

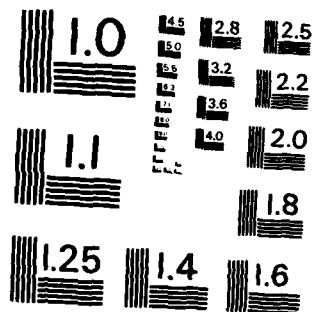
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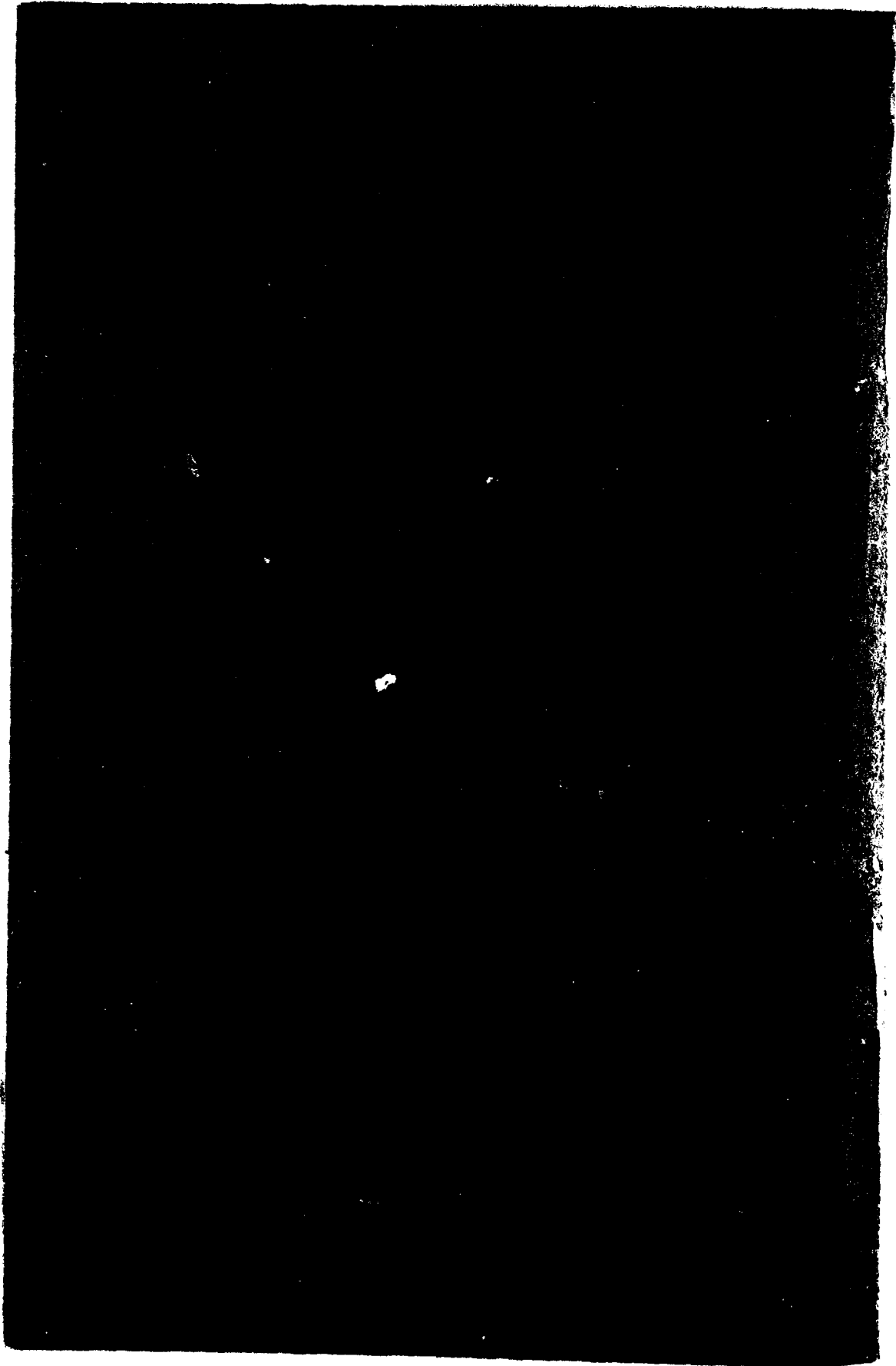
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The Soviet Gas Campaign

Politics and Policy in Soviet Decisionmaking

Thane Gustafson

June 1983

A Project AIR FORCE Report
prepared for the
United States Air Force

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PREFACE

In the 1980s, as perhaps never before in its history, the Soviet Union confronts a severe prospect: a largely new and untried leadership must wrestle with unprecedented economic and social problems while attempting to sustain momentum in foreign and military policy against stiff resistance by the USSR's main adversary. The economic dimension of this challenge involves a sharpening policy dilemma of faltering growth and high political costs of coping with, let alone reversing, the severe retardation. What options will the Soviet leadership have for managing the economics of low growth and how can the West get better clues to the probable Soviet choices? These are obviously important questions for Western policymakers.

To contribute to the effort to answer these questions, Rand is conducting a study of "Economic Decisionmaking and Soviet Power in the 1980s," under sponsorship of Project AIR FORCE and in association with the Office of the Assistant Chief of Staff, Intelligence, Hq. USAF. This project hopes to enhance our understanding of the possible directions of Soviet economic policy choice by examining the interaction between central economic policy formation and decisionmaking on the one hand, and major sectoral resource allocation problems on the other.

This report on "The Soviet Gas Campaign" treats the issue of the critically important energy sector. In terms of the volume of resource costs involved, the importance for Soviet foreign trade, and the implications for East-West relations, this is an important issue. The report is a detailed analysis of the policy problems and decisionmaking approaches in this vital area of Soviet resource allocation. It should be of interest to the U.S. national security community concerned with both East-West economic relations and assessment of Soviet economic potential and its implications for more general threat analysis.

Abraham S. Becker
Project Director

SUMMARY

Goaded by what they perceived as the threat of a serious energy shortage, in 1980-81 Soviet leaders launched an ambitious program to increase the output of natural gas by 50 percent in five years. According to their plans, natural gas must provide about two-thirds of the net increment of Soviet energy output in the first half of the 1980s, and it may replace oil as the Soviets' chief source of hard-currency income for years to come. The center of the current five-year plan is energy, and the center of the energy policy is gas.

To reach its output targets on time, the Soviet gas industry expects to invest up to 45 billion rubles on gas between 1981 and 1985, about double the total of the last five-year plan. This jump represents nearly half of the investment increment available to all of Soviet industry. Much of the new gas output will come from one field, Urengoy, located on the Arctic Circle in West Siberia; from there it will flow to the European USSR and Western Europe through six giant pipelines spanning 20,000 kilometers with 56-in. steel pipe.

The Soviet gas campaign illustrates the pressures and dilemmas confronting Soviet economic policy today. How the Soviet leaders have met the policymaking challenges of the gas campaign reveals a great deal about their strengths and weaknesses in coping with the economic problems, both domestic and international, that they will face in the next two decades.

The present gas program stands out from innumerable Soviet economic campaigns of the past, first, because the logistics of the gas campaign in north Tiumen' province and along the pipeline routes are as tough as anything the Soviets have undertaken in peacetime. Second, the gas program requires numerous and coordinated technological and production advances. Third, it comes at a time when investment resources are scarcer than they have been at any time in the last generation. Ironically, just as the Soviet leaders were forced to realize as never before the need to modify the traditional "extensive" mode of economic growth, which relies above all on massive new inputs of manpower and materials, they were driven into the biggest campaign they have undertaken since the 1930s.

Finally, never before in Soviet experience has there been a major program in which domestic and foreign issues have been so intimately, fundamentally, and inextricably connected. Major changes in domestic policy were required to deal with the foreign opportunities

and problems posed by energy; major changes in foreign dealings were required to deal with domestic energy problems. In that respect the gas program represents the new pressures and opportunities the Soviet Union faced in the 1970s as a result of its increased participation in the world economic system.

The Soviet hope has been to conduct this campaign unlike any previous one. Growth in gas output is to come mainly from gains in productivity rather than added inputs. The question is, can the Soviet gas and pipeline-construction industries achieve such productivity gains in the midst of the crisis atmosphere surrounding the gas campaign? The basic trends in the industry are in the opposite direction. The Soviet energy sector as a whole turned from a low-cost to a high-cost affair during the 1970s. Moreover, the Soviet system has never yet succeeded in getting fast results while cutting costs and improving efficiency. Yet that is what the top policymakers say they must do.

Despite the leaders' aims, the gas program has proceeded so far much as other Soviet campaigns have in the past. One of the most important reasons has been pressure on the gas industry stemming from the high political priority Soviet leaders have given to energy policy since 1978, and the abrupt switch to gas that took place in 1980-81, further heightened by the American embargo of December 1981 to November 1982.

As they begin the third year of the gas campaign, the Soviet leaders have several causes for satisfaction. The most important annual targets have been achieved, some of them ahead of schedule. An agreement for a second gas pipeline to Western Europe, the largest East-West commercial deal to date, has been negotiated and signed, and they have successfully weathered the American embargo. Soviet industry is now well launched toward achieving essential independence from foreign suppliers in gas-related technologies by the end of the decade.

On the negative side of the ledger, bad initial planning and overly ambitious targets have worsened already severe constraints in manpower, housing, transportation, auxiliary support (fuels, power, etc.), and industrial innovation for the gas program. Although constant oversight and intervention have prevented these constraints from strangling the program, the result has been high costs and distortions in the allocation of effort. These in turn promise future troubles.

Also on the negative side is that the Soviets were unable to find firm buyers for more than about half of 40 billion cubic meters (bcm) of new gas they had hoped to sell to Western Europe. There are now growing downward pressures on gas prices. Hard-currency income from new gas by the late 1980s may be only \$3.5 billion a year instead of the \$10 billion originally hoped for. Finally, the American embargo

may have imposed substantial indirect costs on Soviet industry by forcing unplanned changes in priorities and targets as a result of the leaders' decision to accelerate substitute domestic programs for compressors and other gas-related equipment.

Despite the fast pace set in gas output and pipeline construction in the first two years, the sum of these pluses and minuses is that the gas industry will probably fall about 50 bcm short of its 1985 target of 630 bcm/year, because of inadequate compressor capacity on the new pipelines and growing infrastructural obstacles at Urengoy. Such a shortfall may not particularly disturb the Kremlin, however. The Soviet economy has also been growing more slowly than planned, and so is demand for energy. West European gas demand is dropping, and consequently there are no further outlets for Soviet gas exports in the near future. There are also obstacles to rapid displacement of oil by gas inside the Soviet Union and in Eastern Europe. For all these reasons, a slight shortfall in Soviet gas output by 1985 may actually be welcome to Soviet planners—so much so, in fact, that the new leaders may cut back the priority of the gas campaign.

If that day of reckoning comes—and there are some signs that it is already coming—it will find the Soviet gas industry in some disarray. Because of the hurried decision to launch the gas campaign in 1980-81, inadequate planning, the campaign atmosphere that surrounded its first two years, and the American embargo, the ministries involved were obliged to put urgency before cost, near-term objectives ahead of longer-term ones, gross output before reliability and quality, and domestic solutions ahead of foreign. In the competition between "extensive" and "intensive" approaches, the gas industry has had to favor the former.

For the last two years, they have had little choice. But if the political leaders now decide that the urgency of the gas program has lessened, can they switch from a campaign mode to a less wasteful, more efficient policy? Such a cutback would have complex repercussions. The gas industry could slow its pace and work to increase its efficiency. But its claim to new resources would also decline, and the gas industry and its construction partners would not be able to count on political muscle to relieve bottlenecks. The result might be further constraints on output growth rather than any real progress in solving the industry's logistical and technological problems.

How far Brezhnev's successors will be able to depart from the traditional campaign style is one of the major questions about Soviet economic policy in this decade. They inherit Brezhnev's problems as well as his programs, but they have little room for maneuver in the short run. Consequently, if there is to be progress toward better planning, more efficiency, and useful innovation, it will have to be fitted into

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the ongoing policies. The dilemmas of the gas campaign are representative of what the new Soviet leaders have to deal with on several fronts.

ACKNOWLEDGMENTS

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Oil and Gas Region

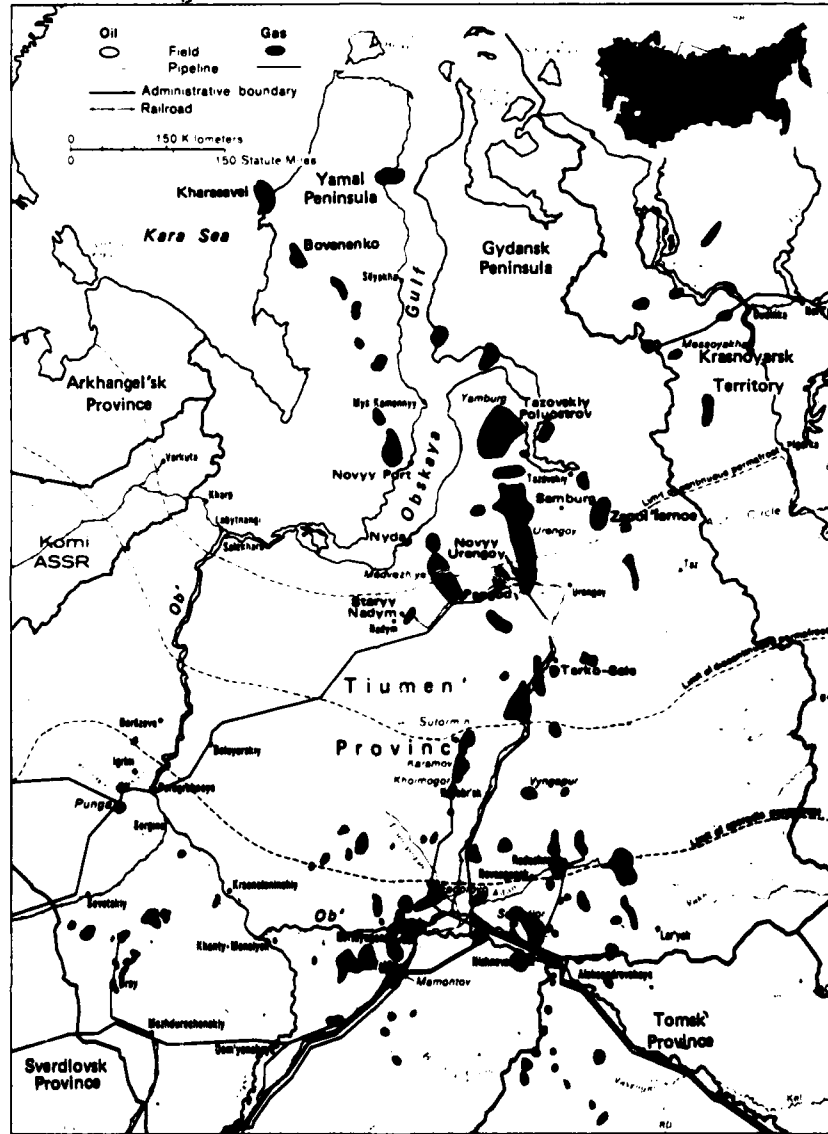


Fig. 1—Oil and gas region

I. INTRODUCTION

The center of Soviet investment policy in the 1980s is energy, and the center of Soviet energy policy is gas. Goaded by what they perceived as the threat of a serious energy shortage, Soviet leaders in 1980-81 launched an ambitious program to increase the output of natural gas by 50 percent in five years. Natural gas must provide most of the increment of energy output in the first half of the 1980s,¹ and it will replace oil as the Soviets' chief source of hard-currency income for years to come.

The stakes are enormous and so are the resources that the Kremlin is devoting to the task. To reach their output targets on time the Soviet leadership may have to spend as much as 45 billion rubles on gas between 1981 and 1985.² This represents nearly half of the investment increment available to all of Soviet industry. Much of the new gas output will come from one field, Urengoy, located in the arctic wastes of West Siberia (Fig. 1); from there it will flow to the European USSR and Western Europe through six giant pipelines spanning 20,000 km with 56-in. steel pipe. Brezhnev called those six pipelines "the central construction projects of the five-year plan," and as the Soviet press never tires of saying, they require more resources than BAM, KamAZ, VAZ, and Atommash (the giant projects of previous five-year plans)³ put together. (See Fig. 2.)

As the new Soviet leaders enter the third year of the 11th Five-Year Plan, they have reaffirmed that the energy sector is their top industrial priority.⁴ Gas output is growing well ahead of the annual plan

¹By converting all the Soviet energy targets to millions of barrels per day of oil equivalent (mbdoe), Edward Hewett puts the share of natural gas at 64 percent, or 3.20 mbdoe out of 4.98 ("Soviet Energy Prospects and Their Implications for East-West Trade," in Becker (1983)). This estimate, however, is drawn from the official targets for the five-year plan. If one assumes instead only slow growth in the oil and coal industries and in nuclear power, then the share of gas in the net increment becomes very much larger.

²For background on Soviet energy policy over the last five years, and the evolution of the gas-centered strategy in particular, see Gustafson (1983).

³BAM stands for *Baikal-Amur Magistral*, a new railroad in Siberia. KamAZ and VAZ are large automotive complexes, located on the Kama and Volga Rivers, respectively. Atommash is a giant plant for the manufacture of nuclear powerplants, located in South Russia. Except for VAZ, all of these complexes are still under construction.

⁴V. Ia. Isaev, Deputy Chairman of the State Planning Committee (Gosplan), outlining the capital construction plan for 1983, referred to energy as the "foundation of foundations" (*osnova osnov*) of the economy, a well-known formula that, to my knowledge, had not been used before in referring to energy ("SSSR na stroike," *Pravda*, January 2, 1983). An editorial in *Pravda* three weeks later added, "The growth rate of the

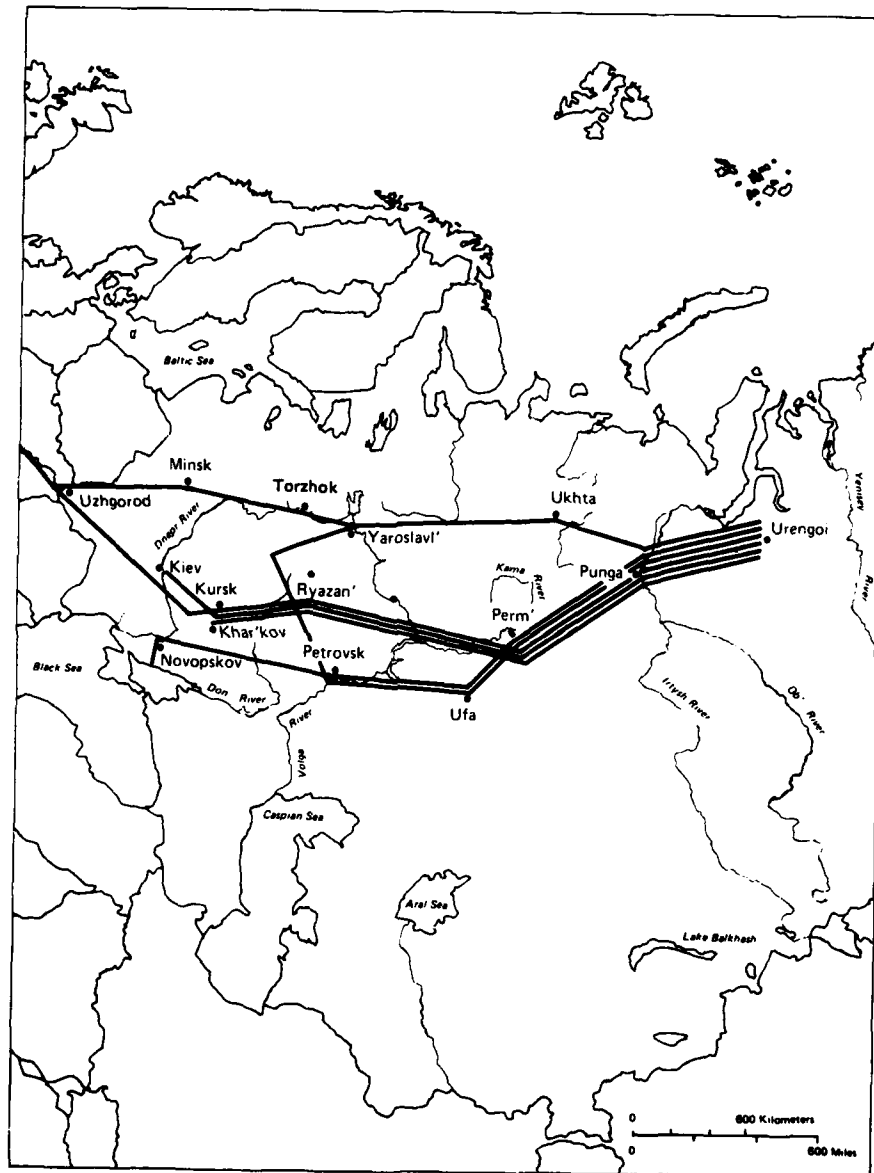


Fig. 2—Planned 56-in. pipelines scheduled for completion during the 11th Plan (1981-85)

targets, having reached 502 billion cubic meters (10 bcm over plan) in 1982. Two of the six major pipelines from Siberia are now on line, a third will begin to transport gas in 1983, and more than half the pipe for the fourth, which is the East-West export line, has already been laid. Gas is the brightest spot in an otherwise bleak economy, but to meet its targets for 1985, the gas industry will have to step up its rate of growth still further over the next three years, simultaneously improving its reliability and productivity.

In short, the gas campaign is one of the most important stories of the Soviet economy in the 1980s, all the more interesting in view of the related controversy in the West over West European imports of gas from the Soviet Union through the East-West line. As the members of the Alliance search for a common policy to govern their economic dealings with the Soviet bloc, their concerns and interests will be shaped by the performance and policies of the Soviet energy sector, particularly of the gas industry.

This report uses the Soviet gas campaign to examine the capacity of Soviet decisionmakers to deal with the severe domestic and international economic problems they will face in the next two decades. The launching of the gas program was in many ways a remarkable decision. It was a crash response undertaken suddenly and after several previous shifts and hesitations in energy policy; and it was a potentially disruptive and risky move, because it required the leaders to allocate to gas a large share of the increment of capital investment planned for Soviet industry in the current five-year plan, at a time of growing economic stringency. At the very least, one must give the Soviet leaders high marks for boldness and decisiveness.

But having launched a crash program, can the Soviet leaders carry it out? How are they going about it? As in all decisionmaking, the commitment to go ahead is only one element, and not necessarily the most important, in a whole network of decisions. Among the decision-making issues are:

- How did the strategy for the Soviet gas program take shape?
- Are the Soviet leaders actually following through with the necessary allocations of capital and resources, even though these may be putting great strain on the economy?
- Because the success of the gas policy depends, above all, on increasing output in Western Siberia (notably on quintupling output in the area's largest field, Urengoy), how is the Soviet leadership going about managing exponential growth in

entire economy depends on how well the various sectors of the fuel-and-energy complex perform" ("Toplivno-energeticheski kompleks," *Pravda*, January 26, 1983).

what is still largely virgin territory, and how are they resolving the controversies that inevitably surround the execution of such a crash program?

- Do they face any bottlenecks severe enough to threaten their chances of reaching their goals? How much is it costing to relieve them, and how much political determination are the leaders showing to do so?
- How did the Soviet leaders originally conceive the balance between the Western and domestic contributions to the gas program, and how were they affected by the American embargo of 1982?
- Since Brezhnev's death, has the new coalition of leaders under Andropov maintained the high priority of the energy program? Are there any signs of major changes in emphasis within it, such as alterations in the relative stress on production and conservation?

WHAT MAKES THE GAS CAMPAIGN EXCEPTIONAL AS A PROBLEM IN ECONOMIC DECISIONMAKING?

The crash campaign is one of the most familiar tactics in the history of Soviet industrialization; without exaggeration one could say that it has been what the Soviet system does best, and over the years it has been one of the leaders' most effective tools. What then makes the present gas program different from the innumerable campaigns of the past, particularly as a decisionmaking problem?

First, the logistics of the gas campaign in north Tiumen' province and along the pipeline routes are as tough as anything the Soviets have undertaken in peacetime. The climate is more rugged and the landscape more forbidding, the performance targets more demanding, the tasks of coordination more complex, the lines of communication longer, the infrastructure more primitive, and the requirements for reliability and quality more stringent than anything the gas industry and the other associated ministries have ever tackled before.

Second, the gas program requires great technological and production advances. Although they do not exceed Soviet capabilities, they are close enough to the outer limits that achieving them will require careful management and constant oversight at numerous industrial plants around the country.

