacrifices in output will be instituted.
- Investment resources increased sufficiently to provide for a low level of growth.
- Expansion of coal mining equipment production in the following areas: larger capacity power shovels and draglines; excavating equipment and electrical systems for Siberian climate; special subcomponents, lubricants, ventilation and other systems for excavators; large diameter steel cables and rolled metal for excavators; spare parts; drilling equipment with improved productivity; larger capacity mine trucks; conveyer belts with improved strength; and equipment for mining coal from thin and steeply pitched seams.
- Continuation of present levels of equipment and technology imports, i.e., of the policy of relying heavily on domestic technology. Specifically, the projections assume that the U.S.S.R. continues to import Japanese equipment for development of Yakutia; to purchase little or no Western underground equipment; and to expand imports of surface mining equipment, mainly from East Germany and Poland.

A major industry concern will be the maintenance of coking coal production. Virtually all Soviet coking coal is mined underground, and underground mining will decline in many basins. Yet, even with substantial declines, four factors suggest that industry need not suffer from a lack of coke:

[67]The CIA in "U.S.S.R.: Coal Industry . . . ," Op. cit., posits a range of 765-785 mmt.

1) there is reason to believe that domestic consumption of coke will rise by only 4.5 mmt between 1977 and 1985, and by only 0.5 mmt between 1986 and 1990;[68] 2) about 44 to 56 mmt of coking coal per year are burned at electrical power generating plants (due to insufficient enrichment capacity to render these coals suitable for coking);[69] 3) some coking coal being mined is improperly categorized as steam coal;[70] and 4) of total coking coal mined each year, about 4 percent may be lost in transport.[71] The latter "use" represents a potential source of coking coal for productive domestic consumption if the Soviets are willing to make necessary but expensive improvements in the transportation system.

The best case growth in output projected here would be largely supported by a growth in surface mined coal from about 264 mmt in 1980 to about 320 mmt in 1985, in accordance with the FYP target. The share of surface mining in total output would therefore rise from 37 percent to about 410 percent. These coal increments could come almost exclusively from Siberia. The following developments seem likely in individual basins:

Donets

Mine depletions here will probably exceed the introduction of new capacity. The share of coal mined from deep, thin seams will increase, resulting in slower rates of coal extraction. At the same time, the cost of coal mined will continue to rise, and this will promote increased substitution in consumption of cheaper eastern coals. Production in the basin will probably fall to 195 mmt or less by 1985.

[68] *Bakinskiv rabotnyy,* Apr. 19, 1981, p. 1.

[69] The slowing of growth in coke consumption is due to likely reductions in the requirements for coke per ton of pig iron produced. This conclusion is based on the finding of a 1980 Battelle report on energy efficiency in the Soviet iron and steel industry. See ch. 7.

[70] M. V. Golitsyn and V. F. Cherepovskiy, "Analysis of U.S.S.R. Coal Reserves and Main Directions of Geological Prospecting Works, " .70 *vetskaya geologiya, No.* 4, April 1980, pp. 25-28.

[71] 1 bid., pp. 27-28.

Kuznetsk

This basin has vast reserves, and coal mined here is cost competitive with Donets coal in many regions of the European U.S.S.R. It is likely to become the U.S.S.R.'s leading producer of coking coal before 1985. However, the growth in new mine capacity has been slow and more coal enrichment capacity is needed. Only a small increase in output —from 154 to 160 mmt—can be expected by 1985.

Karaganda

Introduction of new mining capacity has lagged seriously. Much of the coking coal cannot be coked without prior enrichment and, due to insufficient enrichment capacity, is not being mined. As in the Kuznetsk basin, only a small increase in production can be expected by 1985. Output may rise to 49 mmt by 1985, but stagnation or a decline in production at the basin cannot be ruled out .

Moscow

Possibilities for increased coal production here are virtually nonexistent. The coal has a high ash and sulphur content and is becoming more and more expensive to mine. Annual production should fall by at least 1 mmt—and perhaps by as much as 5 mmt—by 1985.

Pechora

The Pechora basin contains large reserves of high-quality coking coal and production could have been substantially expanded, but little new mine capacity has been added in the last 15 years. The basin probably will lose 4 to 5 mmt of yearly capacity by 1985.

Urals

The coalfields in the Urals are being depleted and production will decline. Current production is not sufficient to meet even local needs.

84-389 O - 81 - 8

Kansk-Achinsk

Production could grow rapidly, but problems of transport and use will remain. The contribution this coal can make to the energy supply of the central regions or the Urals before 1985 therefore is highly questionable. In any event, annual production could increase by 10 mmt by 1985.

Ekibastuz

Plans for Ekibastuz production have been announced and call for increases of some 15 mmt by 1985. However, the quality of Ekibastuz coal is extremely low.

South Yakutia

Development of this basin is behind schedule, but production could grow to 11 mmt by 1985. However, a large share of output will be exported to Japan as compensation for developing the basin (see ch. 11.)

It is at least possible that the Soviet Union could come close to reaching its 1985 coal output targets. But the significance of this growth in output should not be overestimated. First, as noted above, the calorific content of Soviet coal has been falling steadily. If past trends continue, it will probably fall by roughly 1 percent per year between 1980 and 1985. Gains in run-of-mine output will therefore be largely offset by declines in calorific content. Fuel output, if calculated in tons of standard fuel, could actually decline unless output at high-quality coal basins remains at least relatively stable.