Third, investment resources are scarcer in the 1980s than they have been at any time in the last generation,⁵ and so are manpower and several other important inputs. Against this background of stringency, the Soviet leaders are making a sudden and dramatic change in investment priorities toward energy, particularly gas. This requires a determined political hand, because it means starving some agencies and force-feeding others, shifting resources from European Russia to Siberia, and sharply altering production plans at dozens of industrial plants throughout the country while overcoming the attempts of the losers to impede or subvert the changes.

These difficulties alone would put the gas campaign in a class by itself. But there is more: Never before in Soviet experience has there been a major Soviet program in which domestic and foreign issues have been so intimately, fundamentally, and inextricably connected. As a result, the Soviets find themselves exposed as never before to the pressures of the world economic system. Gas in the 1980s and 1990s will be the Soviets' chief source of hard currency, whether directly or through displacement of oil resources currently consumed internally. In addition, despite the skill and experience of the Soviets in this field, the success of the gas campaign, given the pace they have set for themselves, depends to a large extent on imported machinery and almost entirely on imported pipe. Finally, because of the American embargo of 1982 and earlier Western publicity about Soviet energy problems, Soviet leaders have made it a point of national pride, even now that the embargo has been lifted, to demonstrate to the world that they can develop West Siberian hydrocarbon resources on schedule and free themselves from dependence on Western equipment for the gas industry by the end of the decade. Thus, the gas campaign represents a substantial departure, to an extent perhaps not fully intended or foreseen by the Soviet leaders at the outset, to the Soviets' traditional approach to foreign trade.

The gas campaign is different from past Soviet campaigns in one more respect: It is an immense, one-time investment in a region that (so far as is known today) has only one major resource. When the gas is gone the region may not exactly return to arctic oblivion, but today's planners are clearly worried about those potential ghost towns of the future that today's gas pioneers, at a cost of tens of billions, are now building. This was a theme one heard particularly frequently from ministry officials in 1980 and 1981, when the current programs were being hammered out in Moscow. One might have expected that as the enormous extent of the north Tiumen' gas reserves sank into the minds of decisionmakers, together with the implication that the

⁵For a good discussion of the reasons for these problems, see Rumer (1982).

Soviets will be drawing gas from north Tiumen' for at least a generation to come, the "ghost-town" argument would fade. Instead, it flares up anew each time a field is opened up. Yet even this aspect of the gas campaign is not really new. It raises again the old (and still unresolved) question of how to deal with Siberia: To settle and develop it permanently or to grab its resources and run.⁶

All the same, the problems we have just listed are "firsts" only in degree, not in kind. Every one of the famous Soviet undertakings of the past, from the development of Magnitogorsk in the 1930s through the Virgin Lands campaign of the 1950s to the most recent examples, the BAM railroad, the VAZ and KamAZ automotive works, and the Atomnash of the 1970s, faced similar obstacles and raised similar issues, which the Soviet leaders have dealt with in the same semi-military style. Where the objective has been clear and precise, the priority high, and the effort sustained, Soviet leaders have damned the cost, accepted some dependence on Western suppliers, and plunged ahead.

COMPETITION BETWEEN THE CAMPAIGN STYLE AND REQUIREMENTS FOR INCREASED PRODUCTIVITY

In recent years the Soviets have found that the campaign method costs more and more and yields less and less, especially when large quantities of foreign equipment must be assimilated at the same time. With the exception of the Fiat-built Volga automotive works, in which the Italians acted as general contractors, the Soviets have run into serious delays in all of the major projects mentioned above.⁷ Recent Western analysis even suggests that the drastic decline in the growth of Soviet industrial productivity in the late 1970s may have been partly caused by the mass infusion of Western technology from 1972 to 1978, combined with the traditional campaign style. Public soul-searching by Soviet planners and economists in the recent press indicates they may be thinking along the same lines.⁸ Thus, there is an irony in the timing and the setting of the gas campaign: Just as

⁶For a good discussion of imbalances in Siberian investment policy see Orlov (1982).

⁷For a review of the current status of the BAM railroad, see Mote (1983). A recent review of the KamAZ plant appears in Robinson (1982a).

⁸See, in particular, Philip Hanson, in Becker (1983). A detailed evaluation of the effect of Western technology on the Soviet economy in the 1970s is being conducted by Wharton Econometric Forecasting Associates; one portion of that study that promises to be especially interesting is a review of Soviet ferrous metallurgy by Elizabeth Goldstein of the Federal Reserve Bank of New York.

the Soviet leaders were confronting the disappointing results of a decade of highly publicized giant projects and of accelerated technology transfer from the West and were being forced to realize as never before how urgent it was to abandon the traditional "extensive" mode of economic growth, they were driven into a campaign that will be the biggest they have undertaken since the 1930s.

To break out of this contradiction, the Soviet hope has been to conduct this campaign unlike any previous one. Gains in gas output are to come mainly from gains in productivity rather than added inputs. Although gas output from West Siberia is supposed to increase by over 123 percent during the 11th Plan (from 162 bcm in 1980 to 362 bcm in 1985),⁹ total capital investment in the West Siberian gas industry is slated to increase by only 80 percent.¹⁰ For the gas industry nationwide, labor productivity during the 11th Plan is supposed to increase by 33 to 35 percent,¹¹ compared with a five-year goal of 23 percent for Soviet industry as a whole.¹²

The question is, can the Soviet gas and pipeline-construction industries achieve such productivity gains in the crisis atmosphere surrounding the gas campaign? The basic trends in the industry are in the opposite direction. The Soviet energy sector as a whole suddenly turned from a low-cost to a high-cost affair during the 1970s, chiefly because a growing share of the Soviet energy supply must now come from high-cost sources east of the Urals, by way of high-cost transportation networks. The gas industry has not escaped from the general rule: Despite the richness of the north Tiumen' gas fields, the same trend toward lower output-to-capital ratios prevails there. Soviet economists, analyzing the record of the 1970s, found that the unit capital costs of opening up new capacity in West Siberia were roughly twice the average elsewhere in the Soviet Union (this presumably includes the added costs of transmission). Although annual rates of investment in gas tripled between 1971 and 1979, gas output did not quite double.¹³ The very abruptness and scale of the recent shift of Soviet energy priorities toward gas will presumably worsen the problem during the first half of the 1980s.

⁹Shabad (1982).

¹⁰Ageeva and Orlov (1982).

¹¹"Zadachi rabotnikov gazovoi promyshlennosti na 1981 god i odinnadtsatuiu piatiletku," *Gazovaya promyshlennost'*, No. 4, 1981, p. 3. In the 10th Plan, according to the late gas minister, S. A. Orudzhev, labor productivity in the gas industry grew by 44 percent (speech at the 26th Party Congress, as reported in *Pravda*, March 2, 1981).

¹²Baibakov (1981).

¹³For the investment figures, see "Ekonomicheskaya effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.," in VNIIEgazprom, *Ekonomika gazovoi promyshlennosti*, seria ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaiia informatsiia), No. 10, 1980, pp. 4-5. For the 1971 output figure, see Central Intelligence Agency (1978), p. 63; for the 1979 figure, see *Narodnoe khoziaistvo SSSR 1922-1982*, Finansy i Statistika, 1982, p. 182.

What does improving productivity mean in the gas campaign? In the Soviets' view it means above all two things: first, substituting capital for labor by mechanizing and automating the major operations in the gas campaign, especially construction, but also operation and maintenance; and second, improving both labor and capital productivity through better labor management, better logistics and infrastructural development (roads, powerlines, ports, etc.). Soviet gas officials and technical experts are well aware that improvements in productivity also depend on more subtle and difficult tasks, such as choosing a development strategy based on the most promising fields, not shortening their life through damaging practices, and maintaining reliable gas transmission by attending to gas quality, sound workmanship in pipeline construction, accessibility of pipeline networks for efficient maintenance and repair, and so forth.

Such a program requires integrated planning and execution. It assumes that managers will emphasize final goals rather than intermediate ones. Success demands that productivity be truly treated as one of the final goals, rather than take second place to gross output targets. But the Soviet command economy is typically weak on all three counts, especially during a crash campaign: Different agencies and offices pull in different directions and horizontal coordination is weak; managers are tempted to concentrate on easily measured, near-term indicators of crude input, such as total miles of pipeline laid or gas-well drilled, rather than final measures such as gas transport work; and when obstacles threaten the output plan, managers try to storm them by throwing in more men and resources, leaving the productivity targets to fend for themselves.

So far, for all its desire to put the economy (as the official phrase goes) "on the rails of intensification," the leadership has not succeeded in breaking these traditional patterns. The practical consequences vary, from merely costly (as in the case of delays in the major showcase industrial projects) to disastrous and self-defeating (as in agriculture). But one thing the Soviet system has not yet succeeded in doing is getting the fast results of the campaign style while cutting costs and improving efficiency. Yet that is what the top policymakers say they must do. If they fail, and the gas campaign proceeds in the traditional way, the leaders will be caught in an unpleasant squeeze, because the campaign's cost will rise far beyond their plans. Indeed, that is already happening.

It is hard to see how it could be otherwise. If one steps back from the gas program to consider the Soviet energy program as a whole, one can see that its entire conception is extensive: It strives above all to raise energy output and deals very little with cutting back energy consumption. This is partly the legacy of the past. For 20 years the

Soviet Union had enjoyed cheap oil. Soviet consumers of energy, never particularly concerned about saving resources to begin with, had little reason to conserve energy. As a result, by 1980 the Soviet economy was roughly two and a half times as energy-intensive as that of Western Europe, and growing.¹⁴ Another lingering effect of the past is that, because in previous decades the development of energy was also cheap, the energy ministries did not develop the same efficient apparatus for mechanization and innovation that Western companies did, particularly for such operations as exploration, drilling, fuel processing and refining, and transmission.¹⁵

Reinforcing this legacy are the political pressures of the present, stemming from the high political priority the Soviet leaders have allocated to energy policy since 1978 and the abrupt switch to gas that took place in 1980-81. The campaign atmosphere surrounding Soviet gas policy was further heightened by the American embargo, in effect from December 1981 to November 1982. Knowing that daily performance reports were (and still are) being sent to the Kremlin, pipeline builders, downhole drillers, and everyone else in the campaign have been encouraged in all the classic tendencies of Soviet "storming." Although that may increase the likelihood that the main targets will be met fast, it also produces distortions and raises costs.

In sum, the gas campaign illustrates many of the dilemmas facing the new Soviet leaders in this stringent decade; most of all, it shows the competition of two contrary aims in current Soviet economic management: to improve productivity and efficiency, while producing crash results. This competition of aims may be typical of much of Soviet economic policy during the coming decade, limiting the prospects for reform.

MAJOR DECISIONS REQUIRED IN THE GAS CAMPAIGN

At the level of strategy, leaders and planners must strike a balance between competing approaches: between the long-term and near-term, between the Western contribution and the domestic, between export considerations and domestic energy supply, between gas and other energy sources, and between new regions and old. None of these issues had been fully worked out when the campaign was launched, and they have all been under active debate since then.

¹⁴Edward Hewett, personal communication, drawn from a forthcoming report on the Soviet energy problem, Brookings Institution, 1983.

¹⁵Campbell (1980).

Next, at the level of implementation, the managers of the campaign must confront two fundamental problems. The first is to put in place the necessary infrastructure and organize the logistics required to build the capacity to extract and ship gas. The main concerns here are manpower, housing and basic amenities, access, and supply. The second category of management concerns is industrial and technological: how to produce enough good-quality pipe compressors, pipelaying machinery, etc. To some extent the organizational/infrastructural and the industrial/innovational are mutually substitutable, because the latter tend to substitute capital for labor, making some of the former unnecessary. But in other respects the two approaches compete. Many of the decisionmaking issues in the gas campaign boil down to disagreements over the right mixture between the two.

As in any policy problem, implementation is loaded with political consequence. The problems encountered in carrying out a program frequently threaten the basic strategy, forcing decisionmakers to review their course as they go. This has been particularly true of the Soviet gas campaign, partly because of the unexpected imposition of the American embargo in December 1981 and the international uproar that followed, which exposed some of the internal vulnerabilities and inconsistencies of the Soviet program. The American action forced the Soviets to take emergency measures that altered their priorities, pushing resources toward pipeline construction, for example, at some cost to other parts of the program. Even though it has been lifted, it continues to have lingering effects, such as inclining Soviet long-term strategy toward greater emphasis on accelerated development of domestic technologies for the gas industry.

Soviet authorities and specialists argue constantly about how to manage this gigantic undertaking and to bring it in on schedule without being swamped by its costs. In decisionmaking, in the Soviet Union as elsewhere, nothing is ever finally settled. Issues keep resurfacing in different forms; and the gas campaign must be redefined and refocused, against competing claimants, against unforeseen obstacles, and against the pressure of time. The battle for high priority must be fought anew each time a powerplant is planned, a river barge is loaded, or a production schedule is altered.

But how efficiently are the issues that arise in implementation communicated to central decisionmakers? Do they lead to reevaluations and mid-course corrections in strategy? These questions require examination of the style and properties of Soviet economic decisionmaking.

II. SOVIET ECONOMIC DECISIONMAKING

To Western observers who have been debating how the Soviet Union would respond to the stringent decade of the 1980s, the change of power in the Kremlin now presents a new leader with possibly new answers. It is clear enough what Brezhnev's answer would have been. Instead of "muddling through" or "massive reform," Brezhnev favored "firefighting" policies that absorbed much of the political elite's personal attention and resources. Firefighting policies were the urgent measures that Soviet leaders felt forced to take to counter the imminent threat of shortages. Food and energy headed the list in the last five years of Brezhnev's life; and if he had lived longer he would probably have had to add to it transportation, if he had been able to spare the resources. Firefighting policies under Brezhnev had four common features: They were emergency programs, they required large infusions of new resources, they were run from the center on a high-priority basis, and they contained a large measure of improvisation. They forced Soviet leaders to continue the campaign approach that had characterized Soviet development policy in the past.

How far Andropov will be able to depart from this style is, of course, one of the major questions of the decade. He inherits Brezhnev's programs, and for the moment there is little sign that he intends to break with them. Indeed, he has little room for maneuver in the short run. The shortages that led to Brezhnev's programs in food and energy were real enough, tens of billions of rubles are already engaged, and there is no sensible course but to go forward.

In the longer run the prospects for any real improvement in economic management require breaking out of the firefighting mode. Firefighting competes with any serious effort at reform because it draws heavily on the scarcest of Soviet commodities, the energy and attention of political leaders at all levels. Yet because of the inertia of inherited programs, it is out of the question to break with them quickly. Consequently, if there is to be progress toward better planning, more efficiency, and useful innovation, it will have to be fitted into the ongoing policies. The dilemmas of the gas campaign are thus representative of what the new Soviet leaders will have to deal with on several fronts in this decade. Their success will depend on whether they are able to implement small changes as they go, not to overcome but to palliate the deficiencies of the traditional economic decision-making system.

DEFICIENCIES OF DECISIONMAKING UNDER BREZHNEV

There are two principal decisionmaking aspects to consider, strategy and implementation. In each, the Soviet command system has a great potential strength. At the level of strategy, it promises concentration of information and integration of political purpose; at the level of implementation, concentration of resources and systematic collection of data about results.

In practice, these potential strengths have never been fully realized, partly because the reporting system generates a flood of false, slanted, or incomplete data that prevents decisionmakers at the top from making well-informed choices, and partly because in implementation conflicting motivations from below and inconsistent commands and signals from above dissipate, weaken, and deflect the leaders' aims.

In recent decades, as the Soviet economy has become more complex and technically sophisticated, the traditional decisionmaking system has revealed still further weaknesses. The political elite has become more differentiated and so have its decisionmaking roles, reflecting the greater technical complexity and interdependence of Soviet economic policies, as well as the fact that the leaders nowadays must pursue a broader array of objectives than Stalin did. This complicates the job of developing integrated and balanced strategies. At the bottom, the traditional organization of the command system into vertical hierarchies with weak horizontal cross-ties is proving even less able than a generation ago to handle problems that cross regional or ministerial lines, as contemporary problems increasingly do.

The traditional corrective for these problems, daily oversight and intervention by the local Party apparatus, despite the growing average level of education and technical sophistication of those who staff it, is also unable to provide the necessary degree of continuity or precision in implementation. The network of state committees, which is supposed to provide functional coordination by general activity (construction, supply, etc.) is irresponsible and remote, and has been a major factor in the demoralization of Soviet managers in the last decade.¹ Modern methods of computerized information processing and other new management tools may have somewhat relieved the strain on the system, but they have not altered its essence.

The symbolic core of the problem, where these weaknesses come together, is the malfunctioning of the planning system. Soviet plan-

¹As Andropov observed, "It cannot be considered normal that decisions about the output of many simple products are made virtually inside Gosplan" (*Pravda*, November 23, 1982).

ners have come a long way since the fevered days of the First Five-Year Plan when, as the late economist Strumilin acidly recalled, "The planners preferred to stand up for higher targets rather than sit for lower ones." (The Russian verb "to sit" means here, "in prison or in a concentration camp.") In the energy sector, in particular, Soviet planners have made elaborate use of modeling, forecasting, and scenario-building;² and in at least some instances, these models have had direct influence as a basis for policymaking.³

Such innovations have had more of an effect on the micro- than on the macro-level, and most Western observers believe that the five-year plan is still arrived at through a combination of political directive, extrapolation "from the achieved level" (as the Soviet expression goes), and a large amount of plain horse-trading. Moreover, as the five-year plan is translated into annual and monthly targets and assignments, the bargaining continues: Politicians change course, ministries plead poverty, unforeseen bottlenecks force readjustments—in short, as it goes along, the plan loses what little consistency and credibility it had to begin with.

As a result, the planning process, which is the command system's indispensable instrument of decisionmaking, fails on two counts. First, it fails to provide policymakers with a clear and integrated picture of the choices before them, or to give them the means of making informed choices among competing objectives, strategies, or horizons. An example that has long intrigued Western observers is the apparent lack of any systematic Soviet mechanisms or procedures for making choices between domestic R&D and foreign technology imports.⁴

Second, the plan fails to provide implementers below with a coherent, predictable, stable, straightforward, and fully realistic blueprint of what they are supposed to do. The plan targets are so numerous and inconsistent that they are simply not fulfillable; and even if they were, it is not in the manager's interest to fulfill them. Indeed, in recent years this problem has been growing worse. One aspect of it

²For an elaboration of this point and some examples, see Dienes and Shabad (1979); and Campbell (1980), pp. 21-25.

³See, for example, the short summaries of modeling of alternative scenarios of fuel supply for electrical power, conducted by Gosplan's Division of Power and Electrification: Nekrasov and Troitskii (respectively head and deputy head of the Gosplan Power Division) (1980), pp. 45ff; and Troitskii (1979). These studies apparently served as the basis for much of the electricity strategy of the 11th Plan, including the strong priority given to nuclear power west of the Urals.

⁴For an attempt to infer the pattern of Soviet decisionmaking on imports of chemical technology, see Hanson (1981); see also Hanson in Amann and Cooper (1982); and Campbell's discussion of the same issue applied to imports of energy technology (1980, Ch. 7).

that Brezhnev himself criticized at the 26th Party Congress and Andropov has attacked since is the growing practice of adjusting plan targets downward in mid-course, which allows ministries and their subordinate units to claim their bonuses for successful plan fulfillment. This practice may be a back-door acknowledgment that the plan targets were unrealistic to begin with, but the price of doing things this way is to unbalance the system still further and to rob the plan of any normative or predictive value.

BREZHNEV'S FAILURE TO ACT

A decisionmaking system is only as good as the political vision and resolution behind it. The increasingly glaring weaknesses of the command system in general, and of the planning mechanism in particular, are largely the result of the leaders' failure to act during the 18 years of Brezhnev's rule, even though they readily admitted that all was not well. No theme was more common in the Brezhnev period than the need for "intensification"—making increased efficiency the main engine of economic growth—rather than "extensification"—the simple addition of ever greater inputs of manpower and materials. But for all its talk about the need for increased efficiency and better management, and successive waves of official decree-writing, the Brezhnev leadership repeatedly shrank from doing anything that would endanger its accustomed roles and powers. In particular, it resisted any fundamental changes in the system of planning, pricing, and targeting; and it was unwilling to fire the incompetent and superannuated ministers who oversaw them. The Brezhnev period's essential character (at any rate in its economic aspects) was intensive in its speeches but extensive in its policies. The unsolved problem of economic reform, especially of reform in planning, is Brezhnev's main legacy to his successors.⁵

It is not accurate to say that Brezhnev did nothing. On the contrary, the reputation of the Brezhnev regime as "immobilist" or "petrified," or even simply "incremental," although deserved at some levels, was not so on others. In agriculture, more recently in energy, and above all in military development, the Politburo under Brezhnev showed that it could respond to a handful of its most serious problems with determined policies and give them top priority and attention year after year. When faced with a crisis, the Brezhnev leadership reacted vigorously.

⁵For a more detailed discussion of this theme, see Gustafson (1981), first and last chapters.

But that should not make us forget that the multiple crises of the late Brezhnev period were generated, or at least aggravated, by the leaders' own choices and by the quirks of the command system. In the energy sector, for example, the long neglect of oil exploration in the 1970s and the oil industry's extraction of oil from existing fields by the fastest methods regardless of damage led to a panic in 1977-78. Yet the resort to a campaign style was an attempt to "run around" the constraints imposed by the existing system without confronting them head on. Thus the agricultural program consisted mainly of industrializing the countryside through the massive production of tractors and fertilizer, but without altering the foundations of collectivized agriculture or the political machine that oversaw it. In energy, the emphasis has been on production instead of conservation (despite the dramatic demonstration in the West of the potential of the latter), as though the leaders resigned themselves in advance to the inability of the command system to produce rapid results in energy saving or fuel substitution. In short, the recent campaigns were a sort of substitute for systematic planning.

THE GAS CAMPAIGN HAMPERED BY INITIAL BAD PLANNING

The gas campaign itself was in several respects badly planned. The targets were set and the work launched before the planners had even figured out where the necessary equipment would come from or how much money would be spent on it. The amount of gas the campaign would produce was more than the economy was likely to be able to absorb; indeed the planners designed it that way by devoting more resources to producing gas than to making the adjustment necessary to consume it. The hard-currency earnings the gas program would yield depended on an export pipeline whose basic concept had not been decided on or negotiated for when the campaign began. Which of the major fields the gas would come from had not been decided either; and, in either case, the necessary infrastructure was lacking.

It is true that there were complicating circumstances that would have defied the most systematic and clairvoyant of planners. Reserve figures for both oil and gas, near-term oil prospects, world energy prices, East European balances of payments and energy needs were all changing rapidly and unpredictably at the time. Soviet leaders had good reasons for thinking that they faced an energy squeeze and that a big gas program was the way out. Moreover, no sooner was the campaign under way than the Reagan embargo came, forcing the

Kremlin to step up the gas campaign even further, while giving top priority to the main pipelines.

But now the new leaders face a reexamination of the gas campaign while traveling at top speed. We do not know whether resorting to a campaign style and carrying it to excess once it has been launched are inherent, inescapable features of a command system. One of the most interesting things about the gas campaign is that it will serve as a test of the new leaders' capacity for asking two of the most difficult and politically delicate questions in any system, "What do we really need?" and "How much is enough?"

ORGANIZATION: THE CAST OF CHARACTERS

The special style of Soviet bureaucratic behavior stems in large part from three basic features: First, most Soviet industrial ministries, being large, vertically integrated hierarchies, do well at focusing effort on their major targets but poorly at meshing horizontally with those of other ministries. Second, the incentive system in which Soviet ministries must operate encourages them to concentrate on intermediate indicators of performance, often to the detriment of the final goals desired by leaders. Third, the targets given to Soviet managers are too numerous and demanding for the managers to hope to meet them all; so they respond by putting first things first, which usually means the gross output target or some functional equivalent to it. But putting first things first also means putting second things second, and that category usually includes product quality and reliability, spare parts, or "auxiliary" outputs such as roads or housing for workers.

Much of the job of industrial management in the Soviet Union, therefore, is essentially a holding action aimed at keeping these three tendencies from crippling the plan. The gas campaign, as we shall see, is no exception.

General Policymaking

The Soviet Union has no single ministry of energy or state committee with jurisdiction over the subject; neither is there a single staff or group that acts as a formal "czar" for energy policy in all its major aspects. Although there have been calls over the years for something like a unified command, there is no evidence that the leaders have been about to create one. When Kosygin was Prime Minister, the staff of the Council of Ministers played the most visible role in energy policy. But since late 1977 the apparatus of the Party Central Committee has been at least as visible, especially the Secretary for Heavy

Industry, V. I. Dolgikh. Dolgikh usually chairs all major official meetings on gas and oil, and since the retirement of veteran Politburo member A. Kirilenko he has chaired those on electricity and nuclear power as well, in addition to construction generally. The greater prominence of the Party in energy affairs reflects the high priority of that issue over the last five years.⁶

The Central Committee does not have the manpower for detailed staff work in most economic sectors, however.⁷ For that it must rely on the government apparatus. The Council of Ministers maintains a consulting body (called the *referentura*) that contains energy planners and experts; the State Planning Committee, in addition to its regular staff, has two research institutes devoted to planning the use of natural resources, one of which specializes in energy problems. Top government and planning officials are much in view: Over the last decade officials of the State Planning Committee (Gosplan) such as Deputy Chairman A. M. Lalaiaants (who is in charge of energy matters at Gosplan) and department heads such as V. I. Filanovskii-Zenkov (oil and gas) and A. A. Troitskii (power and electrification) have become familiar bylines in the Soviet press. Several other government bodies have advisory staffs on energy matters, notably the State Committee for Science and Technology, the Academy of Sciences, and the ministries specializing in various branches of energy (see Fig. 3).

Despite the lack of a single formal policymaking body for energy, something like unified control comes from the fact that the Kremlin has given that sector direct daily attention. Table 1, a partial listing of the major documents, pronouncements, and recent meetings devoted to the gas industry, gives some idea of how close the attention of top policymakers has been.

Vertical Hierarchies: The Ministries

Three principal ministries occupy the "vertical dimension" of the organization chart in the gas and oil province of West Siberia: The Ministry of Oil (which we shall refer to by initials designating its

⁶Other major Party figures who attend energy-related meetings reported in the Soviet press include I. P. Iastrebov (veteran head of the Central Committee Industry Department) and V. S. Frolov (head of the Central Committee Machine-Building Department). Another occasional attendee is A. A. Titarenko, second secretary of the Ukrainian Party. And since his appointment as Central Committee secretary in November 1982, N. I. Ryzhkov, head of the newly created Economics Department of the Central Committee, has also been named in reports of such gatherings. How his responsibilities may overlap with those of Dolgikh's is not yet known.

⁷In the area of censorship and media control, the Central Committee's staff is much larger and its supervision more detailed.

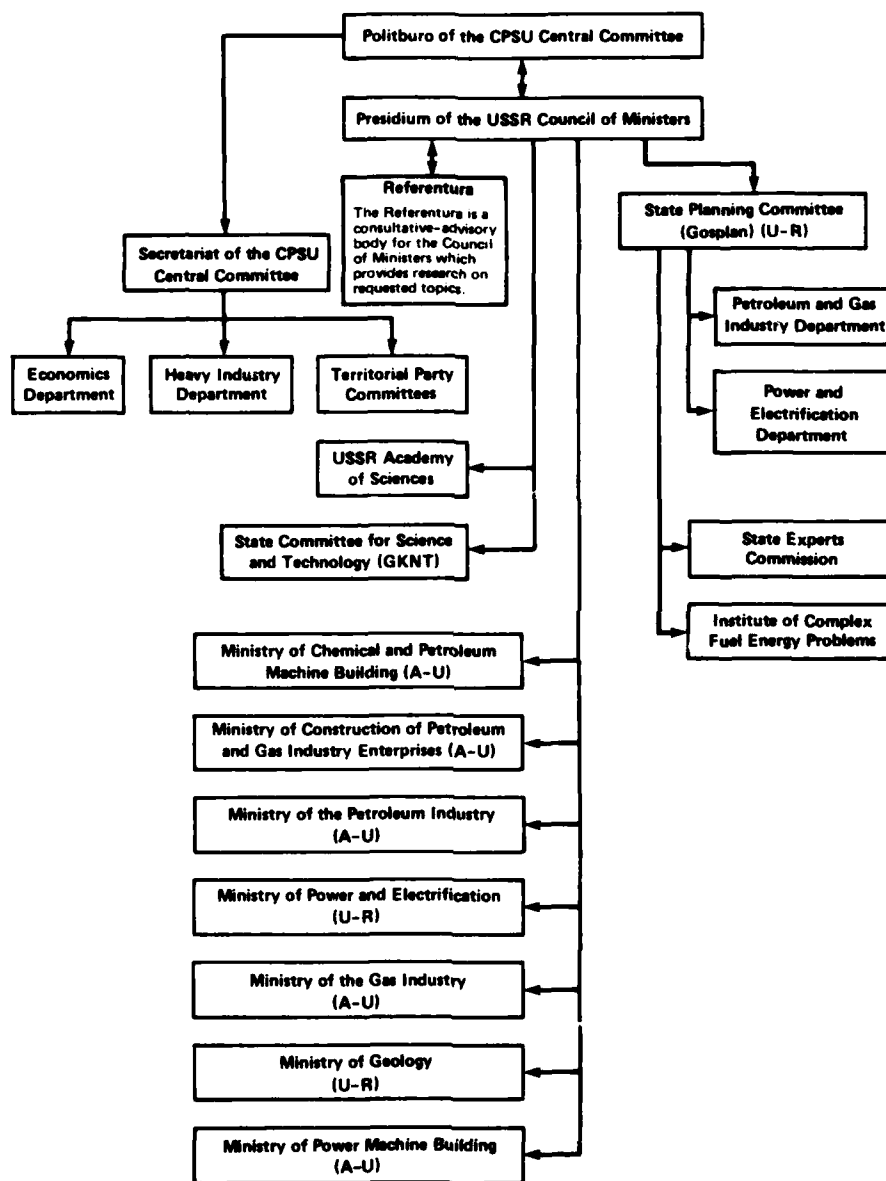


Fig. 3—Institutional structure for decisionmaking in the gas campaign

Table 1

SIGNS OF HIGH-LEVEL ATTENTION TO THE GAS CAMPAIGN

Date	Meeting
July 1981	Presidium of USSR Academy of Sciences reviews R&D tasks in oil, gas, and pipeline development
August 1981	Meeting at Central Committee headquarters on gas and gas transportation
August 1981	Central Committee decree approving initiative of Tiumen' oil and gas workers for early fulfillment of output goals
(late 1981)	USSR Council of Ministers criticizes Gas Ministry and Gas and Oil Enterprises Construction Ministry for poor workmanship in pipeline construction
November 1981	Final version of 5-year plan reaffirms high priority of the gas campaign, as do speeches by Baibokov and Brezhnev
January 1982	Front-page <i>Pravda</i> editorial on gas pipelines
January 1982	Dolgikh visits Tiumen' province
March 1982	Brezhnev speech includes plea for Central Asian manpower contribution to Siberian energy development
April 1982	Central Committee decree on the Ministry of Oil and Gas Enterprise Construction
July 1982	Central Committee resolution on accelerated and independent development of the East-West gas pipeline
August 1982	Front-page <i>Pravda</i> editorial on gas pipelines
October 1982	Meeting at Central Committee headquarters on the East-West pipeline
November 1982	Andropov speech to Central Committee reaffirms high priority of energy sector and of gas and oil programs
January 1983	Front-page <i>Pravda</i> editorial on fuel and energy sectors
March 1983	Front-page <i>Pravda</i> editorial on gas industry
April 1983	Politburo meeting on energy policy

Russian name—MNP), the Ministry of Gas (MGP), and the Ministry of Construction for the Gas and Oil Industries (MNGS).

MNGS has the broadest assignment: In the gas campaign, its main job is to build pipelines and compressor stations, as well as the infrastructure needed at both ends of the pipeline network—gas-treatment plants and gas-gathering networks in the gas fields, and local distribution lines and gas-storage facilities for users. Like other Soviet construction ministries, MNGS acts as the contractor (in Russian, *podriadchik*), and MNP and MGP are the customers (*zakazchiki*).

When MNGS completes a project, it turns that project over to MNP or MGP, which operates and maintains it. Once the Soviet gas network is built, it is the responsibility of MGP, which handles transmission, development strategy and operations in the gas fields (including drilling), and service to customers. There is potential trouble in such arrangements, because even though MNGS is technically responsible to MGP, it receives its basic marching orders (as well as its resources and materials) from the State Planning Committee (Gosplan) and its related state committees (State Committee for Construction, Supply, etc.). Consequently, although MGP is for all practical purposes a hostage to MNGS, MNGS is much less answerable to MGP. MNGS has every incentive to build fast, but not necessarily to build well. In allocating its scarce time and resources it is naturally encouraged to concentrate on the most central tasks (such as completing the export pipeline), which results in leaving more peripheral jobs undone. MGP, the customer, has little recourse except to appeal to higher political authority and complain loudly to the press, neither of which will necessarily do much good.

The same is true, incidentally, of most Soviet operating ministries in their relations with construction ministries.⁸ To free themselves somewhat, the operating ministries have increasingly resorted to developing their own home-grown construction firms (10 percent of all Soviet construction projects are now of that type).⁹ But such efforts are an inefficient second best. MGP can offset the worst consequences of MNGS's neglect of roads and housing by building its own, but if MNGS delivers badly welded pipeline or falls behind schedule in

⁸See, for example, a description of the relations between the Ministry of Reclamation and the Ministry of Agriculture in Gustafson (1981). In the case of reclamation, however, the builder of an irrigation or drainage network continues to operate it. This means that the conflict between "builders' incentives" and "operators' incentives" is simply moved inside the Ministry of Reclamation, but it is not resolved for all that. In addition, the farms and the operators of the reclamation networks soon discover that their interests are not the same. Consequently, simply making MNGS the operator of the gas pipelines would not necessarily alleviate the problems that lower the transmission efficiency of Soviet gas pipelines.

⁹Zhigailov, Sabirov, and Chekalin (1983).

completing gas-treatment plants, MGP has to live with the consequences. These problems not only lessen the efficiency of the gas campaign as a whole, but can also distort its direction.

MNGS has existed in its present form only since 1972, and its head from the beginning has been Boris Shcherbina, who was formerly the first secretary of the Tiumen' province Party organization and an enthusiastic early booster of Siberian gas. MNGS has concentrated its resources on the Siberian pipelines with little sign of internal dissent or reluctance, and its spokesmen have consistently advocated higher targets for the gas campaign. Since 1979, when the gas program began taking its present form, there have been almost no changes in the top ranks of MNGS, which suggests that the ministry's performance has been, on the whole, successful.¹⁰

The Ministry of the Gas Industry has had a longer history as a distinct entity than MNGS, much of it in the Ukraine and Central Asia, where the Soviet gas industry first grew up in the 1950s. In those earlier days MGP frequently fell short of its output plans; indeed, it did not begin meeting them consistently until 1976. This may account for a certain caution, visible around 1980, in the attitude of MGP officials toward the idea of a crash expansion in north Tiumen'. The late minister S. A. Orudzhev, a native of Azerbaijan whose career encompassed the whole history of his ministry, was consistently less bullish on Tiumen', and particularly on Urengoy, than his colleague Shcherbina. In the second half of the 1970s, MGP began investing a growing share of its resources in the older gas-producing regions,¹¹ which suggests a certain amount of "drag" on the ministry from its older operations and regions. Since Orudzhev's death and his replacement by former first deputy minister V. A. Dinkov, there has been substantial movement in the top ranks of MGP,¹² but most of it has affected the functional offices of the ministry (especially the economic and technical departments) rather than the regional directorates.

¹⁰Conceivably a casualty of the strain induced by the embargo was the deputy minister in charge of pipeline construction and mechanization, G. A. Arendt, who suddenly died on the job three weeks after the imposition of the second round of the American embargo in July 1982. Arendt had been the most recently appointed of the MNGS deputy ministers, named to his post in 1980 after 34 years in the gas and oil industries. His obituary appears in *Sotsialisticheskaiia industriia*, July 30, 1982. Information on the major personnel of MNGS comes from CIA, Directorate of Intelligence, *Directory of Soviet Officials: National Organizations*, various years.

¹¹"*Ekonomicheskaiia effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.*," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaia informatsiia)*, No. 10, 1980, p. 5.

¹²Information on movements of personnel can be obtained by comparing the 1982 edition of the CIA *Handbook* with successive issues of the gas industry's journal, *Gazovaiia promyshlennost'*, especially No. 1 (1983).

The Ministry of Oil plays an important part in the gas campaign, partly as MGP's ally and partly as a direct competitor for resources, especially in Tiumen' province. The basis for alliance comes from the two industries' common interest in securing more resources for Siberia. Local oil and gas officials frequently sound like a Siberian lobby. The two industries between them account for more than 90 percent of the productive capital invested in Tiumen' province and, because of the high priority of the energy program as a whole, oil and gas investments have squeezed those of other industries.¹³ But inside Tiumen' the oil industry, long dominant, is accustomed to having top priority, especially as it too is growing rapidly during the 11th Five-Year Plan.¹⁴ Geology and climate work to the oil industry's advantage, because oil in Tiumen' is concentrated in the more accessible southern half of the province, and most of the gas is located in the inhospitable north. Workers and their organizations prefer to work in the south, which has hampered the smooth northward transfer of resources that the gas campaign requires.¹⁵

This phenomenon of unplanned "drag" in resource allocation—in effect an unplanned weakening of the high priority of the gas program—shows up sharply if one examines the secondary players in Tiumen', the ancillary ministries that build roads and housing, ship freight and workers for the gas campaign, assemble powerplants and powerlines, develop and build new machinery, and so forth. Even though they are crucially important to the gas campaign, the gas campaign is not necessarily crucially important to them, and the job of wrestling the noncongruent priorities of such side players into even minimal alignment is one of the most difficult tasks of Soviet administration. For the Ministry of Power and Electrification (Minenergo), for example, building a 500-kv powerline to the Urengoy gas field is a minor (and fairly unappealing) part of a country-wide construction program, some of which—such as nuclear power—is also under direct Kremlin scrutiny. Consequently, although power supply to the oil and gas industries of Tiumen' province has turned into one of the most highly publicized problems of the area, putting pressure on Minenergo does not necessarily produce results. As the colorful head of Gosplan's special office in Tiumen' declared to a reporter:

Several times I've had occasion to talk to V. Filoniuk, who is responsible for electrical-power development in West Siberia. He never fails

¹³Ageeva and Orlov (1982).

¹⁴Oil investment in West Siberia is scheduled to double in the 11th Five-Year Plan, according to Ageeva and Orlov (1982).

¹⁵This question is discussed in Sec. III.

to point out to me that the work of the power construction teams in Tiumen' constitutes only a small fraction of the ministry's overall load. Consequently the ministry, he says, gives more attention to other problems than those of Tiumen'.¹⁶

Devices to Provide Horizontal Integration

The problems of vertical hierarchies are well known in Soviet experience; and to deal with them, particularly in high-priority programs, Soviet administrators have long used several classic palliatives. The oldest and most important of these is the network of state committees, which are organized by function: planning, prices, supply, etc. Gosplan is a particularly prominent player in Soviet energy policy; its chairman, N. K. Baibakov, headed the oil industry in the 1950s and, to judge by his frequent signed articles in the MGP and MNGS house organs, is actively committed to the current gas policy. Because of its strategic position as the place where political goals and limited resources must be reconciled, Gosplan is one of the few institutions in the Soviet decisionmaking system where a broad overview can take place, and the recommendations of its staff have on some occasions set the terms of major policy debates, such as the finding that pipelines were more cost-effective than high-voltage electrical lines as a means of bringing energy from Siberia to the "Mainland" in European USSR.¹⁷

But "verticalism" affects even Gosplan, because inside its walls it is divided into departments that reproduce the broad lines of the ministries—electrical power, for example, is handled by a different department than is oil and gas. Moreover, Gosplan is far away from the field, where the real job of integration must take place. In earlier times, this problem was dealt with by giving full authority to one ministry for all the tasks involved in developing a regional complex. For example, when the Ministry of Power and Electrification built the great hydropower plants at Bratsk and Krasnoirsks in the 1960s, it was also responsible for building the towns and major industries that could draw on them. But the gas campaign is too big and complex for any one ministry to handle. New devices have been needed for concentrating priority in north Tiumen'.

Several of these are new variants on old arrangements: (1) A high-level "command" staff (*shtab*) created within the Ministry of Gas, and high-level coordination between the boards (*kollegia*) of MNP and MNGS; (2) a special council for West Siberian energy within the apparatus of the USSR Council of Ministers; (3) a local "plenipotentiary"

¹⁶Kuramin (1982a).

¹⁷This recommendation is described—and criticized—in Vainshtein (1982).

agency for West Siberian oil and gas located directly in Tiumen', in the form of a special department of Gosplan; (4) crossovers of personnel between energy industries and the Party apparatus in West Siberia, with the Party apparatus playing a strong and prominent role; (5) similar cross-cutting ad hoc commissions for important related tasks, such as gas turbine compressor development in Leningrad. What are the powers of these groups? Do they really help to keep the gas campaign on target? Do they control costs and maintain productivity, or are they mainly command centers throwing more resources into the front lines?

In early 1980, the chief of oil and gas planning in Gosplan, V. Filanovskii-Zenkov, called for a single agency to deal with all oil and gas development in West Siberia.¹⁸ In that same year two new bodies were created, a staff group within the apparatus of the USSR Council of Ministers to oversee oil and gas in Western Siberia, and a special division of Gosplan for the same purpose.

What is novel about the latter is that it is located directly in Tiumen' city; in the history of Gosplan such a thing had never been done before. Its head, Vladimir Kuramin, is not a career official of Gosplan but the former head of oil and gas construction in Tiumen' province, a man with long experience of the area. Although his agency has the status of a Gosplan department, it has the formal title of "commission," and one of its prime functions is to bring together the local heads of all the major ministries involved in West Siberian gas and oil. Its 36 members include apparatus secretaries from the province committees (*obkomy*) of the Party. Since May 1981, when it began operations, Kuramin's commission has been one of the most highly publicized efforts to put muscle into the administration of a regional complex.¹⁹

What are the commission's actual powers, and what has it achieved? In an interview, Kuramin described its functions in revealingly weak verbs: To "call" meetings, to "hear" reports, to "draw" local officials into work on major problems, and to "present" its suggestions and recommendations. The commission's staff is small. Its activities, although in principle covering the entire range of gas and oil activities (its four subdivisions deal with planning, capital construction, infrastructure, and "social" development), seem to have been limited in practice to a handful of targets. In interviews, Kuramin talks mainly about the problem of electricity supply in West Siberia.

¹⁸Filanovskii-Zenkov (1980).

¹⁹The following discussion is drawn from Kuramin (1981a, b, and c; 1982a and b). There is also an account of an interview with Kuramin in Lisin (1983).

The impression that emerges from press accounts is that the Gosplan commission has had only a small effect so far; indeed, it may have lost momentum since it first began. Kuramin has complained that the commission's charter needs to be revised to give "a more precise definition of its functions and a strengthening of its role in decisions concerning planning and management in Tiumen'," and he adds that he needs more staff. Despite all the publicity given to Kuramin and his commission by the press, it gets no mention at all in interviews with officials of the Tiumen' Party province committee (*obkom*), even though the obkom department head for industry, B. Trofimov, presumably sits on it. Instead, Trofimov declares that the Moscow offices of the major ministries continue to call the shots,²⁰ and that the problems of horizontal integration are as severe as ever.²¹ And when Trofimov discusses the problem of power shortages in Tiumen' without so much as mentioning the Gosplan Commission, it begins to look as though it is being studiously ignored by a Party apparatus that does not welcome potential rivals.

The organization that has traditionally provided the most effective horizontal coordination and local oversight is the Party itself. The professional Party apparatus at the province and district levels not only acts as expeditor, overseer, rescuer, and occasional knocker of heads, but it can also intervene to advocate changes in policy, sometimes in defense of regional viewpoints. The Tiumen' obkom, for example, claims to be the originator of a policy change that, more than any other, put the Soviets in a position to weather the American embargo—that of building all six major pipelines from Tiumen' along a single corridor in West Siberia, thus making maximum use of scarce manpower and infrastructure.²²

The gas campaign contains many examples of personnel crossovers between the Party apparatus and the oil and gas industries. Such career-switching makes it possible to put top technical experts from industry into positions of authority to oversee major projects. One of the most important figures in the gas campaign is E. G. Altunin, the Tiumen' obkom secretary for industry (and Trofimov's boss), who was previously head of the Tiumen' gas industry, Tiumengazprom. Altunin's superior, First Secretary G. P. Bogomiakov, was formerly an institute director in the oil industry. Bogomiakov's predecessor, Boris Shcherbina, moved in the opposite direction when he became head of

²⁰Trofimov (1981), p. 81.

²¹Trofimov (1982), pp. 107-110.

²²Trofimov (1981). But Kolotilin (1981, p. 4) mentions the same initiative, but not the role of the obkom.

MNGS. As a result of such career-crossing, the traditional powers of the local Party apparatus are being exercised in north Tiumen' by officials who have ample technical expertise and experience of the area.²³

²³For the best and most thorough discussion of the role of the Party apparatus in industrial administration at the district and province levels, see Hough (1969). Such cases of career-switching are by no means confined to the oil and gas industries. For example, B. G. Kalutskii, the late chief of the electrical and nuclear machine building department of Gosplan, began as an engineer, then switched to "responsible Party work" in the 1950s, before joining the State Committee for the Use of Atomic Energy in the 1960s (*Sotsialisticheskaia industriia*, November 28, 1979); V. N. Fedotov, the late chief of the electrical engineering department of Gosplan, had worked in the apparatus of the CPSU Central Committee before joining the Ministry of Electrical Engineering (*Sotsialisticheskaia industriia*, November 3, 1981).

III. POLITICS AND POLICY

Three themes run through most of the discussion in this section: (1) Soviet energy policy has been highly changeable over the past decade, for reasons that could well cause it to change again if the new leaders depart from the "crisis mode" of the last five years; (2) ever since the beginning of the gas campaign there have been signs of strain over the immense rerouting of resources required, and as a result the gas industry may not actually be getting the resources that were originally projected; (3) the administrative and technological burdens of the gas program, compounded by the pressures imposed by the American embargo, have led to distortions in the implementation of the gas program, which may cause problems in the future.

THE PLACE OF THE GAS PROGRAM IN SOVIET ENERGY POLICY¹

As late as the mid-1970s, the energy situation as viewed from the Kremlin must have appeared trouble-free. With the development of the major oil and gas fields of the Volga basin and the Ukraine in the 1950s and the rise of the even larger fields of Western Siberia in the 1960s, the Soviet Union, like the industrial West, had enjoyed a long period of smooth economic growth fueled by cheap hydrocarbons.

If one looks back a decade to Soviet publications of 1972 and 1973, it is hard to find any public sign of high-level concern over future energy prospects. In the public summaries of his reports to the December plenary sessions of the CPSU in 1972 and 1973, Brezhnev gave hardly more than a passing reference to the subject; and Kosygin, in two of his few published speeches on domestic policy during this period, had equally little to say about energy production or conservation.² In September 1972 the deputy prime minister for science and technology, V. A. Kirillin, gave an entire speech to the USSR Supreme Soviet on the subject of "Rational Utilization of Natural Resources" without more than a passing mention of energy waste, except as a source of pollution.³

¹The following section is a revised and updated version of Gustafson (1983).

²On September 30, 1972, Kosygin spoke to an audience of Gosplan officials and on October 6 to the State Supply Committee (Gossnab). Unfortunately, only excerpts of these speeches are available. Kosygin (1979), pp. 149-160.

³*Pravda*, September 16, 1972. There is equally little mention of the subject in the discussion that follows.

The most eloquent evidence is investment shares. The share of the energy sector in industrial investment fell steadily throughout the early 1970s, from 29.4 percent in 1971 to just over 28 percent in 1975.⁴ The rumblings that were coming more strongly from Tiumen' province evidently took some time to penetrate the consciousness of the leaders, although energy's investment share stopped falling after 1975.⁵

The oil and gas industries, as portrayed in the press at that time, were not without their problems, but they were mainly those of rapid growth, not of long-term shortages of supply. At the September 1972 session of the USSR Supreme Soviet, for example, speakers criticized slow construction, particularly of oil and gas pipelines and of compressor stations.⁶ One of the earliest items to appear in the Soviet press with a portent of things to come was a complaint from the chief of the oil agency for Tiumen' province (Glavtiumenneftegaz), Viktor Muravlenko, that funding for oil exploration in West Siberia had been frozen at a constant level for several years.⁷

Gathering Anxiety, Followed by a Crash Program

In 1973, concern about inadequate oil exploration in Tiumen' province and anxiety about the lack of hard new data on reserves became greater. The Middle Ob' fields, one technical specialist asserted, could not provide an adequate base for further expansion of Soviet oil output after 1980.⁸ Official attention began to shift north and east of Tiumen'.⁹ The tone was not yet one of panic, but in hindsight 1973

⁴This measure is derived by comparing figures for energy investment with those for industrial investment in *Narodnoe khoziaistvo SSSR*, the Soviet statistical annual. Because those figures exclude much of Soviet investment in energy transport, the result is a progressively greater understatement of energy's real share as one moves through the 1970s into the 1980s.