Second, the fact that much of the increase in coal output is to come from Kansk-Achinsk and Ekibastuz puts severe limitations on the use to which the coal can be put. Kansk-Achinsk coal cannot at present be transported to the Urals or the European U. S. S. R., let alone to export markets. Production is soon likely to exceed local demand and, as chapter 5 discusses in detail, generation of electricity at the mine site creates a number of other problems for Soviet planners. Ekibastuz coal is also of very poor quality, some of it nearly half ash.

In sum, even an increase in production of coal to 765 mmt per year, very close to plan targets, may mean an absolute decline in standard fuel produced. Moreover, much of what is mined cannot at present contribute to fuel supplies in consuming centers of the European U.S.S.R. because it is uneconomical to transport in untreated form. Achievement of 1985 plan targets, therefore, will contribute little to efforts to substitute coal for oil in existing powerplants or the few new ones to be constructed in the European part of the country.

1986-90

Projections for the Twelfth FYP period are necessarily highly speculative and must remain sketchy. In general, however, if present trends continue, and if the U.S.S.R. can come close to realization of 1985 targets, output could continue to grow. The amount of this increase would depend on the success of surface mining operations, although gains in surface mining would continue to be offset by declines in underground production.

The most likely areas in which to expect high rates of growth in the latter half of the decade are the Kansk-Achinsk, Kuznetsk, Ekibastuz, and South Yakutian basins. Stable or declining production can be expected in the Moscow and Donets basins, but the Soviet literature hints at investment plans that could lead to a small growth in output at Karaganda and a recovery at Pechora to about the 1980 level.[72]

Even assuming very high rates of growth in surface mining basins, however, (50 percent in Kansk-Achinsk, 25 percent in Kuznetsk, 35 percent in Ekibastuz, and 35 percent in South Yakutia)—a highly optimistic assumption—it is difficult to imagine coal

[72] "Russians Plan Surface Mine Complex for Power Generation," *Coal Age,* October 1978, p. 47.

output rising over 1985 levels by more than 100 mmt. Surface-mined coal would thus have to constitute about one-half of all coal. The significance of this level of output for the Soviet economy would depend upon success in constructing the coal treatment plants necessary for making use of Kansk-Achinsk and Ekibastuz coal, and on the fate of plans for long-distance electricity transmission.

SUMMARY AND CONCLUSIONS

The Soviet coal industry has encountered serious problems in the past few years for which no solution is yet in sight. These have to do with the declining output of underground mines located near centers of consumption; the fact that new deposits lie in remote areas of Siberia; and the declining quality of the coal that is being produced.

The Eleventh FYP establishes goals that are dramatically less ambitious than those of previous plans, a fact that may reflect a realization and acceptance by planners of the real limits placed on growth of output by the combination of problems facing the industry. Even so, these targets are probably excessively optimistic, and even gains in overall coal production will be offset to some degree by the fact that the quality of much of the new coal being mined is low. In fact, coal output could increase and its standard fuel equivalent actually decline.

The Soviet coal industry suffers from many of the same ailments afflicting most sectors of the economy. The problems are to a large degree systemic and have no permanent solutions short of major reforms of the system itself. The time has come for the coal industry to "fine tune" its operations. Unfortunately, the Soviet economy is ill-suited to such a task. The situation here has been aggravated by the low priority assigned to the coal industry in the past, and the fact that in order to achieve meaningful increases in output, a number of problems must be simultaneously addressed. These include labor productivity, additions to mine capacity, increasing the quality and quantity of mining equipment, resolving coal transport problems, and devising ways to use the low-quality coals that are making up an increasing share of production.

It is the combination of these difficulties that has led to the declining performance of the coal industry as a whole. There is little reason to expect that such obstacles will be overcome in the present decade. Nor is it clear that even massive improvements in one or several of these areas (e.g., labor productivity) could do more than increase coal industry efficiency, without necessarily significantly affecting output.

At present, there is no evidence to suggest that extensive Western participation in Soviet coal development would greatly boost production. Aside from the South Yakutian basin, which is being developed with the assistance of the Japanese, the Soviets have made little use of Western coal mining equipment and technology. Most such imports have been in the area of surface mining, especially large capacity mining trucks. The cessation of these supplies could have an impact on the efficiency of Soviet surface mines, but it is unlikely that the converse would hold, i.e., that more Western trucks would alone lead to increased coal output. The Soviets, moreover, have recourse to their own truck industry. If sufficient resources are allocated to production of such domestic models (something that cannot be taken for granted), the Soviets could satisfy demand for large-capacity trucks themselves. The Soviets are constructing a plant near Kansk-Achinsk to manufacture heavy excavators. Its successful completion would be another step towards independence from Western surface mining technology.

An embargo now, therefore, of all Western trade with the U.S.S.R. would inconvenience it—but would not seriously impair coal production. Similarly, Western assistance alone is unlikely to be able to boost coal production. Possibilities for expanded domestic production of equipment and for imports from Poland and other East European countries would compensate for losses of Western equipment. The longer run impact of such an embargo is more difficult to predict. If the U.S.S.R. places priority on expanded coal output, this growth will have to come largely from surface mining, since it appears that underground mining capacity has irreversibly peaked. If later in the decade bottlenecks in surface excavation and haulage equipment become troublesome, it is possible that the U.S.S.R. would look to the West for significant amounts of this equipment. However, these imports would have to be accompanied by serious efforts to solve a much wider array of coal industry problems.