⁵*Narodnoe khoziaistvo*, various years.

⁶Speeches by Deputy P. A. Rozenko (*Izvestiia*, December 20, 1972) and Gosplan chairman N. Baibakov (*Izvestiia*, December 19, 1972).

⁷*Izvestiia*, July 18, 1972, translated in *Current Digest of the Soviet Press*, Vol. XXIV, No. 29, 1972, p. 20. Muravlenko was soon to become known as one of the most pessimistic critics of the oil outlook for Tiumen', until his death in 1977. In an article in 1976 he dwelt at length on the daunting infrastructural requirements for meeting the official output targets of the 10th Five-Year Plan (*Sotsialisticheskaiia industriia*, January 1, 1976).

⁸*Ekonomika nefianoi promyshlennosti*, No. 6, 1973, p. 8.

⁹The leaders themselves were at least beginning to be attentive to the problem, as can be seen from the fact that a major meeting on oil exploration, held in Tiumen' in late November 1973, was attended by Central Committee Secretary V. I. Dolgikh, Gosplan Deputy Chairman A. M. Lalaiaants, and the Minister of Oil V. D. Shashin. The Tiumen' obkom First Secretary, then B. E. Shcherbina (he was promoted a month later

proved to be an important year: Not one supergiant oilfield has been discovered in West Siberia since.

By 1974 the tone of official writings had clearly begun to change and there is evidence of greater official attention to energy policy, at least among technical experts. In that year Gosplan established an Institute of Complex Fuel and Power Problems. In November 1974 energy was the major topic on the agenda of the Academy of Sciences' annual meeting.¹⁰ The energy crisis that had struck the West the year before was clearly on the speakers' minds. V. A. Kirillin, then chairman of the State Committee on Science and Technology and an expert on nuclear fusion, observed that one root of the crisis lay in the simple fact that annual consumption of hydrocarbons worldwide had grown to a sizable fraction of known reserves, and that it was not too soon to begin thinking about the next stage. But in these writings there was no perceptible sense of a crisis, as in the West, but rather an air of unhurried positioning for the future.¹¹

At the 25th Party Congress in February 1976 the leaders' speeches began to sound more like those of the technical experts but still showed no particular sense of urgency. Brezhnev gave little more time to energy than he had in earlier speeches, such as his reports at year-end Central Committee plenums over the previous five years. Kosygin stressed the potential role of coal, thus echoing the position taken by the R&D establishment in the previous year or two. Oil and gas, Kosygin declared to the Congress delegates, should be saved as much as possible for nonfuel uses. In his conception, large coal-fired powerplants would supply the Volga and Ural regions, and the vast brown coal reserves of Kazakhstan and Siberia would be converted to electricity by mine-mouth plants located nearby, the power flowing to points of demand in the European USSR over the world's longest

to the post of Minister of Oil and Gas Construction), criticized the geologists for their failure to move north (*Pravda*, November 23, 1973). Oil minister Shashin voiced the same concern in an article signed at about the same time (*Neftianoe khoziaistvo*, No. 3, 1974, p. 4).

¹⁰*Vestnik Akademii Nauk SSSR*, No. 2, 1975, pp. 3-31. This issue carried the speeches of M. V. Keldysh, A. P. Aleksandrov, V. A. Kirillin, and M. A. Styrlikovich. Already in Keldysh's introductory address and in Kirillin's article one can find the stress on coal that became the centerpiece of official energy policy at the 25th Party Congress in February 1976.

¹¹Neither was the stress on coal entirely new, as one can see from an article by the economist Tigran Khachaturov, "Natural Resources and the Planning of the National Economy," in *Voprosy ekonomiki* the year before (No. 8, 1973, pp. 16-29, translated in *Current Digest of the Soviet Press*, Vol. XXV, No. 49, 1973, p. 6). Khachaturov observed, "Since petroleum reserves are not as great as coal reserves, their use as fuel must be limited; petroleum should be used increasingly as a raw material for obtaining products of organic synthesis. . . . It will be better to use gas not as a fuel but as a chemical raw material." But it is clear from the context that Khachaturov was writing about something he considered to lie in a fairly remote future.

high-voltage transmission lines. To begin this long-term shift toward coal, the guidelines for the 10th Plan called for an increase in coal output of 14 to 16 percent by 1980.

But instead, the coal industry in 1980 came in a phenomenal 74 million tons short of the low end of the initial 10th Plan target, that is, 716 million tons instead of 790. Very few new coal-fired powerplants were actually built (and no oil-fired ones were converted to coal); and the preliminary groundwork for the high-voltage transmission lines had barely begun by the time the next Party Congress opened in 1981. What had gone wrong? The reasons were long in the making. One of the main ones was poor technological modernization in the coal industry;¹² another (related to the first) was a history of underinvestment.¹³ Consequently, when faced in late 1977 with what they perceived as an imminent energy crisis, the Soviet leaders quickly dropped the program of 1976 and turned away from coal, searching instead for energy sources that would give them quick results.

Their first answer was oil. In an abrupt shift in late 1977, Brezhnev launched a crash program to speed up West Siberian oil output. In his speech to the December 1977 plenum of the Central Committee, Brezhnev stressed the decisive importance of Tiumen'.¹⁴ In the months following, there was a good deal of discussion over the course to take, during which officials with links to Tiumen' lobbied vigorously for Siberian oil.¹⁵ Most major officials in Moscow, including Kosygin and Gosplan chairman Baibakov, did not immediately follow Brezhnev's line. During the winter and spring of 1978 Brezhnev did some campaigning, reminiscent of his efforts to launch his agricultural policy in the late 1960s. The new line was apparently consolidated following a trip by Brezhnev to Siberia in the spring of 1978,¹⁶ and by

¹²For background on Soviet coal and on technological innovation in that industry, see Kelly (1981); Central Intelligence Agency (1980a and b); and Campbell (1980), Ch. 4.

¹³For the three years before the 1976 Party Congress—and these were the years in which coal was being spoken of as the energy source of the future—actual investment in coal remained unchanged. See *Narodnoe khoziaistvo SSSR* for those years.

¹⁴Brezhnev's speech has not yet been reprinted in its entirety. A paraphrase appeared in an editorial in *Pravda*, December 18, 1977.

¹⁵See, in particular, an article by Tiumen' obkom 1st secretary G. P. Bogomiakov in *Literaturnaia gazeta*, January 18, 1978, in which he states that the December 1977 plenum had determined precisely the place of the Tiumen' complex in satisfying the needs of the country for oil and gas, thus settling what Bogomiakov described as "not just a few contradictory judgments in views on the future."

¹⁶Brezhnev's 1978 trip to Siberia is treated by Tiumen' "patriots" as a highly symbolic event, as one may see from the words of G. P. Bogomiakov at the 26th Party Congress: "Of fundamental importance have been the instructions of L. I. Brezhnev on the future development of the fuel and power sector, the advice and comments made by him in the course of his trip to the regions of Siberia and the Far East." *Pravda*, Febru-

his strongly worded speech to the 13th Komsomol Congress in April 1978. In December an "enlarged session" of Gosplan officials was convened to review the practical issues of speeding up energy development in Siberia.¹⁷

Over the next four years Brezhnev's role in energy policy grew ever more prominent, although the initial stress on oil gave way in 1979 to a policy officially described as "balanced," which then led in 1980 to a rapidly growing priority for gas. But Brezhnev's hand was visible throughout. At the 26th Party Congress Prime Minister Tikhonov described the shift toward gas as Brezhnev's initiative. During the same period, the apparent role of the Central Committee staff grew also, as did that of V. I. Dolgikh, the Central Committee secretary in charge of heavy industry.¹⁸

The official investment statistics dovetail neatly with the change in tone of official speeches after 1977. The share of investment in energy development, measured as a percentage of total industrial investment, took a sudden jump after 1977 and continued climbing rapidly from 1978 through the end of the 10th Plan in 1980. During that time energy's share increased from 28.1 to 32.4 percent.¹⁹

Beginning in 1978 oil investment likewise took a sharp upward turn, increasing its share in industrial investment from an average of 9.5 percent in the first half of the 1970s to 14.3 percent in 1980, roughly a doubling in the absolute annual amounts invested.²⁰ In sum, the energy sector appeared well on its way to reoccupying the 40-odd percent share it routinely held in the 1950s, before the Soviet economy shifted to cheaper hydrocarbons (see Fig. 4).

The Evolution of the Current Gas Policy

Gas had been the star performer of the 10th Plan, being the only energy source that actually achieved the five-year targets set for it in 1976 (see Fig. 5). The latest turn in Soviet energy policy came in 1980-81, with the dramatic shift of priority to gas that has already

ary 27, 1981. At the time, the fundamental importance was far from plain, since Brezhnev's trip occurred right on the heels of a similar trip by Kosygin, and the energy aspects of both trips received modest treatment in the press.

¹⁷See Granberg (1981), p. 73. The Gosplan meeting was followed in June by a big conference at Academic City in Siberia on the same subject, followed by detailed recommendations.

¹⁸In January 1980, for the first time, an article on energy policy appeared under Dolgikh's byline, in *Partiinaiia zhizn'*. In addition, in the last two years Dolgikh's name has appeared regularly in Soviet accounts of major official meetings on energy.

¹⁹*Narodnoe khoziaistvo SSSR v 1980g*, Finansy i Statistika, 1981, p. 338.

²⁰*Ibid.*

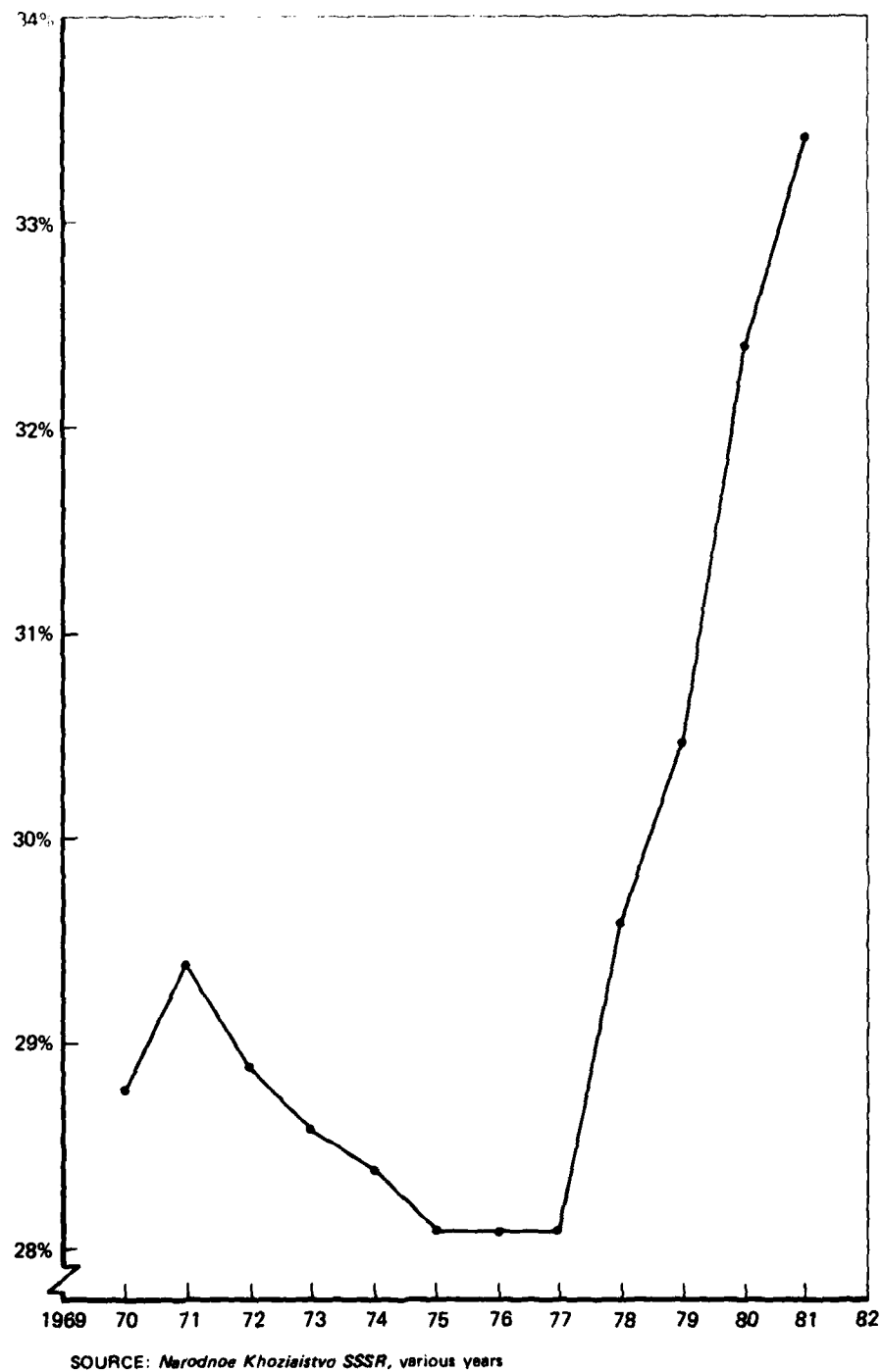
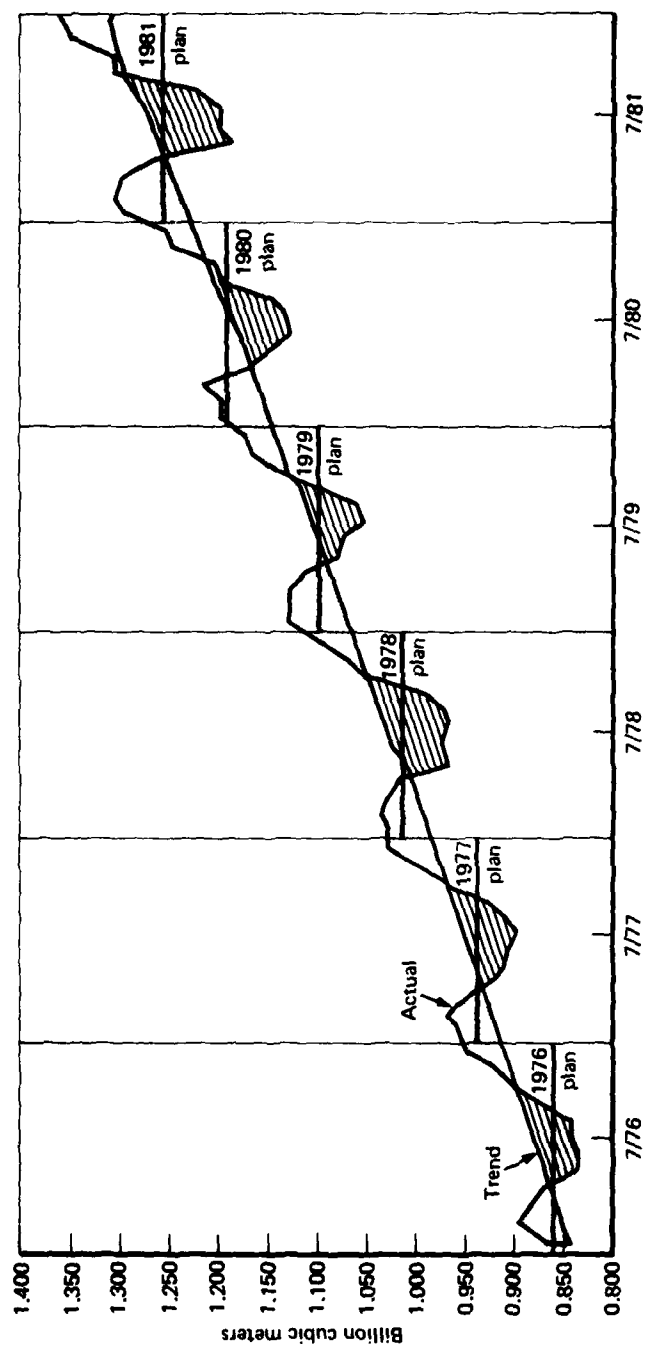


Fig. 4—Investment in the energy sector as a percentage of industrial investment, 1970-81 (ex-transport)



Source: E. A. Hewett, 1983
 Note: Trend is $\log(X) = -0.173 + .0067T - .00001T^2$
 Data source: Monthly plan fulfillment reports in *Ekonomicheskaya Gazeta*

Fig. 5—Monthly Soviet gas output, 1976-81
 (trend and actual)

been described. As Brezhnev stated in February 1981, in his report to the 26th Party Congress:

I consider it necessary to single out the rapid development of Siberian gas output as a task of first-class economic and political importance. The deposits of the West Siberian region are unique. The largest of them—Urengoy—has such gigantic reserves that it can meet for many years both the internal needs of the country and its export needs, including exports to the capitalist countries.

How the different pieces of the gas program were supposed to fit together, however, was evidently not clear even to the top leaders at the time. There was some lingering opposition to increasing gas sales to the West, as evidenced by the fact that it was not until July 1980 that the Soviet leaders finally committed themselves officially to the export pipelines project, in a joint communique signed by Brezhnev and Schmidt. Only a month before, then-deputy prime minister Tikhonov had told German officials in Bonn that Moscow was still debating over whether to export new gas or keep it inside the Soviet bloc and export extra oil instead.²¹ There were also glaring inconsistencies between the ambitious goals of the gas program and the more modest technical means available for achieving them; Sec. V of this report looks in detail at one of the most important examples, the apparent gap between the need for compressors and Soviet capacity to produce them. The draft five-year plan still had many loose ends when it was first unveiled at the 26th Party Congress, not just in the energy sector but throughout; and the next several months, between February and November 1981, when the final version was announced, were spent in straightening them out.

One may imagine the long faces of officials in every Soviet ministry but that of gas in the spring of 1981, as they contemplated the prospect of meeting their assigned targets with the straitened investment budgets that the draft plan had given them, while the gas industry seemed to be receiving more resources than it could absorb. The death of the gas minister, S. A. Orudzhev, one month after the Party Congress, must have seemed like a golden opportunity to clip the gas program back a bit. But by the time the final version of the five-year plan was published in the fall of 1981, the priority of the gas campaign stood higher than ever. Although all the other energy targets for 1985 had been cut to the low end of the spread announced in the draft plan, the final gas target was set close to the high end. The gas campaign, in other words, survived the first round of the budgetary wars pretty much intact.

²¹*Financial Times*, July 3, 1980.

The one partial exception was the pipeline program, which remains unsettled even now. The initial November 1980 five-year goal of 50,000 km of new trunkline was cut to 38,000 by November 1981,²² and the targets for new 56-in. pipe dropped from 26,000 to the low 20s.²³ The initial plan to build seven major 56-in. lines from Urengoy was reduced to six. The reduction, incidentally, came at the expense of domestic consumption, for at that time the Soviets were still expecting to export 40 bcm of new gas to Western Europe.

Higher target figures for pipeline construction continue to appear in the statements of some high-ranking officials connected with the gas campaign. As late as the end of 1981, for example, S. Kashirov, a deputy minister of gas with responsibility for pipelines, still used the draft plan's target figure of 50,000 km as the goal for the 11th Plan;²⁴ and in the winter of 1982 the journal of the ministry in charge of pipeline construction also used the higher figure.²⁵ More recently, the minister in charge of the pipeline program, B. Shcherbina (long known as a promoter of the West Siberian gas program), boasted that the Soviet Union would not only complete the six pipelines called for by the plan by 1985, but would even build a seventh for good measure—thus reverting back to the original draft target.²⁶

The persistence of such echoes suggests that although Western observers (and evidently the majority of Soviet leaders as well) felt in 1981 that the pipeline targets initially proposed by the pipeline builders were too ambitious and cut them back, there are still some pioneering souls in the Soviet hierarchy who believe it is good politics to call for higher construction targets. Curiously, Gosplan chairman

²²By the beginning of September 1980, *Pravda* began to use the figure 40,000 (September 6, 1981), and in October 1981 the new lower figure was confirmed in *Ekonomicheskaya gazeta* ("Razvitie truboprovodnogo transporta," No. 43, October 1981, pp. 1-2).

²³The initial figure of 26,000 km appeared in Orudzhev (1980) and was cited also in the address of Baranovskii (1981). The later figures can be found in "Razvitie truboprovodnogo transporta," *Ekonomicheskaya gazeta*, No. 43, October 1981. The picture is clouded somewhat by the fact that several figures have appeared on Soviet plans for 56-in. lines, and it is not clear how they are to be reconciled. Gas minister Dinkov, in August 1981, uses the figure 19,000 km (Dinkov, 1981) for the six major pipelines from Siberia. A still lower figure, 16,600 km, appeared in the spring of 1981 in *Planovoe khoziaistvo* ("Ratsional'noe ispol'zovanie material'nykh i trudovoykh resursov na stroitel'stve magistral'nykh nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 50). This figure, which comes from the Tiumen' obkom, is matched by a lower figure for gas-processing capacity than the gas minister uses. More recently, an article in the journal of MNGS uses the figure 23,000 km in line with the general tendency of MNGS officials to use more bullish figures for pipeline construction (Dertsakian, 1982, p. 5).

²⁴"Chetkii ritm," *Sotsialisticheskaya industriia*, December 27, 1981.

²⁵Dertsakian (1982).

²⁶*Financial Times*, September 8, 1982, quoting a TASS release. Shcherbina has since repeated the boast (1982b, p. 7). It has been echoed by *Pravda's* Tiumen' correspondent Lisin (1982b), and in another TASS release on November 4, 1982 (FBIS/USSR, November 5, 1982).

Baibakov may be one of them, because in his official speech as rapporteur of the final draft of the 11th Plan, he too used the high-end figure of 48,000 km.²⁷ At the moment, the meaning of these variations is unknown.

What was not in question, however—at least as long as Brezhnev was alive—is the top priority of the core of the gas pipeline program. At the November 1981 plenary meeting of the Central Committee, Brezhnev described the six major Siberian pipelines as “without a doubt the central construction projects of the five-year plan”; and he added, “They must be finished on time without fail.”²⁸

One of the most interesting aspects of this recent history is that twice before, during the 1970s, the leaders had examined and rejected an energy policy centered on natural gas, before finally accepting it in 1980-81. Did they miss an important opportunity five and ten years ago in north Tiumen? If they had shown more imagination and foresight then, would they have avoided the need for a crash program later on?

The answer is no. Without giving the Soviet leaders more credit for foresight than they necessarily deserve (there are, after all, many indications of their failure to respond quickly to the gathering trouble in oil and coal), in the case of gas they probably made the right decision. Consider the state of knowledge and skills ten years ago. The technology required to ship gas at 75 atmospheres or higher (without which the proposition is hardly efficient) was not available in the Soviet Union to the extent that it is today, so that the gas option would have meant greater dependence on foreign technology than now. The infrastructural base in north Tiumen', skimpy as it is today, was even worse then, and the expense of a big gas program would have been astronomical. Reserves in north Tiumen' were not nearly so well known, and the gas industry had little experience in working in such rugged conditions. Above all, five and ten years ago the oil option looked much more cost-effective. If all other things are equal, after all, oil is the more versatile fuel and the better money-earner, as well as being cheaper to ship (the Soviets may yet decide to use more gas at home to free oil for export). In sum, on both the positive and negative sides of the ledger it was not until the end of the 1970s that the big gas option stood out as the most attractive course.

Regional boosters and institutional advocates did not have much success in pushing the leaders at that time, although it was not for lack of trying. As early as the 1960s, when the first north Tiumen' gas

²⁷*Pravda*, November 18, 1981.

²⁸*Pravda*, November 17, 1981.

fields had just been discovered, supporters of the gas option made extravagant claims about the output levels that could be gotten from the area. Indeed, the figures bandied about in the mid and late 1960s were no less large than the ones being heard now. In those days the most vocal enthusiast of north Tiumen' was Boris Shcherbina, then first secretary of the Tiumen' obkom and now the minister in charge of pipeline construction.

Recent Soviet Energy Policy

Interpreting the twists and turns of recent Soviet energy policy does not require invoking complex political causes such as a divided leadership or feuding bureaucracies or interregional rivalries. Such elements were undoubtedly present; but one can account for what happened equally convincingly by viewing it as the result of the leaders' attempts, however delayed and halting, to respond to the information they were getting from the field and from their experts. That information was often incomplete and misleading, and it frequently held surprises. Thus the top leaders may have been lulled by the relaxed view that the scientific and planning establishment took of Soviet energy prospects until 1976. Then they were jolted by the bad news from the coal industry, alarmed by the threat of a Siberian oil shortage—and then came the glad news of the oceans of gas to be found in north Tiumen'. It is perhaps not surprising that Soviet energy policy has been so changeable.

To complete the picture, one should add the probable effects on Soviet decisionmakers of the rapidly shifting international energy scene. In 1980 Soviet gas export prospects, viewed from the Kremlin, must have seemed excellent. Gas prices in Western Europe had trailed behind oil prices at about two-thirds the level of residual fuel-oil (gas's principal competitor) ever since 1973. West European gas demand had increased steadily as a result, and the West Europeans were beginning to worry about where their future supplies were going to come from. Soviet leaders did not foresee, any more than the West Europeans did, that starting in that same year, 1980, gas prices would start shooting upward while those of residual fuel-oil would start to fall, with the result that two years later the Soviets would end up with less than 20 bcm in new gas contracts instead of the 40 they had based their export plans on.

All of these considerations taken together could justify a crash energy program with gas as its leading edge at the time. But now that the gas program is well launched, oil and coal output are holding their own, and the slower-than-expected pace of Soviet economic growth is lessening the rate of increase of energy demand, will Soviet leaders

not respond once again to the logic of the situation? As far as Brezhnev was concerned (at least to judge from his words at the 26th Party Congress), the new energy priorities were intended to hold for at least the next ten years. But the enormous expense and difficulty of the gas campaign make one wonder whether there will not be another turn in Soviet energy policy before very long.

INVESTMENT DATA

The most important single measure of the real priority of the gas program is the amount of money the top leaders are willing to spend on it. Ambitious five-year spending plans, announced with fanfare at a Party Congress, may shrivel up when the time comes to translate them into annual budgets, as the full implications of the sums involved dawn on all concerned. High-level political battles over major budgetary shares must be fierce, if one is to judge by the vigorous and open lobbying that goes on at lower levels, which the Soviet press describes from time to time.²⁹ But we know almost nothing of them. Indeed, the more high-level controversy is going on behind the scenes the fewer numbers appear in print.

Such appears to be the case, at any rate, in the gas campaign. Two years into the 11th Five-Year Plan, there has been no direct official statement of what the gas sector will receive over the whole period, or even what it is getting year by year. However, the little one can glimpse leads to the suspicion that the gas campaign is receiving less than the five-year plan initially called for.

From 1965 to 1980 the investment budget of the gas industry grew very rapidly, from 4.05 billion rubles in the 8th Plan (1966-70) to around 21 billion in the 10th (for annual flows in the 1970s, see Table 2).³⁰ For the 11th Plan, there have been two indirect statements by top officials. At the 26th Party Congress, Orudzhev stated that the

²⁹A recent example is an article by a Party province secretary, who describes how he accompanies enterprise directors from his district to Moscow, to help them get needed supplies or easy output targets (Katushev, 1983).

³⁰The figures for the 8th and 9th Plans come from Margulov (1976), p. 17. For the 10th Plan, there are various figures. In 1980, the minister of the gas industry gave the figure 21.5 billion (Orudzhev, 1980, pp. 5-6). A total of 20.7 is possible if one proceeds as follows: Good figures for 1976-79 can be found in "Ekonomicheskaya effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaia informatsiia)*, No. 10, 1980, pp. 4-5. They give a total of 16.18 billion rubles for those four years. For 1980, Orudzhev, in the article cited above, gave a figure of 4.5 billion. Total (with rounding): 20.7 billion. In both cases, incidentally, the figures include pipeline investment and lump together the categories of "productive" and "nonproductive" investment.

Table 2
CAPITAL INVESTMENT IN THE GAS INDUSTRY, 1971-79
(Millions of rubles)

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	1382.1	1677.2	2036.1	2599.5	2700.9	3521.3	3575.4	4503.4	3912.4
Development	338.4	486.4	591.9	780.6	816.9	833.4	1014.8	1128.0	941.5
Treatment	36.2	55.5	97.4	109.0	103.4	155.8	139.8	160.8	101.1
Transmission	769.4	1088.7	1276.4	1540.0	1701.6	2446.8	2309.9	2623.0	2356.7

SOURCE: "Ekonomicheskaya effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti*, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaia informatsiia), No. 10, 1980.

gas industry would spend as much in the coming five-year plan as in the last three combined, which adds up to around 36 billion rubles. Six months later, after Orudzhev's death, the new gas minister V. Dinkov used the formula that gas investment in the 11th Plan would be double that of the 10th—around 42 billion rubles.³¹ For the 20-year period from 1966 to 1985, the trend is as shown in Table 3.

It is possible to derive a figure in the same range as that implied by Dinkov by another method, if we work from what we know of Soviet estimates for pipeline costs and of the share of pipeline investment in total gas investment. For the former, a frequently used Soviet rule of thumb is that the six 56-in. pipelines from Urengoy to the West will cost roughly 1 billion rubles per 1000 km.³² With a five-year target of

³¹For the first estimate, see Orudzhev's speech at the 26th Party Congress, reported in *Pravda*, March 2, 1981. V. Dinkov's formula comes from Dinkov (1981).

³²See, for example, Shcherbina (1982b, p. 6), minister of MNGS. The lowest figure I have seen is from *Pravda* correspondents Lisin and Parfenov (1982a), who use a range from 2.5 to 3.0 billion rubles per line. A second estimate, from early 1981, comes from the deputy director of the SOAN Institute for the Organization and Economics of Industrial Production, who projected 3 to 4 billion rubles per line (Granberg, 1981, p. 76). A somewhat higher figure comes from Lalaiants (1981) (deputy chairman of USSR Gosplan), who puts the cost at 3 to 5 billion rubles "and more." All these figures agree roughly with Shcherbina's rule of thumb, if one allows for the fact that the six pipelines have lengths ranging from 2500 to 4500 km.

Table 3

**TOTAL INVESTMENT IN THE SOVIET GAS INDUSTRY,
1966-85**
(Billions of current rubles)

8th Plan (1966-70)	4.05
9th Plan (1971-75)	10.90
10th Plan (1976-80)	20.7 to 21.5
11th Plan (1981-85) (projected)	
Orudzhev's formula	35.7 to 36.5
Dinkov's formula	41.4 to 43.0

21,000 km of 56-in. pipeline,³³ then, the gas industry must spend about 21 billion rubles, plus a certain additional amount for lesser pipelines, say, 8 billion rubles, for a total of 29 billion. As for the share of total investment that this pipeline figure represents, gas minister Dinkov states that pipelines in the current plan period account for 70 percent.³⁴ That implies a total investment for the gas industry of something over 40 billion rubles.

Authoritative sources also mention higher figures, particularly for pipeline investment, and this suggests that cost estimates for the gas campaign have been unsettled and may even now be surrounded by controversy. M. S. Zotov, chairman of USSR Bank for Construction,

³³Officials of MNGS have been consistently more bullish, using five-year figures of 23,000 and more. See Dertsakian (1982), p. 5. More recently, the head of MNGS has been advocating that a seventh major Siberian pipeline be built during the 11th Plan period (Shcherbina, 1982b, p. 7).

³⁴Dinkov (1982a), p. 2; and Dinkov (1982c), p. 19. A statement by TASS uses the figure two-thirds instead of 70 percent (FBIS/SU, January 13, 1982). This represents an increase over the last two five-year plans. During the 9th and 10th Plans, investment in gas transmission ran at about 63 percent of total investment in the gas sector, or 6.38 billion rubles in the 9th Plan and 9.74 billion in the first four years of the 10th. "Ekonomicheskaya effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaia informatsiia)*, No. 10, 1980, pp. 4-5.

states that for the six main lines from Urengoy the planners have allocated a total of 31 billion rubles,³⁵ or 1.5 billion rubles per 1000 km, 50 percent more than the estimates cited earlier. Similarly, *Pravda* gives the cost of the export line as 7.6 billion rubles, or about 1.7 billion rubles per 1000 km,³⁶ although the export line, because it uses imported compressors, is presumably somewhat more expensive than the others. The implication of both figures is that the gas campaign could require some 10 billion rubles more than the range implied by Dinkov—somewhere above 50 billion rubles.

One should bear in mind, incidentally, that these figures include only the *direct investment* costs of the gas campaign—that is, those actually charged to MGP and MNGS. A full reckoning would include indirect items such as capital investment in electrical power (the power ministry is supposed to invest 3 billion rubles in the West Siberian oil and gas complex during the 11th Plan)³⁷ or dock facilities. Consequently, the full gas bill, in all, is higher than the direct investments reconstructed here.

How have the five-year targets been translated into real annual outlays? On this point, unfortunately, the evidence is even more fragmentary. Table 4 is tentative, more suggestive of trends than of absolute levels. It is clear that, if these figures are at all close to the true trend, the actual five-year investment in the gas campaign will end up in the low to mid 30s instead of the higher figures projected above. What we cannot know at this point is whether the lag in funding is due to competition for scarce resources or inability of the gas program to absorb more. The official statistical handbook states that for 1981 "gas investment" (which in its definition excludes much of the transport investment) showed no growth from 1980 to 1981 (2.1 billion rubles in both years), while oil investment increased from 6.8 to 8.0 billion.³⁸

³⁵"Vazhnye zadachi finansirovaniia i kreditovaniia kapital'nogo stroitel'stva," *Finansy SSSR*, No. 4, 1982, p. 4.

³⁶"Urengoy-Uzhgorod: pervaiia tysiacha kilometrov," *Pravda*, October 4, 1982.

³⁷Lisin (1983); also Kuramin (1982a).

³⁸*Narodnoe khoziaistvo SSSR, 1922-1982*, Finansy i Statistika, 1982, p. 371. Just what the handbook's figures cover is a little mysterious. It is not quite the case that they exclude pipeline investment altogether; if that were true, then it would list 9.7 billion for gas investment from 1971-79 (which we know to be gas investment minus pipelines for that period, as per "Ekonomicheskaiia effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti* (obzornaia informatsiia), No. 10, 1980). Instead, it gives a figure of 15.44 billion. It is possible that its definition includes investment for pipeline hardware (pipe, compressors, etc.) but not the money spent on assembling them (so-called *stroitel'no-montazhnye raboty*, or SMR). Because several sources mention that SMR account for between 60 and 70 percent of total pipeline investment, such a definition produces a result in approximately the right range.

Table 4

SOVIET INVESTMENT IN GAS, 1979-83
(Billions of rubles)

Year	Amount
1979	3.9
1980	4.5
1981	5.3
1982	>6
1983	~7

NOTE: The figure for 1979 is the last of the series given in Table 2. The next two figures are plan figures, not actual. The one for 1980 comes from Orudzhev (1980). The 1981 estimate comes from "Zadachi rabotnikov gazovoi promyshlennosti na 1981 god i 11.uiu piatiletku," *Gazovaia promyshlennost'*, No. 4, 1981, pp. 2-7. The 1982 figure is inferred from the MNGS minister's year-end statements for 1981 and 1982, which give figures for MNGS construction and assembly work: The 1982 plan was for 4.4 billion rubles, of which 2.8 was to be gas; the actual figure for 1982 turned out to be 4.5. Assuming then that MNGS construction-and-assembly work for the gas industry was roughly 2.8 billion, one can work backward: In recent years, construction and assembly together have been running at about 60 percent of total pipeline cost, while pipeline cost has been about 70 percent of total gas investment. If most of MNGS's construction and assembly work has been concentrated on pipelines, these figures together produce a guesstimate for total gas investment somewhere in excess of 6 billion rubles. (Shcherbina's year-end statements, in *Stroitel'stvo truboprovodov*, Nos. 4 and 12, 1982.) Finally, the "draft plan" for 1983 provides for an increase of 14.3 percent in gas investment (Kolotilin, 1983).

These figures suggest two things: First, most of the incremental investment in gas is going to build pipelines, perhaps much more than the 67 to 70 percent range one commonly finds cited in the Soviet press; indeed, investment in other sectors of the gas industry may be declining in absolute terms. Second, in Tiumen' province itself the oil industry may be getting more priority, and the gas industry less, than one would have expected from the official speeches.

Such unexpectedly slow growth may be due to political competition for capital; but it is also possible that the gas industry is simply incapable of absorbing capital faster. In the 1970s, both MGP and MNGS suffered from chronic delays in project completion. The capital tied up in uncompleted gas projects more than tripled between 1971 and 1979, passing from about one billion rubles to about 3.6 billion, of which slightly more than half was pipelines.³⁹ In the last two years MNGS has improved its record where the six major pipelines are concerned—it has been bringing them on line ahead of schedule—but probably at the cost of allowing construction schedules to slip for most other projects. Separate figures for the gas industry are not yet available, but those published for the gas and oil industry combined show that capital tied up in incomplete projects (much of which is under MNGS jurisdiction) has continued to climb steadily, reaching 7.84 billion rubles in 1980 and 8.85 billion in 1981.⁴⁰

The investment figures for the gas campaign bear close watching as they unfold from year to year, because they are the single most important measure of the real priority of the gas campaign. If gas investment is falling short of the levels originally set in 1981, then pressures on the industry's managers grow also, forcing them to make mid-course corrections in their allocation of effort. The American embargo of 1981-82 undoubtedly added to those pressures, by forcing MNGS and MGP to concentrate their resources on the six major Siberian pipelines and the East-West export line in particular. If at the same time gas investment was short of what MGP and MNGS had expected, then one should expect to find signs of unbalance and strain in the lower-priority parts of the gas program. The trends sketched here are based on highly fragmentary data, and the tentative inferences drawn must await more detailed data before they can be confirmed or disproved.

POLITICAL STRAINS: THE ISSUE OF SIBERIA

The gas campaign is essentially a Siberian affair, and in that it is characteristic of trends in the entire Soviet energy sector. According to the targets for the 11th Five-Year Plan, West Siberia will account for 63 percent of Soviet oil production by 1985 (i.e., 399 million tons/

³⁹"*Ekonomicheskaya effektivnost' kapital'nykh vlozhenii v gazovoi promyshlennosti za 1971-79 gg.*," VNIIEgazprom, *Ekonomika gazovoi promyshlennosti*, seriia ekonomika, organizatsiia i upravlenie v gazovoi promyshlennosti (obzornaia informatsiia), No. 10, 1980, p. 10.

⁴⁰*Narodnoe khoziaistvo SSSR. 1922-1982, Finansy i Statistika*, 1982, p. 377.

year). In 1980 it was 52 percent. The same trend is under way in the coal industry, although there it has been delayed somewhat by problems in open-pit mining east of the Urals. But the eastward shift is the most striking for gas: 57 percent in 1985 (357 bcm) versus 36 percent in 1980 (156 bcm) will come from Siberia.⁴¹ More than half of the 44 billion ruble increment scheduled for the energy sector—which represents the bulk of the increment for Soviet industry as a whole—will go to West Siberia during the 11th Plan. B. Trofimov, head of the industry department of the Tiumen' obkom, reports that capital investment in oil and gas for Tiumen' province will be 55 billion rubles in the 11th Plan, twice the level of the previous plan.⁴²

Such a dramatic Siberian focus means a policy heavily skewed away from other claimants (notably the western regions of the USSR) at a time of unprecedented shortage of investment resources. It also aggravates the separation between energy production, which is shifting rapidly east of the Urals, and energy consumption, which is much slower to change and remains centered in the European zone of the USSR. This has two effects: first, a rapidly rising transportation burden, which makes necessary (at least for gas) twice as much investment in pipelines as in the rest of the gas industry—in short, still more Siberian investment. Second, because the preferential allocation of scarce capital to energy production in Siberia slows down the investment required for conservation, substitution, and relocation in the rest of the country, it perpetuates the inefficient pattern of consumption that makes the forced march across the Urals such an urgent priority in the first place. The result is a vicious circle.

Is the rapid rise of investment in Siberian energy causing political tensions? The gas and oil campaigns in Siberia do serve the common good. In addition, in 1980-81 it must have been obvious to all that there were no good alternatives to crash Siberian investment—provided, that is, that one accepted the leaders' view that a major energy crisis loomed. Finally, because Brezhnev personally designated the gas campaign the country's top domestic priority and the American embargo (which came a month after the final version of the five-year plan) made it a matter of national pride to execute the program on time, potential competing claimants were discouraged from voicing dissenting views.

But now that the embargo has been lifted and Brezhnev is dead, as the costs of the gas campaign continue to mount and evidence ac-

⁴¹*Ekonomicheskaya gazeta*, No. 5, 1982, p. 1.

⁴²Trofimov (1981), pp. 84-88. Not all estimates are quite so large, however, and the differences may stem from different implicit definitions. The head of the Gosplan Inter-agency Commission in Tiumen' uses the figure 40 billion rubles, which he too asserts to be twice the level of the previous five-year plan (Kuramin, 1982b).

cumulates that the gas campaign is producing more gas than can be either used or sold abroad, executives of nonenergy sectors and western regions of the country may find it politically feasible to raise a few questions.

In the months before the American embargo one could find occasional signs that not everyone in the Soviet Union was pleased by the pace and scale of the energy build-up or by the high priority being given to Siberia. In early 1981, for example, Academician A. Aganbegian, the influential director of the Institute for the Economics of Industrial Production of the Siberian Division of the Academy of Sciences, declared to a French correspondent,

In planning agencies, economic circles, and in the ministries, one often hears the following remark: it is necessary to develop Siberian resources, but circumspectly and only when all other options have been exhausted in other regions.⁴³

Similarly, the head of Gosplan's Tiumen' Commission spoke out sharply in an interview against equally invisible critics:⁴⁴

Kuramin: The voices of skeptics to the effect that Western Siberia is played out, and that consequently one should not spend so much money there, are unjustified by the facts.

Interviewer: By the way, about these skeptics: Here and there, especially among nonspecialists, one finds the opinion that ever faster rates of consumption of non-renewable resources (hydrocarbons, to which oil and gas belong) will have a harmful effect, after a certain time, on the country's economy. What is your opinion?

Kuramin: According to scientists' reckonings, energy reserves in our country are so large that if we don't use them on a growing scale we will resemble the miser who died of hunger while sitting on a cache of food.

Kuramin then goes on to call the unnamed skeptics "dilettantes." When one bears in mind that these non-specialists and dilettantes include (at least, to judge from their writings over the previous five years) some of the top figures in the Academy of Sciences and even some major Party figures, one is struck by Kuramin's vehemence.⁴⁵ To judge from their timing (spring and summer 1981), both Aganbegian's and Kuramin's remarks reflect the battles over resources that were

⁴³Quoted in Ferenczi (1981).

⁴⁴Kuramin (1981a).

⁴⁵For evidence on the variety of views expressed in writings with high-level bylines see Gustafson, "Soviet Energy Policy: From Big Coal to Big Gas," in Bialer and Gustafson (1982), pp. 121-139; and Gustafson (1983).

presumably taking place behind the scenes as the preliminary targets of the five-year plan, announced the previous fall, were hammered into final form for official adoption in November 1981.

Now, however, the issue may be surfacing again. Although the first major *Pravda* editorial on energy policy after Brezhnev's death reaffirmed the high priority of the energy sector as a whole, it gave top billing to electricity, oil, and coal (in that order), but made no special mention of gas.⁴⁶ The gas minister's year-end report, published in early 1983, was defensive in tone and stressed more than ever the need to control the costs of the gas campaign.⁴⁷ These are not necessarily signs of interregional strains, however, because the beneficiary of any loss of favor to gas might be oil.

To be Siberian, incidentally, is not necessarily to love gas or oil. The growth of those industries in the last 15 years has caused dramatic shifts of investment priorities within Siberia, not only toward West Siberia (thus reversing the trend of the 1960s, when investment in eastern Siberia grew at a faster rate),⁴⁸ but also within West Siberia toward Tiumen' province, whose share in Siberian investment rose from 23 percent in the second half of the 1960s to over 50 percent in the second half of the 1970s.⁴⁹ By now Tiumen's share must be higher still, because the 11th Plan allocates almost all of the increase in total investment for West Siberia to the oil and gas industries in Tiumen' province.⁵⁰ When one bears in mind that the overall share of Siberia in total Soviet investment has not increased much over the years—from 10.9 percent in the second half of the 1960s to 12 percent in the second half of the 1970s⁵¹—it is clear that the rapid growth of Tiumen' oil and gas has meant holding back the development of other industries. This has led to calls for a change of policy, toward more balanced development of Siberia, beginning with more investment in industries that will use Siberian energy on location.

There is also a certain rivalry between the oil and gas industries in Tiumen' province itself. The result is a certain drag on the smooth transfer of resources, which is perhaps due less to intentional subversion than to the fact that normal human and bureaucratic inertia causes people to gravitate (if left to their own devices) toward the somewhat more hospitable south of the province (where the oil is) instead of the uninviting north. Moreover, until recently the oil industry had been the main business of Tiumen' province, and gas ran a

⁴⁶"Toplivno-energeticheskii kompleks," *Pravda*, January 26, 1983.

⁴⁷Dinkov (1983), pp. 2-6.

⁴⁸Orlov (1982), p. 65.

⁴⁹Ageeva and Orlov (1982), p. 85.

⁵⁰Orlov (1982), p. 65.

⁵¹Orlov (1982), pp. 64 and 68.

poor second. There have been accounts in the Soviet press suggesting that there is still a tendency for the oil industry to get preference in Tiumen' province. *Pravda's* economic correspondent for West Siberian oil and gas reported in June 1981 that the entire increment in the work plans of the construction organizations belonging to MNGS's main agency in Tiumen' province Glavtiumenneftegazstroi was going to the oil industry.⁵²

It is necessary, of course, to develop the base for oil extraction; there can be no two opinions about that. But who will fulfill the development program for the gas industry? Builders are reluctant to go to the far north, where the gas has been discovered. Moreover, there are already well-established relations with the oil industry, and the transportation network in the Middle Ob' area (i.e., the oil region of Tiumen' province) is a lot easier than in the north of the province. But in the interests of the cause it is essential to shift the construction workers to the new tasks.

Gas officials (and even local Party apparatus workers) complain that oil regions in Tiumen' province have been systematically favored in road construction, housing, and project infrastructure. Thus the Ministry of Transportation Construction (Mintransstroï) built "several thousands of kilometers" of hardtop roads in Tiumen' province during the 10th Plan,⁵³ but only 150 km in the gas region,⁵⁴ and only 10 of that at Urengoy, the largest single field.⁵⁵ Clearly the prospects of the gas industry in the 1980s depend not only on its *de facto* priority in the allocation of resources in Moscow, but also on the extent to which that priority is enforced at the local level. Recently the local authorities in Tiumen' have taken steps to lessen this competition. For example, the agencies previously in charge of both oil and gas development and drilling have been split in two, so that the gas operations are now independent of the oil.

Even within the Ministry of Gas, not every department can be equally pleased with the current stress on Tiumen'. A striking feature of the investment data from the 1970s is that beginning in 1976 the share of investment going to maintain output in older fields began growing faster than investment in new fields. On the face of it, such a pattern seems to violate common sense, because the flow rate of new wells in Siberia is exceptionally high and, other things being equal, a ruble invested in expanding new output there will yield much more than a ruble invested in maintaining output in a declining province.

⁵²Lisin (1981a).

⁵³Trofimov (1981), p. 84.

⁵⁴Dinkov (1981).

⁵⁵Topchev (1981), p. 14.

Although that policy has been sharply reversed in the current five-year plan, it reminds us that there are interregional strains inside ministries as well as across them.

The signs of conflict should not be construed to mean that the ranks are drawn up, with Siberian or Tiumen' "patriots" on one side and their competitors on the other. That there are winners and losers in the budgetary competition is clear enough. But the result is a multitude of cross-cutting cleavages that do not necessarily add up to a single big one with political consequences. In bureaucratic wars for scarce resources, Siberians may tug against non-Siberians, but there are many other tugs going on as well: oil versus gas, West Siberia versus East, Tiumen' versus Tomsk and Kemerovo. In short, one should beware of ascribing too much significance to the signs of interregional tension, as a driving force in policymaking or even as a factor that the top leaders need take into account. The signs bear watching, and for the moment that is the most one can conclude from them.

AN EXAMPLE OF STRUGGLE OVER PRIORITIES: THE POSTPONEMENT OF YAMBURG

Following is a mini-case study of a dispute over priorities and timing that has divided Party and industry officials for several years. The issue is, should one concentrate one's resources on Urengoy (which now seems like the safe course but did not always seem so), or press on right away to the more northerly fields, Yamburg and Kharasavei? Behind this seemingly narrow question are larger ones involving the relations of local officials to ministry leaders in Moscow and the question of how decisionmakers weigh the future against the present.

The initial sequence of gas development envisioned by ministry planners in the late 1970s called for more or less simultaneous development of Urengoy and the more northerly fields of the Yamal Peninsula, beginning with Yamburg. In negotiations with the West Europeans over a new East-West pipeline, it was initially understood that the gas would be drawn from Yamburg, and the project was commonly referred to in the Western press as the "Yamal" pipeline, a reference to the Peninsula where Yamburg is located. In the fall of 1980, Soviet press articles spoke of reaching an output level of 100 bcm a year from Yamburg by 1985.⁵⁶

⁵⁶"Gazovyi kompleks," *Sotsialisticheskaia industriia*, September 19, 1980.

However, during the course of 1980 Yamburg gradually faded from the front page, while development targets for Urengoy grew steadily. By some point in early 1981, Yamburg had clearly been postponed, and for a time there appeared to be a debate in Soviet circles over whether to give Yamburg much attention at all during the first half of the 1980s, or simply to push back the whole business until the latter half of the decade. In the final version of the 11th Plan, all six of the trunk lines scheduled for construction originate at Urengoy, including the one intended for the West European market.⁵⁷

The debate over development strategy in north Tiumen' actually goes back a number of years. According to the Tiumen' obkom secretary for industry, E. G. Altunin, as early as 1978, local Party officials wanted to develop Urengoy and the southern fields first and then turn to Yamburg only in the 12th Plan.⁵⁸ Altunin's main reason, which turns out to have been a winning argument, was that there was too little infrastructure in the north. Altunin's proposals projected that the entire southern tier of fields would be producing at a steady-state level of only 300 bcm until 1990, whereas under current plans output may reach twice that amount. In 1979, when Altunin's article was published, commercial production from Urengoy had been under way for no more than six months and there was still a lot of disagreement over its size.

On the other side was the gas ministry, which (according to Altunin) argued that many of the southern fields were too small, so that it was essential to move on to Yamburg as soon as possible. There were two basic reasons for the gas ministry's position, according to Altunin: The gas ministry wanted to preserve Urengoy's reserves for later needs (in 1978, the official emphasis was on saving gas wherever possible, because the accepted view then was that Soviet gas was in danger of running out), and second, Yamburg was destined for export to the West. (Altunin's reaction to that was to snort, "What? Does it have a different smell?") The Ministry's plan, still according to Altunin, was to extract 35 bcm a year by 1985 from Kharasavei, a field located near the coast of the northern end of the Yamal Peninsula, a plan that would have involved liquefying the gas and exporting it by sea. Altunin argued that each increment of 35 bcm from north Yamal would cost 1.5 billion rubles more than the equivalent volume taken from Urengoy. This may have been a lingering echo of the abortive North Star project, discussed with the United States in the early 1970s and then abandoned.

⁵⁷Strictly speaking, however, it is still correct to refer to these as "Yamal" pipelines, because geographically Urengoy is also part of the Yamal area. Indeed, the entire gas-producing region of north Tiumen' lies in the administrative entity known as the "Iamalo-Nenetskii okrug."

⁵⁸Altunin (1979), pp. 17-18.

Around 1980, economic and climatic studies demonstrated that there were dramatic cost differences between Yamburg and Urengoy. In fact, one could draw an imaginary line from west to east placing Yamburg and Urengoy in two separate zones. South of the line, for example, 2-10 percent of all working days would be lost because of weather conditions that would force work to be stopped (officially defined as a combination of -40°C and a wind speed of 15 meters per second); north of the line, more than 10 percent of all workdays would be lost. This confirmed the position of those who held that the costs of development at Yamburg would run far higher than at Urengoy. Although pipeline construction costs in the area around Urengoy would run 24 to 30 percent more than the norm for the rest of the country, in the more northerly zone including Yamburg and the Yamal Peninsula, the cost differential would range from 31 to 39 percent.⁵⁹ According to the new gas minister, V. A. Dinkov, this information weighed heavily in the gas ministry's decision to focus on Urengoy alone.⁶⁰

What probably also tipped the scales in favor of Urengoy is that the Soviet estimates of proven gas reserves in northern Tiumen', and Urengoy in particular, were growing larger and larger. The latest detailed reserve figures show the latter's dominance; compared with earlier Soviet estimates, the expected size of Yamburg has actually been cut somewhat. These are shown in Table 5.

As the reserve figures grew, so did the 1985 target figures for Urengoy. Soviet planners had not always been so optimistic. From the first discovery of gas at Urengoy in 1966 to the beginning of construction of the first commercial well in 1974, there were steady arguments over its size and area.⁶¹ The drive to develop Urengoy received official approval only around the beginning of 1977 and commercial production began in the spring of 1978.⁶² As recently as May 1980, *Pravda* reported that Urengoy would "eventually" reach a cruising output rate of 180 bcm a year.⁶³ But by September 1980 the "eventual" target reached 200 to 250 bcm,⁶⁴ and over the winter it was rapidly overtaken by the targets for 1985. Those reached 250 by March 1981,⁶⁵ 270 by April 1981,⁶⁶ and by October 1981 one could find unofficial statements that implied as much as 275 bcm.⁶⁷

⁵⁹Epishev (1979).

⁶⁰Dinkov (1981).

⁶¹Gramolin (1981).

⁶²Kostylev and Noskov (1980).

⁶³Lisin and Parfenov (1982a).

⁶⁴"Gazovyi kompleks," *Sotsialisticheskaiia industriia*, September 19, 1980.

⁶⁵Orlov (1982).

⁶⁶This was the figure used by Baranovskii (1981), who in all such figures was echoing Orudzhev (1980).

⁶⁷Lisin (1981a).

Table 5

RECENT SOVIET GAS RESERVE FIGURES

Area	May 1981	January 1983
Urengoy	6.2 Tcm	6 Tcm
Yamburg	5.0	4.4
Bovanenko	3.3	1
Medvezh'e	1.6	1.55
Zapol'iarnoe	1.9	2.67
Kharasavei		1

SOURCE: *Oil and Gas Journal*, January 10, 1983, pp. 38-39. Earlier estimates from Baranovskii (1981).

The reason for the rising tide of optimism was not only the revised reserve figures, but also the information coming in about Urengoy's growing real output. In 1980 Urengoy produced 50 bcm, but by the spring of 1981 the field was showing rapid growth. Not all Soviet sources, incidentally, were quite so bullish on Urengoy. The head of gas development operations at Urengoy, I. S. Nikonenko, as recently as May 1981 estimated that Urengoy would reach 250 bcm only by 1990, and did not predict annual increments greater than 25 bcm,⁶⁸ whereas only the month before *Ekonomicheskaja gazeta* had published targets that implied annual increments from Urengoy of 40 bcm.⁶⁹ Nevertheless, these were only minor off-notes in the chorus of optimism.

How exactly was MGP led to drop its earlier preference for the northerly fields? Was it the logic of the numbers, or was it pressure from above? As usual, there are only hints. In February 1981, when Brezhnev announced his gas program he mentioned only Urengoy, not Yamburg. Yet it was not until August 1981 that MGP announced officially that Yamburg would take second place to Urengoy.⁷⁰ In the interim there was a change of leadership in MGP. S. A. Orudzhev died

⁶⁸Gramolin (1981). For a profile of Nikonenko, see Lisin (1982b).

⁶⁹Orlov (1982).

⁷⁰Dinkov (1981).

in April 1981 and was replaced, after some hesitation, by the more junior of the two first deputy ministers, V. A. Dinkov. Orudzhev's death may have somehow cleared the way for MGP to adjust its priorities.

Has Yamburg now been postponed altogether, at least until the next five-year plan? At first, it seemed so. Yamburg was knocked out of the 1981 plans of both MGP and MNGS, and even though 3.5 billion rubles were reportedly provided for Yamburg in the 11th Plan, Gosplan showed no great desire to get off to a fast start either.⁷¹ Other ministries showed even less enthusiasm. The Ministry of Transportation Construction (Mintransstroï), Tiumen' officials said, failed to take the preparatory steps to build docking facilities to serve Yamburg,⁷² and although the gas minister called upon Mintransstroï to deliver in 1982,⁷³ the fate of the docking facilities then ran into further bureaucratic difficulty, when local river fleet officials refused to approve the designs for the docks.⁷⁴ Some Tiumen' officials favored extending a railroad line directly from Urengoy to Yamburg, but that approach was apparently rejected too.⁷⁵

Behind the bureaucratic delays the debate over strategy and timing goes on. Recalling Altunin's opposition four years before to a premature move to the northern fields, a *Sovietskaia Rossiia* correspondent in early 1982 lined up a string of cautions from technologists, emphasizing the risk of basing so much of the country's gas output on Urengoy alone. He concluded, "If we're going to crack the Yamburg nut, we have to at least put it in our mouths."⁷⁶

Where then does Yamburg stand now? In 1982, the gas ministry's plans still called for commercial output to begin at Yamburg by 1984, to reach a level of 36 bcm by 1986, and the first three exploratory wells were to be begun in 1982.⁷⁷ Maps in 1982 showed that Minneftegazstroï still intended to build one and perhaps two 56-in. lines from Yamburg southward⁷⁸ during the 11th Plan, to connect up with the network leading out of Urengoy. In 1981 the gas ministry designated the gas city of Nadym (previously the development center for the Medvezh'e field) as the jump-off spot for Yamburg.⁷⁹ In

⁷¹Ognev (1982).

⁷²Lisin (1981a).

⁷³Dinkov (1982b), p. 3.

⁷⁴Ognev (1982).

⁷⁵Topchev (1981).

⁷⁶Ognev (1982). It is highly unusual to criticize a Party official directly, and Ognev does not. He refers to Altunin only as the man who four years ago was director of Tiumengazprom.

⁷⁷Ognev (1982).

⁷⁸Dertsakian (1982).

⁷⁹Strizhev (1982a).

January 1982 the first work party left Nadym for Yamburg to begin preparing access to Yamburg for river shipping, an indispensable first step for bringing in supplies for development. By the end of 1982, a drilling party at Yamburg was preparing to sink the first development well. But the development schedule has slipped further since then, and major output will begin only in 1986.⁸⁰ The main obstacle now may be a lack of connecting pipelines.

The decision to postpone Yamburg in the spring of 1981 appears in retrospect to have been a rational response to the technical difficulties of developing Yamburg, in contrast to the rapidly growing perceived potential of Urengoy. What is puzzling is not the postponement, but the fact that the gas ministry for so long maintained a bias in favor of developing the Yamal Peninsula ahead of the more southerly fields. But the further delay since then may be evidence of bureaucratic distortions, as ministry officials try to postpone whatever is not directly tied to the pressing tasks of the 11th Plan.

⁸⁰*World Gas Report*, December 6, 1982, p. 6.

IV. ORGANIZATIONAL AND INFRASTRUCTURAL ISSUES OF IMPLEMENTATION

Soviet accounts of conditions in the north Tiumen' fields often strike the Western reader as barely controlled chaos: shortages of manpower, housing, and roads; supply bottlenecks of every description; and lags and failures in essential services. Could such constraints, which have been less publicized in the Western press than the more glamorous technological issues such as pipeline compressors, slow down the rate of Soviet gas development? They have in the past. Until the mid-1970s such bottlenecks made the Soviet gas industry an undependable performer that missed the annual plan just about as often as it met it.¹ But since then the north Tiumen' region has come in consistently ahead of the official targets, and in the first two years of the current five-year plan, despite the greatly increased demands placed on it, it has continued to do so. Can the Soviet gas industry continue to manage these greatly heightened demands? If it is not successful, what will be the resulting costs and distortions in the gas program?

These problems have generated constant controversy among the players, pitting local interests in north Tiumen' (including the local Party apparatus) against those of ministry headquarters and central planners in Moscow, and MGP and MNGS against the other major ministries involved in the gas campaign. Four issues stand out in the Soviet press: (1) How to deal with shortages of manpower and high labor turnover? (2) How much to invest in permanent infrastructural development rather than temporary? (3) How to provide power and energy for gas development and transmission? and (4) How to provide access for supplies and personnel to a remote, hostile region?

These are not, by and large, sophisticated technological problems. Rather, the choices and tasks involved here are aimed at concentrating resources around a few fairly simple operations. In this respect the gas campaign must solve the same problems as the rest of Soviet management—that is, to offset the rigidity and compartmentalization of the vertically stratified Soviet system by somehow creating enough

¹Russell (1976), Tables 4 and 5, p. 63; updated in Stern (1980), pp. 26-27. The story is brought up to date by Hewett, in Becker (1983), p. 11 (chart 3), which is reproduced here as Fig. 5.

horizontal coordination to make sure that resources come together in the right order and at the right time.

But what is special about the north Tiumen' operation is both the scale of the effort and the difficulty of the region. To reach the remote, uninhabited wilderness of north Tiumen', supplies must be threaded through narrow lifelines that are open only part of the year; manpower must be used to maximum effect before it turns over and departs the region; and elementary infrastructure must be built in a region that until recently had none.

MANPOWER

The Soviet press worries more about manpower than about any other aspect of the gas campaign. Not only is labor short in the country as a whole, but it is especially so in Siberia; and thus manpower problems in north Tiumen' must be seen in the context of a persistent policy problem to which Soviet leaders have so far found no solution.² The Urengoy region, in particular, was uninhabited as recently as 1978, so all the people working there today have had to be drawn from elsewhere. But from where, and how? The gas industry must not only obtain workers in sufficient numbers and with the necessary skills, but once they have arrived, it must somehow induce them to stay and work efficiently.

First, how many people are working on the gas campaign? The following fragmentary data (Table 6) give a rough idea. In Siberia, where the gas industry faces its toughest challenge, the figures for the "urban" population of north Tiumen' can serve as a rough surrogate for the population directly or indirectly employed in the gas campaign. At the beginning of 1982 the Yamalo-Nenetsk autonomous district, which encompasses most of the north Tiumen' gas region, listed an "urban" population of 175,000, some 90,000 more than four years before.³ Assuming that the population continued to grow at the same rate throughout 1982 and that most of the increase is due to the gas campaign, in the last five years the managers of the gas campaign have probably had to house, transport, feed, entertain, and employ a new population of about 125,000 people.⁴

²For a sample of Soviet worry about manpower in Siberia, see an article with the byline of the chairman of the Russian Federation State Committee on Labor, Sozykin (1980).

³*Narodnoe Khoziaistvo, 1922-1982*, p. 17. The district includes the town of Salekhard, which is a major transportation node for the gas campaign.

⁴Not all those working on Siberia gas, of course, are the direct responsibility of MGP and MNGS. For example, there are some 60,000 geologists in West Siberia, employed by the Ministry of Geology ("Zapadnaia Sibir': nadolgo li khvatit resursov?" *Sotsialisti-*

Table 6

**MANPOWER ASSOCIATED WITH MAJOR PARTS OF THE GAS
CAMPAIGN, AS OF LATE 1982**

Gas operations in Tiumen' province	50,000
Export pipeline	
Pipelaying operations	20,000
Compressor stations	20,000
Novyi Urengoy, total population	60,000 approx.
Yamal-Nenetsk region, total "urban" population	210,000 approx.

NOTE: The first figure is the total employment of Tiumengazprom, as given by its director, Topchev (1982). The second figure, for the export pipeline, is frequently used by the minister of MNGS, Shcherbina (1982b, pp. 5-10). The figure for Novyi Urengoy is an inference from frequent partial references in the Soviet press, and the population estimate for the Yamal-Nenetsk region is an extrapolation from growth trends given annually in *Narodnoe khoziaistvo SSSR*.

One of the gas industry's most serious concerns is the lopsided growth of the main urban base for Urengoy, a mushroom town called Novyi Urengoy. It had a population of 1,000 in early 1976, 18,000 by January 1980,⁵ and then doubled between the beginning of 1981 and mid-1982.⁶ Novyi Urengoy has grown so fast that by the end of 1983 it may pass the 70,000 mark it was planned to reach by the end of 1985.⁷

cheskaia industriia, April 16, 1982), and 25,000 people work for the electrical-power sector in Tiumen' province (Lisin, 1983). Many of these are presumably involved in gas development.

⁵Kostylev and Noskov (1980). This is still much less than the counterpart base city for the oil field of Samotlor, Nizhnevartovsk, which at the beginning of 1982 had 151,000 inhabitants, a respectable gain of 17,000 over the previous year (*Narodnoe Khoziaistvo*, 1922-1982, p. 24).

⁶Romaniuk (1982).

⁷Kostylev and Noskov (1980).

Although some planners foresee an eventual population of 240,000 for Novyi Urengoy,⁸ at the moment they are unable to keep up with its growth.

Some of the expansion at Urengoy has apparently been achieved by wholesale transfers of manpower (or at least of the *flow* of manpower—not necessarily the same bodies) from nearby Medvezh'e field and its principal base, Nadym, as well as other smaller fields such as Vyn-gapur. But from the rapid net growth in the population of north Tiumen' many of the new workers are clearly recent arrivals from outside.

Labor turnover has been a serious problem. The average worker in the oil- and gas-producing areas of Siberia is young, as one might imagine; in Surgut and Novyi Urengoy, the average inhabitant is 26 to 27 years old, male, and single.⁹ Most of the new workers come to Siberia without much specialized technical training.¹⁰ Overall turnover in Tiumen' province is 50 percent annually,¹¹ but that figure includes the oil industry as well as gas, and the turnover rate for the latter is apparently higher. In 1979, turnover at Novyi Urengoy was one-third in the first six months and individual instances are mentioned of field organizations that have lost nearly two-thirds of their original complement in a period of nine months.¹² Along the pipeline corridors, advance teams building access roads and trenches ahead of the pipelayers "until recently" lost half of their complement each year.¹³ This is a turnover rate far higher than the 27 percent reported for MNGS as a whole for 1981.¹⁴

However, it is not clear that manpower shortages, whether of numbers or of quality, have held back the progress of the gas campaign so far. Their net effect is more likely a distortion of priorities or an increase in overall cost. Manpower problems probably most severely affect the lower priority auxiliary, infrastructural operations that tend to be less glamorous, less closely monitored, and less mechanized than the high priority "main line" tasks such as pipelaying. The prime example is housing. Another is roads. In the 11th Plan the road-build-

⁸Kozlov (first secretary of the Novyi Urengoy gorkom CPSU) (1981).

⁹"Ratsional'noe ispol'zovanie material'nykh i trudovoykh resursov na stroitel'stve magistral'nykh nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 57.

¹⁰Ibid.; 80 percent have no "spetsial'nost'," a term that implies higher or technical secondary education.

¹¹Ibid., p. 57. Just which workers this refers to is not clear: All workers in Tiumen' province, or just the oil and gas industry? Nor is it clear how the concept of "turnover" is defined; presumably it is the ratio of annual "quits" to the total employed.

¹²Kostylev and Noskov (1980).

¹³Lisin and Parfenov (1982a).

¹⁴Shcherbina (1982c).

ing crews in the area are supposed to triple their volume of operations but without any increase in personnel or other resources.¹⁵

To prevent manpower shortages from becoming a bottleneck in the gas campaign, every available source of manpower is being tapped: the Komsomol, the Student Construction Brigades,¹⁶ workers from Yugoslavia and various Comecon countries such as East Germany, which is contributing 10,000 workers to help build the export pipeline,¹⁷ and possibly (although the Soviets vigorously deny it) convict labor as well. In addition, MNGS has stepped up its recruitment of regular employees, hiring 18,000 new people in 1982.¹⁸ As a result of all these efforts, an MNGS spokesman describes the export pipeline project as "overgrown" with manpower.¹⁹

To attract workers and keep their morale high one obvious response is to raise wages and benefits. These have been rising since the mid-1970s, more rapidly in the gas industry than in the oil industry. In 1981 the average monthly salary in Minneftegazstroi (which handles both oil and gas industry construction) was over 230 rubles a month,²⁰ with pipeline workers in Siberia presumably making considerably more than that. Nevertheless, there are occasional observations in the Soviet press that the structure of the wage system is defective, leading to counterproductive stimuli and unattractive earnings. An article on the life of construction crews on the Urengoy-Cheliabinsk pipeline in late 1980, for example, suggests that the workers there felt they were not making much more money than they might in skilled industrial jobs back in the European part of the USSR.²¹ The bonus system is said to encourage turnover. If a worker decides to extend his contract in the same location, he gets a bonus of a half-month's wages; but if he moves to another city he gets a bonus of two months' wages plus another half-month for his family.²² In addition, there is veiled criticism of inequitable differences in wage scales for the same work from one organization to another, which further contributes to labor

¹⁵Lisin (1981a).

¹⁶The Komsomol "each year" sends 15,000 volunteers to work in the West Siberian oil and gas fields, and the SSO (*Studencheskie stroitel'nye otriady*) 28,000. In 1982 the Komsomol was supposed to send an additional 8,000 to work on the pipelines and the SSO 12,000 (statement by Komsomol official Karniushin (1982)).

¹⁷Kalashnikov (1983). The East Germans will be responsible for 500 km of the line and 7 compressor stations. The source does not mention whether the compressors are of East German manufacture or how much gas East Germany will receive in return.

¹⁸Shcherbina (1982a), p. 2.

¹⁹Veselkov (1982), p. 3.

²⁰Matusiak (chief of the directorate for personnel and accommodations, Minneftegazstroi) (1982).

²¹Rodionov (1980), pp. 29-36.

²²Lisin and Parfenov (1982a). This may be intended to encourage workers to transfer to newer sites, for example from Nadym to Novyi Urengoy, but it is clear that the correspondent writing the article did not regard this arrangement as a good one.

turnover,²³ and may reflect attempts by some organizations to outbid the others for scarce labor.

However, the matter of wages in Siberia gets little attention in the Soviet press, which suggests that other aspects of the labor question are considered more important. In view of the rugged conditions in north Tiumen', the main problem is not wages but the lack of things to spend them on. Raising wages would only encourage black marketeering and worsen labor turnover, as workers save up their money for their return to the Mainland. Instead, Soviet policymakers appear divided between two broad solutions: either to improve local housing and amenities, which will help attract a permanent population, or to fly in a temporary labor force instead.

HOUSING AND BASIC SERVICES

The housing shortage in north Tiumen' is the single most serious constraint on the ability of the gas industry to attract more qualified labor. Housing and services, like manpower, are not new problems in Siberia. The "business end" of a big Siberian project has always come first, and housing and services have always brought up the rear. But housing has become especially controversial in the gas campaign. A running debate has been going on between local officials (including the local Party apparatus), who want to make a commitment to build permanent cities in the gas regions, and the central authorities in Moscow, who are reluctant.

At the center of the housing problem in the 11th Plan is Novyi Urengoy. It is short of everything: schools, child-care facilities, shops, telephones, and roads. The town until mid-1980 did not have the official administrative status of an urban center.²⁴ The first brick apartment buildings only started going up in 1980, built with imported brick that reportedly cost one ruble apiece. Until then, those who were lucky lived in rough-hewn wooden houses, and the rest slept in bunk houses at their work places. In the field, MGP and MNGS have been using mobile dormitories, small wagons on wheels. According to local officials, the designs of these accommodations are inadequate for keeping out the cold.²⁵

²³"Ratsional'noe ispol'zovanie material'nykh i trudovoykh resursov na stroitel'stve magistral'nykh nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 58.

²⁴Gramolin (1981).

²⁵Accounts of these conditions are legion in the Soviet press. Almost any of the sources cited above contains examples.

In the 11th Plan, expansion of housing at Novyi Urengoy has had top priority, because it is the major support center for the field that will supply 40 percent of Soviet gas by 1985. Out of 1.32 million m² of new housing space planned for the gas industry in West Siberia during the 11th Plan, over one million is to be located at Novyi Urengoy.²⁶ That, at least, is the five-year target; but the performance year by year suggests that by 1985 the city will come up substantially short (see Table 7). Housing growth for Novyi Urengoy evidently fell considerably below plan in 1981, because the target for that year had been 205,000 m².²⁷ For 1982 the plan was cut back to a more modest 150,000 m² and then again to 142,000.²⁸ Information is not yet available on whether it was met.

Until the present five-year plan the gas ministry had not been in the housing construction business directly; that is supposed to be the

Table 7

ANNUAL CONSTRUCTION RATES OF NEW
HOUSING AT NOVYI URENGOI

Year	Square Meters of New Housing
1979	13,000
1980	68,000
1981	106,000
1982 (plan)	142,000

SOURCE: Romaniuk (1982).

²⁶Statement by Tiumen' obkom secretary E. Altunin, in *Gazovaia promyshlennost'*, No. 12, 1982, p. 27. That figure means housing for the gas industry proper—that is, the Tiumentgazprom industrial association. Housing goals for MGP and MNGS gas operations in Tiumen' province are substantially larger; for example, the two ministries together had a new housing plan of 348,000 m² for 1982.

²⁷Lisin (1981b).

²⁸Dinkov (1982a), p. 2. MNGS had evidently hoped to do better: In mid-1982 deputy minister Iu. P. Batalin, who is evidently in charge of MNGS's gas operations, stated that his construction crews had undertaken a "socialist obligation" (*sotsob"iazatel'stvo*) to build 300,000 m² of new housing space at Novyi Urengoy in 1982. An "obligation," however, does not have the same force as a plan target. Cf. *Gazovaia promyshlennost': itogi i perspektivy*, *Planovoe khoziaistvo*, No. 6, 1982, p. 22.

job of the construction ministries. But as the pace of Siberian gas development picked up in the late 1970s, MGP began to complain that it was being let down. From 1978 through 1980, according to the gas minister, housing contractors (*podriadnye stroitel'nye organizatsii*) were supposed to complete 300,000 m² of residential space in Siberian gas areas; instead they finished 180,000.²⁹ During the period 1981 through 1983, they are supposed to complete more than two-and-a-half times as much housing space, as well as schools and child-care facilities,³⁰ but the figures cited earlier suggest that the same pattern persists.

Who are these contractors? For the gas industry, the principal one is MNGS. Gas officials in mid-1981 denounced that ministry's failures: In the first half of 1981, out of 195,000 m² of planned new housing space, Minneftegazstroï delivered only 68,000.³¹ The press reports MNGS has been building housing for its own work crews but not for the substantial numbers of MGP personnel who will subsequently operate and maintain the compressors and the lines.³²

In addition to the usual bureaucratic distortions, there appear to be underlying policy differences at work. Take for example a news item that in the first two years of the current five-year plan 4 million m² of new housing have been completed in 'Tiumen' province.³³ The gas industry has clearly been getting only a small fraction of that total. The same conclusion emerges when MNGS minister Boris Shcherbina states that his ministry built a total of 750,000 m² of housing space in West Siberia in 1980 and 935,000 m² in 1981.³⁴ If one compares these figures with those cited by the gas industry earlier, the gas industry is apparently getting only about a third of Minneftegazstroï's attention in the housing department. And although the bias is gradually being reversed (MNGS-built housing increased 50 percent for the oil industry in 1981 but 70 percent for the gas ministry), at present rates it will take a long time for the gas industry to catch up. Indeed, although figures for 1982 are not yet available, they are likely to show an absolute decline in new MNGS housing from the 1981 level,³⁵

²⁹Dinkov (1981).

³⁰Ibid.

³¹Statement by Gud'z' (late deputy minister of gas) (1981), p. 53.

³²"Gas Pipeline under Construction," *Sovietskaia kul'tura*, September 21, 1982; translated in Joint Publications Research Service, *USSR Report: Energy*, No. 132, January 11, 1983, p. 82.

³³Zhdanov (1983).

³⁴Shcherbina (1982d), p. 3.

³⁵In the first ten months of 1982, according to Shcherbina (1982d, p. 5), MNGS built a total of 990,000 m² nationwide. The equivalent figure for all of 1981 was 1,713,000 m² (Shcherbina, 1982d, p. 5).

probably a reflection of MNGS's need to concentrate its resources on the main pipelines.

The classic response of a ministry faced with MGP's problem is to develop its own housing industry, and since the early 1970s the gas ministry has been doing just that. In North Tiumen', construction outfits belonging directly to Tiumengazprom built 24,000 m² of housing in 1980, 36,000 m² in 1981, and were assigned 60,000 m² in 1982.³⁶ This is an expensive solution, however. The 1981 space cost 100 million rubles to build, and the 1982 space will cost another 136 million.³⁷ If those figures are at all representative of housing costs for Novyi Urengoy as a whole, then the 1,000,000 m² of space to be built during the 11th Plan could run between 2,000 and 3,000 rubles per m² for a total of 2 to 3 billion for housing alone. These figures give some idea of the drain the housing program represents and why it is both perennially neglected and politically controversial.

The local Party authorities attempt to close the gap somewhat with "non-plan" projects at the local level. The latter strategy cannot go far, however, because the major construction ministries oppose the growth of such local competition.³⁸ Another device used at Novyi Urengoy has been to mobilize construction organizations from other republics and cities, which has the bonus of providing propaganda. The Ukraine has contributed a housing construction train, a nice Civil War touch, and other regions have also sent building crews.³⁹

Yet the obstacles remain formidable. Nearly all construction materials (with the exception of wood) must be brought in from what the local residents call the "Mainland" (*Bol'shaia Zemlia*) and must therefore compete for access to crowded supply lines with pipe, drilling equipment, and other material that hard-pressed local bosses may consider more urgent. That bottleneck will not be eased soon.

But there is a deeper issue, which goes beyond the immediate need to attract manpower: What is the future of the north Tiumen' region? Is it worthwhile to develop the region's basic infrastructure? Is it rational to waste money building future ghost towns? Here, the relevant precedent is the "giant" gas field of the last five-year plan, Medvezh'e, and its base city, Nadym.

³⁶*Gazovaia promyshlennost'*, No. 4, 1982, p. 7.

³⁷*Ibid.*

³⁸Mironov (first secretary of the Iamalo-Nenetskii okruzhkom CPSU. This is the intermediate administrative level between Tiumen' province and the Urengoy district) (1981). The same point is made by *Pravda's* correspondent Lisin (1982a).

³⁹"Tempy ob"iazyvaiut," *Stroitel'naia gazeta*, August 14, 1982. Construction groups from Leningrad were reported to have built 50,000 m² of housing in Novyi Urengoy in 1981 (although that figure seems hard to believe, in light of the overall statistics cited earlier).

When Nadym first began to develop at the beginning of the 1970s as the principal support town for Medvezh'e, there were similar arguments over whether to develop it into a regular city or not.⁴⁰ Large amounts of ink were spilled over whether to build a brick factory at Nadym, just as ten years later the same argument is going on over a proposed brick factory for Novyi Urengoy.⁴¹ The local leaders of north Tiumen' (including the Party officials) have been strongly in favor of systematic urban development, and they have a city with more than 100,000 people to show for it.⁴² But the heads of major organizations at the province level in Tiumen' city are evidently reluctant, including some of those of the gas ministry itself (officials of Tiumengazprom, for example, have been described as "indifferent to the development of Novyi Urengoy")⁴³ and so are the central planners in Moscow.⁴⁴

The main alternative is to avoid developing towns and cities in the area and instead to fly in manpower from outside for temporary tours of duty, rotating them frequently back to home bases located in developed areas, outside Siberia when necessary. This method is already being extensively used, but as the scale of gas development grows, and the region's growing gas reserves make it clear that the gas boom will last for a long time, the fly-in system has been coming under increasing fire.

ARGUMENTS OVER THE OUTPOST SYSTEM

The practice of flying in temporary workers is an integral part of both the gas and oil programs in Siberia.⁴⁵ It has been the margin of

⁴⁰Kostylev and Noskov (1980); Lisin (1982c).

⁴¹Gramolin (1981). After many conflicting reports, the famous brick factory apparently began producing in the fall of 1981 (Strizhev, 1982a).

⁴²Lisin (1982c); also Mironov (1981).

⁴³Ibid.

⁴⁴At least this is the view of Strizhev (1982b), the head of the gas industry in Nadym.

⁴⁵There are apparently two different systems in use. The "vakhtovyi" ("vakhtennyi" system is the name given when a team is flown to a work site from a nearby base for a limited time, lives in a temporary settlement (usually little wagons or the like), and then rotates back to its base. A term with a reasonably similar military flavor might be the "outpost method." The second method is the "ekspeditsionnyi" system, under which specialized teams (such as drilling teams) are flown in over long distances from outside the region. The latter is in wide use in the oil industry, whereas the former may be more widespread in the gas industry, in which there may be less need for highly trained crews who know about mud, logging, etc. The two systems are frequently referred to together as the "vakhtovo-ekspeditsionnyi" method, because a team of temporary workers may operate under both systems simultaneously. See "Ratsional'noe ispol'zovanie material'nykh i trudovoykh resursov na stroitel'stve magistral'nykh

difference in preventing manpower shortages from becoming a bottleneck in the gas campaign, and it is safe to say that that will remain true for at least the rest of the decade. Most workers will not stay long in Siberia; even if they wanted to, sufficient housing and amenities are not available. Meanwhile, because the historic center of both the gas and oil industries lay until recently outside Siberia, there is a surplus of experienced workers in the older areas. Yet it is not easy to relocate them permanently, not least because local authorities in the other areas (including those of the oil and gas ministries themselves) resist the removal of key units from their regions and fight against the downgrading of their areas. In short, the fly-in method cannot be dispensed with.

That is particularly true of the oil industry. About 15,000 workers fly to West Siberia from other parts of the country twice a month.⁴⁶ In the 1982 plan, such temporary crews were slated to do nearly 38 percent of the oil drilling in West Siberia.⁴⁷ Among local Siberian authorities in the gas regions, however, the fly-in system has become increasingly unpopular, even for manning pipelines. The large pipeline corridors leading out of Urengoy, consisting of as many as six parallel pipes running along a common corridor, require very large compressor-station crews and maintenance units that may number 500 people and more.⁴⁸ So far, these have been staffed by temporary crews, but they are growing into such a large force that many feel it makes better sense to attempt to create permanent communities instead.

The local authorities claim that the fly-in system brings them the wrong kinds of workers, with the wrong attitudes. The first Party secretary of the Yamal-Nenetsk district (in which the north Tiumen' gas fields are located) puts the problem this way:

Human values cannot always be translated into the language of economic categories. The experts reckoned that the "expedition" method for oil exploration would pay for itself within three or four years. But such gains here and now may end up costing us large losses in the future. . . . The temporary worker often has a mentality that is alien to society (*neset chuzhduiu obshchestvu psikhologiiu*), a consumer-minded approach to the job, and a plundering attitude toward nature. A person like that has no reason to take good care of expensive equipment. In short, many temporary workers tend to work for themselves and give little in return.⁴⁹

nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 57. But in practice the Soviets themselves are inconsistent in their use of the terms.

⁴⁶Laletin (1982).

⁴⁷"Ispol'zovanie trub na stroitel'stve neftegazoprovodov uluchshaetsia," *Planovoe khoziaistvo*, No. 8, 1982, p. 125.

⁴⁸Altunin (1979), p. 14.

⁴⁹Mironov (1981).

The fly-in system, moreover, is hard on the workers and bad for efficiency. Two *Pravda* correspondents, observing that oil workers are flown in from as far away as Moldavia and Simferopol', wrote that their productivity is lower than that of the locally based teams, because of fatigue and jet lag, lack of acclimatization to the area, etc.,⁵⁰ and this leads to problems of morale. Temporary teams flown in to oil fields typically work 15 days on and 15 days off; construction crews in both industries (particularly pipeline construction) work 20 days on and 10 days off. Soviet experience has been that skilled workers and brigade leaders cannot keep up that kind of pace—a serious problem, since these are the categories of workers and specialists that are apparently the most difficult to draw to Siberia in the first place.

Finally, the fly-in method is expensive. Observing that for both gas and oil the airplane bill to fly in workers has been running at 40 million rubles a year, the head of Gosplan's Interagency Commission in Tiumen' asks,

What if this system grows further? For example, certain overenthusiastic souls are suggesting that the number of flown-in workers be increased by 10 times by the end of the five-year plan. Can you imagine what that would cost the state?⁵¹

This kind of claim has led to a battle of the numbers. According to a defender, building a pipeline with temporary labor, because it economizes on permanent housing and other structures, saves a half-billion rubles in project costs.⁵²

The interesting thing about this dispute is the vigor with which the local authorities in north Tiumen' argue for their point of view. Even allowing for the fact that many of them are veterans of the area and therefore feel an understandable pride in their region, one is startled to find such a strong lobbying effort in favor of a policy—to build a large settled population in a forbidding northern wilderness—that a generation of determined Soviet effort has not been able to achieve in other rugged parts of Siberia. In view of the dubious record to date, the romantic optimism of the head of the gas industry in Nadym seems divorced from reality:

⁵⁰Lisin and Parfenov (1982a). For a vivid description of the reasons why oil workers reach Siberia in less than top physical shape, see Laletin (1982). The *Trud* correspondent traveled with oil workers from Bashkiria to Tiumen' and shared with them the sleepless nights, the long waits for delayed planes and buses, and the lack of accommodations for the workers along the way.

⁵¹Kuramin (1981a).

⁵²Laletin (1982).

Many young specialists arrive in Nadym with families. They come with the hope of getting housing. At first, a room in a tour-of-duty dormitory seems like paradise in a hut. Contrary to the idea of the combined fly-in and outpost method, people want to settle down in the North, even in barely acceptable living quarters.⁵³

Because the gas and oil industries both face the same problems, it is interesting that they have responded differently. The oil industry is flying in more and more temporary workers; the local gas officials are gradually emphasizing permanent settlement. On the face of it, one would have expected the opposite, because the better developed infrastructure of the southern Tiumen' area should be better suited to supporting a permanent population than the northern region. What is the explanation?

One reason may be that the two ministries have had different histories. In the previous generation of oilfields, in the Ural and Volga regions, MNP built large permanent settlements, but with the usual lag, so that by the time the housing was completed the fields were already declining. Although the housing is now full, many of the occupants are unemployed; indeed, they are among those who are being flown on temporary duty to Siberia today. As one Soviet article asks, "Must we repeat this experience in West Siberia?" Another reason is that the oil industry's great period of Siberian growth is behind it. Its future, unlike that of the gas industry, seems to promise a multitude of small fields and few giants. For the oil industry, therefore, the fly-in method may well be the best one.⁵⁴

In the fall of 1981, authorities in Moscow laid down a policy that looked like a compromise. The basic idea was to reduce the volume of long-distance fly-ins and to emphasize instead a combination of "outpost settlements" (*vakhtovye poselki*) located close to work sites, from which workers would be rotated periodically to "base cities" (*bazovye goroda*), no more than 150 to 200 km away, where their families would live.⁵⁵ Although defending the system of long-distance fly-ins as indispensable and economically justifiable, especially at the early stages of a new energy province's development, the *Pravda* editorial echoed the criticism of local Party officials about wrong workers with wrong attitudes.

Under the new system, local officials in the new gas regions got a large part of what they wanted. The *Pravda* text gave its blessing to the development of Nadym and Novyi Urengoy as base cities, on the model of similar towns created earlier by the oil industry. At the same

⁵³Strizhev (1982b).

⁵⁴Laletin (1982).

⁵⁵"Vakhta na severe," *Pravda*, November 14, 1981, p. 1.

time, an effort was to be made to improve living and working conditions at the "outposts," particularly at the pipeline sites. In May 1982 new regulations were published to spell out the guarantees and benefits the *vakhtoviki* are entitled to. In places the regulations are revealing: Its authors felt obliged to specify, for example, that workers at outposts must receive three hot meals a day and that women with children under the age of eight cannot be assigned to outpost duty "without their consent."⁵⁶ One begins to understand the large turnover.

The running debate over Siberian manpower and urban development is bound to continue, because the tensions are built in to the situation itself. For the foreseeable future more manpower will be needed than can be properly accommodated or induced to move permanently. Consequently there is no alternative to bringing in temporary crews. According to oil industry plans, the amount of oil drilling work to be performed in West Siberia using the "vakhtovo-ekspeditsionnyi" method will increase by 2.6 times between 1981 and 1985, and the number of workers involved will double.⁵⁷ The same will presumably be true of the gas industry, too. Nor is the issue of the long-term future of north Tiumen' laid to rest, because the debates that have already taken place over Nadym and Novyi Urengoy will surely break out again over Yamburg in the second half of the 1980s.⁵⁸

The interest of the Siberians on this question evidently differs from that of the central government. For the central planners, at least at the early stages of a new field, it is presumably rational to transfer personnel temporarily from the "Mainland" to West Siberia up to the point where the marginal gas produced per worker in north Tiumen' equals the marginal output in the older areas, allowing for the additional costs of getting the workers to Tiumen' and maintaining them there. Only if the flown-in workers turn out to perform unsatisfactorily does this calculation break down. But for those who have an emotional stake in Siberia—and there are many—such a policy results only in grabbing Siberian resources without really developing the region. This they condemn as a short-sighted and, in the longer run, an irrational use of resources. The issue turns on one's guess about how long Siberian gas is likely to last and whether north Tiumen' can be made economically workable once most of the gas is gone.

⁵⁶"Vakhtovyi metod organizatsii rabot," *Ekonomicheskaya gazeta*, No. 21, May 1982, p. 16.

⁵⁷"Problemy forsirovannogo razvitiia neftegazovogo kompleksa Zapadnoi Sibiri," *Planovoe khoziaistvo*, No. 10, 1981, p. 125.

⁵⁸Indeed they already have, judging from the appeal of the top Nadym official to avoid the mistakes of the past at Yamburg (Strizhev, 1982a).

It is hard to know whether the actual reasons for policy decisions are quite so carefully thought out as that. The reliance on temporary fly-ins, one suspects, is mainly the result of desperate improvisation in the face of stubborn housing shortages and the unwillingness of most workers to settle in north Tiumen'. It is all the more striking, therefore, that the local officials of north Tiumen' have made as much headway as they have. That may be a sign that planners and decision-makers are beginning to think ahead to what may lie beyond the present gas campaign.

ACCESS AND SUPPLY

The third critical problem in north Tiumen' is poor access to the gas fields and to the pipelines. Almost everything must be brought in from the Mainland, by land (road and rail), by air, but above all by river. There are constant reports of delays, and transport costs are high. At what point does the difficulty of access begin to limit the rate of growth of Soviet gas output and delivery? What are the Soviets doing about it? What are the main policy issues?

Transportation

Most of the burden of supplying the gas campaign in north Tiumen' falls on the river-transport system. Elsewhere in the Soviet Union, transportation by water plays a small and declining role, but in Tiumen' province the rivers are the main artery and will remain so for the foreseeable future. But deliveries only cover about 80 percent of requirements. According to the industry department head of the Tiumen' Party obkom, river shipping to the oil and gas regions of Tiumen' stands as shown in Table 8.⁵⁹ To achieve such targets requires not only additional shipping capacity and manpower, but also expanded dock facilities. The Ob'-Irtysh fleet is getting 110 to 115 new vessels a year but says it needs 150.⁶⁰ River ports are being expanded at Labytnangi, Sergino, Staryi Nadym, and Urengoy, but the work is running behind schedule.⁶¹ In the meantime, there are reports of equipment piling up all over Siberia, awaiting delivery to north Tiumen'. The pipeline construction program is also being

⁵⁹Trofimov (1982), p. 109.

⁶⁰Zhivotkevich (1981a; 1981b, p. 16).

⁶¹According to the gas minister, the expansion program for river transportation in West Siberia stalled during the 10th Plan: Of the 10 planned dock locations scheduled for availability by the end 1980, not one actually made it to completion (Dinkov, 1981).

Table 8

**RIVER-BORNE FREIGHT TO OIL AND GAS
REGIONS OF TIUMEN' PROVINCE, 1981-82**
(Millions of tons)

	1981	1982
Requirements	16.8	17
Plan	14.4	14.8
Performance	13	NA

SOURCE: Trofimov (1982).

affected. In the fall of 1981, 3000 km of pipe were estimated to be stacked up in staging areas, equivalent to the length of one of the major pipelines to be built in the 11th Plan.⁶² One can imagine, in these circumstances, the fierce interagency battles that must take place over the river fleet's shipping targets. The Ministry of the River Fleet in 1980 fought down demands from the oil and gas industries that would have added three million tons to its 1981 plan for Tiumen' province. Its officials warned that by 1985, even with planned additions to capacity, they would fall short of the gas and oil industries' needs by five million tons a year.⁶³ Even with the targets as they are, local shipping operators complain that they cannot keep up, especially with deliveries to the Arctic Circle.⁶⁴

Consequently, in this as in the other aspects of the logistics problem in north Tiumen', decisionmakers are being forced into tradeoffs between speed and cost. The least-cost avenue is to expand the capacity of the river system by gradual and orderly stages, particularly through greater mechanization of dock facilities. Increasing traffic on the local rivers is often the most logical course, because when they are frozen over one can use ice roads instead.

But that course will take time, and time is the one thing that the gas targets do not allow. Desperate managers at all levels are being

⁶²Kuramin (1981c), p. 75. This was one of the findings of the Gosplan Interagency Commission in Tiumen'. The cause, apparently, is not solely the transportation system, according to the Commission, but also poor planning on the part of MNGS.

⁶³Zhivotkevich (1981a).

⁶⁴Zhivotkevich (1981b).

forced into high-cost solutions. Many small rivers, for example, are already being developed, not by the Ministry of the River Fleet (which finds them unprofitable)⁶⁵ but by the user ministries themselves, who are developing little flotillas that are described as highly inefficient.⁶⁶ And at every step there are fierce exchanges in the press, which presumably reflect still fiercer ones behind the scenes, over what to do.

A complementary means of access to north Tiumen' is by rail. Railroads can operate year-round; and once the roadbed is in place, they can deliver the heaviest loads at a fraction of the cost of waterways and winter roads.⁶⁷ But the capital requirements for building roadbeds over Siberian swamp and permafrost are daunting. Consequently, there have been vigorous arguments for several years over how far to extend the system. Since 1976 a 1500-km line has been under construction between Surgut and Urengoy, which will add to a previous line from Nadym and provide at long last a direct link between the gas regions and Tiumen' city (which is located directly on the Irtysh river and is well equipped with dock facilities).⁶⁸ It was finally completed in mid-1982,⁶⁹ one year behind schedule.⁷⁰ But long before it reached its destination local authorities were saying that it was too small to meet requirements.⁷¹ One might have expected to hear proposals to double-track the new line, but instead the debate centered on whether to extend the system northwestward toward the major river ports in north Tiumen' or northward to the new gas fields. One major consideration was that the railroad-construction crews available in north Tiumen' might be disbanded and a valuable opportunity lost.⁷²

Gosplan resisted any extensions beyond Urengoy; even the new gas city, Novyi Urengoy, was not to be served by the new line, and thus

⁶⁵Kuramin (1981a).

⁶⁶Ibid.

⁶⁷Melkonov (1980), deputy minister of Mintransstroï, states that shipping oil by rail costs only one-ninth as much as by water.

⁶⁸There is still no direct rail connection to the European USSR. One way to provide one would be to build a line between Nizhnevartovsk on the Surgut-Urengoy road to connect with the existing West Siberian network at Belyi Iar.

⁶⁹*Ekonomicheskaya gazeta*, No. 28, July 1982, p. 3.

⁷⁰Lisin (1981a).

⁷¹Altunin (1979), p. 20. Also Sulimenkov (1979).

⁷²One could read proposals in the press that the rail-laying teams should continue on to Norilsk, Salekhard, or new fields such as Zapoliarnoe, Russkoe, or even Yamburg. The future of railroad expansion in north Tiumen' was one of the few important issues to be raised in the public "debate" over the preliminary guidelines of the 11th Plan, but the outcome seems to have been that advocates of further expansion during the 11th Plan did not get their way. The proposal to build a line to Salekhard is part of a plan to connect Nadym to dock facilities at Labytnangi (Korotchaev, 1981). There may already be an older stretch of rail along that route, but it is not currently usable (Altunin, 1979, p. 21).

Nadym, the gas region's largest city, was not to be connected up to Tiumen' city.⁷³ By the time the draft targets for the 11th Plan appeared in late 1980, Gosplan was still resisting. But a few months later the planners had been overridden and it was decided to extend the railroad to Novyi Urengoy after all, but not to undertake any further railroad construction in north Tiumen' during the 11th Plan.⁷⁴ The last stretch from Urengoy to Novyi Urengoy is only 75 km long, and it was scheduled to be in operation in 1982.⁷⁵

This struggle appears to be due to the scarcity of investment resources and the urgent need for railroad expansion elsewhere in the country. Top priority in railroad construction east of the Urals is going instead to a badly needed new railroad line connecting the Kuzbas coal field to the European USSR.⁷⁶ Gosplan evidently wants to do a minimum of railroad-building in north Tiumen', where it may be less cost-effective.

Finally, there is the question of roads. Building all-weather, hard-surface roads in north Tiumen' is an extremely expensive proposition, and consequently they will never compete with waterways and railroads as arteries for long hauls. But roads for local access to fields and pipes are another matter, and in north Tiumen' they are seriously lacking. According to the gas minister, the Ministry of Transportation Construction (Mintransstroï) managed to build 150 km of roads in all of West Siberia during the 10th Plan,⁷⁷ of which only 10 are at Urengoy.⁷⁸ In the targets for the 11th Plan, the road-builders must increase the completion rate for Tiumen' province as a whole to 300 km a year.⁷⁹ In addition, there is a program for building a major road in the Urengoy field proper. But here too there have been battles. Mintransstroï refused to take on the job, leaving MGP to do it instead.⁸⁰ Yet only about three million rubles a year have been allocated for building roads at Urengoy.⁸¹ Consequently, this target is unlikely to be met.⁸²

⁷³Melkonov (1980).

⁷⁴"Rukotvornyi meridian," *Pravda*, January 22, 1981; "Razvitie zheleznodorozhnogo transporta," *Ekonomicheskaya gazeta*, No. 42, October 1981, p. 2.

⁷⁵In a message at the beginning of 1982, gas minister Dinkov also called for operation to begin during the first quarter of 1982 on the stretch from Tikhaya to Iagel'naia, which will create a direct connection between Urengoy and the extant line from Nadym to Pangoda No. 2 (Dinkov, 1982a).

⁷⁶"Razvitie zheleznodorozhnogo transporta," *Ekonomicheskaya gazeta*, No. 42, October 1981, p. 2.

⁷⁷Dinkov (1981).

⁷⁸Topchev (1981).

⁷⁹Ibid. This is an interesting further indication that the transfer of priorities to Urengoy may be slower in the field than it is in the speeches in Moscow.

⁸⁰Trofimov (1982).

⁸¹Ognev (1982).

⁸²The problem of roads may be due in part to the natural characteristics of the area: Americans working on the North Slope have found that the best kind of road for arctic

What are the practical implications? Two examples will give the flavor: Because there are no service roads alongside the major pipelines, in the summer months maintenance and repair must be done by air. As of the late 1970s, at any rate, a major leak in a pipeline took eight to ten days to repair by helicopter, and during that time one could lose as much as one billion cubic meters of gas.⁸³ Although the newly adopted single corridor design makes such a road more attractive than before and influential people have lent their voices to the idea,⁸⁴ it has apparently not yet been adopted.

The other example concerns gas-processing facilities in the field itself. In the summer of 1980, poor access caused many months of delay in installing the fourth gas-processing unit, as well as many interruptions in drilling. In 1981 workers were busy installing the seventh and eighth gas-processing units at Urengoy, but with no better access than before.⁸⁵ The result is serious delays.⁸⁶

In the end, what the waterways, railroads, and roads cannot deliver must go by air. Some of the greatest heroics of the gas campaign are performed by pilots, who in 1981 flew in more than a half-million tons of equipment and building materials for the oil and gas industries in Tiumen'.⁸⁷ But the price is high, although the Soviet press says only that the aviation bill runs into the "tens of millions of rubles" each year for the gas industry in north Tiumen'.⁸⁸ Air freight costs 50 times per unit of weight that river transportation does, and during the 10th Plan "Nadymgazprom," the industrial association in charge of gas development at Medvezh'e, spent 74 million rubles on air transport services.⁸⁹ Presumably the cost at Urengoy in the 11th Plan will be very much larger, not to mention that of aircraft for construction and maintenance of pipelines. Beyond the issue of cost is that of availability. Helicopters, typically Mi-8s and Mi-10ks, which come from the local directorate of civil aviation in Tiumen' city, were reported to be in short supply in mid-1981. The gas regions expect to

conditions is gravel, in some places as much as six feet of it. Gravel is less readily available in West Siberia, and Soviet road-builders have been using less of it. Consequently, even such roads as exist in the area are frequently impassible.

⁸³Altunin (1979).

⁸⁴For example, the minister of oil and gas construction, Shcherbina, quoted in Lisin and Parfenov (1980). In early 1982, gas minister Dinkov also called for a service road, running along the stretch of pipeline between Nadym and Komsomol'sk (Dinkov, 1982b, p. 3).

⁸⁵Lisin (1981a).

⁸⁶Lisin (1982c).

⁸⁷"V nebe Tiumeni," *Pravda*, December 8, 1981.

⁸⁸"Bystree sooruzhat' gazoprovody," *Pravda*, January 9, 1982.

⁸⁹Topchev (1981).

receive Mi-26s, a more powerful model, but as of the end of 1982 these were not yet available.⁹⁰

Transportation problems interlock with others already mentioned. For example, much of the equipment that must be shipped is excessively heavy, which in turn is a reflection of well-known tendencies of Soviet manufacturers. Older models of gas-processing units weigh 80 tons and are 16 meters high. By 1979 a new model of one-fourth the weight was being installed at the Iubileinoe gas field,⁹¹ but whether it is now in wide use is not yet known. This is one of the side-effects of slow industrial innovation and perverse production incentives that worsen the transportation problem.

Do all these problems add up to a supply bottleneck at Urengoy? According to an estimate published in 1979, every increment of 30 bcm of gas output adds one million tons to the annual supply requirement for the development area and 3000 tons of cargo for every kilometer of new pipeline.⁹² According to the plans then being projected for 1985, it was expected that river transportation would have to be able to bring five million tons of supplies annually to the north Tiumen' gas industry, most of that to Urengoy.⁹³ But those plans were based on much more modest output projections for Urengoy. If the requirements are scaled up proportionately, then reaching a 1985 production level of 250 bcm a year would require an annual supply capacity of over eight million tons. What does a back-of-the-envelope estimate tell us about the chances of reaching that volume by 1985?

Railroad capacity: In 1980, with the Nadym-Urengoy connection as the only rail link available, 750,000 tons of supplies were delivered by train.⁹⁴ By 1985, the link from Surgut to Urengoy will be available as well. Its capacity in its first three years of operation running from Surgut to Nizhnevartovsk was 500,000 tons per year, but much of that is committed to the oil industry. Possible total by 1985: one million tons per year.⁹⁵

Waterway capacity: The limiting factor here is docking facilities, and that is apparently expanding only slowly. If the 1981 plan for deliveries to arctic regions was three million tons, and if that level will not be reached until 1982 or 1983, then a very rough guess for 1985 is four million tons per year.⁹⁶

⁹⁰"Vblizi Urengoi," *Izvestiia*, November 23, 1982.

⁹¹"Ratsional'noe ispol'zovanie material'nykh i trudovoykh resursov na stroitel'stve magistral'nykh nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 56.

⁹²Altunin (1979), p. 20.

⁹³Ibid., p. 21.

⁹⁴Lisin (1981a).

⁹⁵Melkonov (1980).

⁹⁶Zhivotkevich (1981b).

Airlift capacity: In 1981, over 500,000 tons was airlifted to the oil and gas industries together. By 1985, the gas industry might receive 250,000 tons by air.

This crude estimate suggests that existing supply lines can deliver about four million tons of goods a year to the north Tiumen' fields today, and might be able to deliver as much as six million tons a year by 1985. Although these figures are scarcely more than guesswork, they do bring out some important conclusions about the supply problem: (1) Even if they stretch every fiber, Soviet managers still have a serious problem in supplying the essentials of the gas campaign in Urengoy; (2) even to come close requires giving top priority to gas in the Tiumen' transportation network, to the sacrifice of important supplies for the oil industry; (3) the continued heavy reliance on waterways for the foreseeable future means that supply will continue to be highly seasonal, and therefore vulnerable to pile-ups and inflexibilities; and (4) even within the gas industry, other needs will have to be sacrificed, which implies that urban construction and amenities will continue to lag, and the fly-in system will remain indispensable. The final implication of all the above (which deals only with the Urengoy field and does not include the additional burden of the pipelines) is that even to stay abreast of the supply problem is going to be very costly.

Fuel Shortages

Considering that Urengoy is the world's largest gas field and also has abundant reserves of condensates, it is ironic that one of the scarcest items is fuel. In 1980 the districts of Nadym and Urengoy imported 250,000 tons of liquid fuel,⁹⁷ nearly their total needs. Some authorities insist that importing fuel is the only way; others insist that there are many opportunities to develop local resources. For example, in the Urengoy field itself, located in the Valangian level some 3,000 to 3,200 meters deep, are gas deposits that are rich in condensate, which could be used as a ready supply of liquid fuel for local needs. But the extra drilling that would be required (the Valangian level is two to three times deeper than the average gas well in Urengoy) would also require diverting additional workers.

The compromise approach that has been adopted is to aim to extract 17 bcm of deep gas during the 11th Five-Year Plan,⁹⁸ to reduce the

⁹⁷Topchev (1981).

⁹⁸Trofimov (1982).

amount of fuel brought in from the outside.⁹⁹ This effort is described as only a curtain-raiser for a larger condensate program in the 12th Plan.¹⁰⁰ But the current interim program, while yielding two or three million tons of condensate a year, will require drilling only about 100,000 or 200,000 meters of well, at an additional cost of less than 1,000 additional workers.¹⁰¹

This is a variant of the debate over housing and manpower: Some argue for long-term infrastructural development, others propose to continue relying as much as possible on outside supplies. For the former group, the development of condensates is a particularly important issue, because even after the main supplies of gas are exhausted (and that point looks ever more distant), commercially valuable condensate will provide a major source of petrochemical feedstocks for a long time to come. North Tiumen' could eventually produce 50 million tons of condensate each year.¹⁰²

The issue of local fuel supply exhibits a line-up that the reader by now will find familiar: The local "horizontalizers" are pressing for accelerated development of local propane and condensates, and hard-pressed central ministries and their local agencies are attempting to evade. The newly established Gosplan Interagency Commission in Tiumen' claims to have fought successfully to have a pipeline for condensate (leading from Urengoy to Surgut) included in the 1982 plan of the local gas development agency, "Tiumengazprom," and to displace imported fuel with locally produced propane.¹⁰³ The Party obkom department head for industry, B. Trofimov, characteristically silent about the Gosplan Commission, defended the idea of building a big condensate-processing facility.¹⁰⁴ A later source adds that in April 1982 it was decided that MGP would build a refinery in Surgut to process Urengoy condensate. Similarly, there has been an effort to counteract the tendency of geological exploration teams at Urengoy to concentrate on the upper depths, to the neglect of the lower levels where the deposits of condensate are to be found;¹⁰⁵ in May 1981, Radio Moscow reported that geologists are now drilling several 4000-meter wells at Urengoy.¹⁰⁶

⁹⁹Topchev (1981).

¹⁰⁰Ibid.

¹⁰¹These figures are inferred from Altunin (1979), p. 13, and are intended to be no more than a first order of approximation.

¹⁰²*Oil and Gas Journal*, January 10, 1983, pp. 38-39.

¹⁰³Kuramin (1982b).

¹⁰⁴Trofimov (1982), p. 109.

¹⁰⁵Khvorostianova (1982).

¹⁰⁶Moscow Domestic Service, reported in FBIS/SU, May 26, 1982.

Power Supply

Shortage of electrical power is a chronic problem in Siberia, and it is one of the reasons why Siberian industrial development has lagged behind planned rates in the last decade.¹⁰⁷ In the second half of the 1970s, output of electricity grew more slowly in Siberia than in the rest of the USSR.¹⁰⁸ The oil and gas industries in Tiumen' province began to feel the effects of insufficient power and unsatisfactory service around 1978, and the situation has apparently grown worse since then.¹⁰⁹

Both the gas and oil industries depend on electricity because much of their drilling and pumping equipment is electrically driven, as are many pipeline compressors. "Constant" power failures cost the Siberian oilmen "many thousands" of tons of oil in 1982.¹¹⁰ The gas industry has been forced to use small, diesel-powered generators, which use expensive imported fuel and tie down nearly 3500 workers.¹¹¹ Because of these and similar problems, improving the quantity and quality of the power supply to the region has become one of the most prominent issues in Soviet discussions of Tiumen', and it is the chief preoccupation of Gosplan's new office in Tiumen' city.

The users' chief complaint is the slow pace of construction of new powerplants and transmission lines. The gas industry has been counting on a 500 kv transmission line to bring power from Surgut to Urengoy, but the line is already nearly three years late and is not yet finished.¹¹² At Surgut, a second gas-fired powerplant (which uses associated gas from nearby oil fields) was supposed to be completed in 1983,¹¹³ but it is still more than two years away from starting up. Powerplant projects at Nizhnevartovsk, Tobolsk, and Urengoy are likewise behind schedule.¹¹⁴ All in all, according to Gosplan's West Siberian Commission, power supply is lagging five years behind needs, and unless urgent action is taken it will become the governing constraint on Tiumen' oil and gas development.¹¹⁵

In its defense, the Ministry of Power and Electrification (Minenergo) argues that the Siberian users initially underestimated their needs for 1985, then upped them sharply, from 28 to 40 billion

¹⁰⁷Orlov (1982), p. 67.

¹⁰⁸Baranova (1982).

¹⁰⁹Kuramin (1982a).

¹¹⁰Lisin (1983).

¹¹¹Dinkov (1982b), p. 3.

¹¹²Trofimov (1982), p. 109.

¹¹³Kuramin (1982a). Surgut No. 2 will have an eventual capacity of 3200 megawatts—a sizable addition over the 2900 mw the entire province had in 1980 (Lisin, 1983).

¹¹⁴Lisin (1983).

¹¹⁵Kuramin (1982b).

kilowatt-hours.¹¹⁶ In plain language, this means that the Siberian energy campaign of the 11th Five-Year Plan took Minenergo by surprise. To compensate in such cases, Gosplan allows a limited number of "above-plan projects" (*sverkhlimitnye ob'ekty*). Out of 18 such projects in the country as a whole, 13 are in West Siberia. But Surgut No. 2 was not one of them, and as a result the State Bank would not authorize financing for it. In 1980, Minenergo was able to spend only 10 million rubles on the project (out of an eventual total of 200 million). Instead of the 5000 workers needed, only 800 are available, and even these are being drawn off to other sites.

Critics are not satisfied with these explanations, pointing out that Gosplan authorization for Surgut No. 2 came in 1981, and they blame Minenergo for bad management. How can Minenergo really focus on Tiumen's problems, they say, when the main offices that handle Minenergo construction there are headquartered in Sverdlovsk and Moscow?¹¹⁷

These are familiar disputes. What is striking is that, despite the attention of Gosplan West Siberian and of its counterpart in the apparatus of the Council of Ministers in Moscow, there has apparently been little progress in improving the power supply in Tiumen'. The 3 billion rubles allocated for investment in West Siberian electricity in the five-year plan will apparently not be spent, and the two-and-a-half-fold increase in output will not be achieved.

LOGISTICS AND INFRASTRUCTURE

There is a peculiar inconsistency in Soviet reporting about the gas campaign. From the pipeline front the daily dispatches are upbeat, yet officials occasionally observe that if there is a bottleneck in the campaign, it is the pipeline network, especially the compressors. From Urengoy the reports sound much more pessimistic, but there is no suggestion that problems there could hold back the gas program. Yet if one looks carefully at Fig. 6, Urengoy is running behind schedule.

Lag in Constructing Gas-Gathering Networks

One consequence of manpower shortages is competition for available workers. MNGS, for example, has split its pipeline operations

¹¹⁶Lisin (1983).

¹¹⁷Lisin (1983) and Kuramin (1982a).

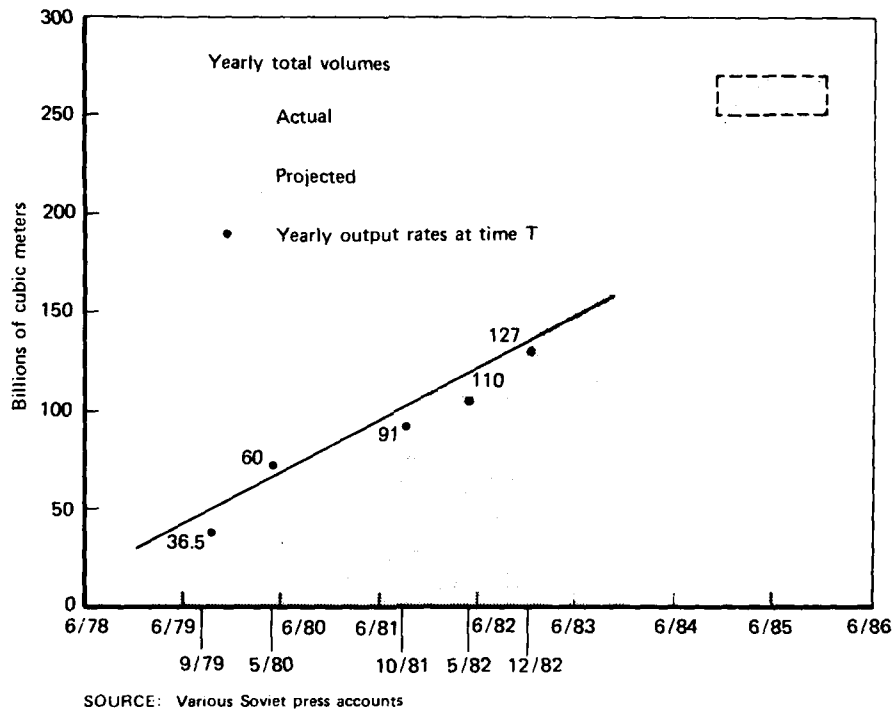


Fig. 6—Gas output at Urengoy, 1978-85
(planned and actual)

from its field development operations. The former are larger,¹¹⁸ more visible, and may have higher political priority because of the international pipeline furor. In addition, because bonuses are based on the weight of the pipe installed, workers get bigger bonuses for installing 56-in. pipe on the large trunklines than for small-bore gas-gathering pipe in the fields; consequently, as the two types of organizations compete for scarce manpower, the trunkline builders are winning.¹¹⁹

What are the practical consequences? The installation of the gas-gathering network is falling behind the planned rate: In 1981, only 52 km of new pipe were installed instead of the targeted 137. As a result, several recently completed clusters of wells are standing idle, as is

¹¹⁸According to *Pravda*, total investment in the *obustroistvo* of Urengoy (i.e., infrastructural development for the field, which presumably includes installing gas-gathering networks) has been only slightly more than 300 million rubles so far (Lisin and Parfenov, 1982b).

¹¹⁹Lisin and Parfenov (1982b).

one recently completed gas-processing plant. The measures taken by MNGS to deal with the problem have not worked so far, because the workers are leaving the field to go work on the main pipelines.¹²⁰

"How then," *Pravda* asks, "are the gas workers managing to increase gas output? To put it plainly, they are opening the valves wider." But this is a costly procedure, say the *Pravda* correspondents, because it shortens the life of the field and cuts its total potential output. Urengoy, Soviet geologists explain, is about 100 km long and 30 km wide. Sound development strategy calls for developers to sink wells along the entire width of the field, but because well-drilling is also behind plan (see below), they are working instead a corridor only 8 to 12 km wide. Coming back later to work the neglected "shoulders" of the field will be difficult and inefficient. The combination of forcing the output of existing wells and restricting development to the richest middle corridor will exhaust Urengoy prematurely.¹²¹

But that is not the end of the developers' headaches. Behind the problems with the gas-gathering network lie other potential bottlenecks, because the rates of well-drilling and installation of new gas-processing plants are also behind schedule.

Drilling New Wells

Since Urengoy began production in 1978, drillers have been struggling to keep up with the rapid growth in output targets, but they have had problems every year.¹²² In 1979, the drilling crews fell short of their target of 84,000 meters (which itself seems to have been a downward revision from the target initially set for the five-year plan) by a full third, completing only 37 wells instead of 51.¹²³ Authorities called attention to alarming drops in productivity, which they ascribed to insufficient infrastructure and inadequate exploration.¹²⁴ By the end of the five-year plan, however, the Urengoy drillers had fulfilled the drilling plan by only 80 percent, and they fell nearly 60 wells short of the five-year target for completions. The situation was serious enough that the organization chart was redrawn in 1980 to give the Tiumen' gas drillers an organization of their own in MGP,

¹²⁰Ibid.

¹²¹Ibid.

¹²²The late MGP minister S. A. Orudzhev (1980, pp. 4-9), who was always on the pessimistic side as far as the infrastructural problems of development at Urengoy were concerned, described the problems of the drilling program there.

¹²³Kostylev and Noskov (1980).

¹²⁴Agapchev (1981), pp. 2-3.

"Tiumenburgaz."¹²⁵ In view of this record, the drilling targets for the 11th Plan seem ambitious, because they demand a large jump over anything the Urengoy drillers have achieved before. Between 1981 and 1985 they must drill over 1000 new production wells.¹²⁶ Although development drilling is slated to increase by 37 percent for the gas industry nationwide, in West Siberia it is supposed to increase by 2.7 times.¹²⁷ On the whole, drilling for gas in north Tiumen' should be easier than drilling for oil, which also requires greater depths. Yet a gas-drilling brigade in MGP averages barely more than 14,000 meters a year, whereas a comparable oil drilling brigade in MNP (Glavtiumenneftegaz) drills between 50 and 100 thousand meters a year.¹²⁸ This means that the gas industry needs more brigades to develop Urengoy, and because they are not available (or not until now, at any rate), the drilling targets have been set low. To meet the Urengoy output plan using sound development practices, the five-year drilling plan at Urengoy should really be 2 million meters, rather than the actual official target of 1.5 million. But that would require 90 brigades, whereas only 10 are available.¹²⁹

The actual record for the 11th Five-Year Plan so far suggests that drilling at Urengoy may fall considerably short of the thousand new wells called for in the official targets. In 1981, out of a planned total of 123 new wells only 93 were turned over as "complete" to the operators by the builders, and of those only 61 were in actual operation in mid-1982.¹³⁰ The target for 1982, 160 new wells,¹³¹ suggests that the planners are sticking so far to the schedule originally laid out in the five-year plan, but unless major new measures are taken the outlook is doubtful.

Gas-Treatment Facilities

Unless natural gas is dried and stripped of its impurities and its heavier hydrocarbon fractions before it is pumped through a pipeline, these materials can solidify and partially obstruct the pipe, lessening

¹²⁵Khvorostianova (1982).

¹²⁶"Razvitie truboprovodnogo transporta," *Ekonomicheskaya gazeta*, No. 43, October 1981.

¹²⁷Agapchev (1981).

¹²⁸Khvorostianova (1982).

¹²⁹The official target is quoted in Kozlov (1981); the "ideal" one comes from an employee of Urengoygazdobycha, Khvorostianova (1982).

¹³⁰Lisin and Parfenov (1982b). Whether the difference between the 93 and the 61 is due to lack of gas-gathering pipe or to incomplete construction of the wells themselves the source does not say.

¹³¹Dinkov (1982a).

the overall throughput capacity and making compressors work harder. Fouled lines may be one of the reasons for the inefficient performance of the Soviet trunk network.¹³² An important part of the development program at Urengoy, therefore, is the installation of gas-treatment units. According to an account in 1980, the first unit at Urengoy was installed in 1978 ahead of schedule. But then the troubles began: By the end of 1978 only two units had been installed (instead of three as planned); then in 1979 only the third unit, which came on line nine months late.¹³³ Lack of roads delayed the fourth unit for several months in the summer of 1980.¹³⁴ Units 5 and 6 were supposed to come on line by the end of 1980 but didn't make it until the following year.¹³⁵ All in all, Glavtiumenneftegazstroï, the contractor for the Urengoy gas-treatment units, was blamed for having fallen three units short of its target at the end of the 10th Plan (i.e., end 1980). By the summer of 1981, the association was struggling with two more units, although the plan had called for four.¹³⁶ In 1982, MNGS was supposed to build three, although it is not clear whether that figure includes the two left over from 1981.¹³⁷

The gas industry says it is coping with this problem by forcing the rate of operation of the existing facilities. Although these are designed for 15 bcm a year, they are actually processing 20. Businessmen in the West believe that the Soviets cannot be fully treating all the gas they are producing at Urengoy, because the output figures do not square with the consumption of the imported gas-treatment chemicals needed to process raw gas.¹³⁸ Running raw or partially raw gas through the pipeline, however, will further lessen the reliability and the efficiency of the system, raising the requirements for compressor capacity. In this case, the left and the right hand are not working together.

Summing Up

The problems reviewed in this section are worth pondering for what they imply about Soviet choices in the gas campaign. If the Soviet

¹³²Campbell (1980), p. 8, citing an article in *Gazovaya promyshlennost'* published in 1978.

¹³³Kostylev and Noskov (1980).

¹³⁴Lisin (1981a).

¹³⁵Gramolin (1981).

¹³⁶Lisin (1981a).

¹³⁷Lisin and Parfenov (1982b). Although MNGS minister Shcherbina (1982c, p. 4) confirms that the 1982 plan is three, MGP minister Dinkov (1982a) says that MNGS is supposed to "bring on line" four units in 1982. The total five-year plan targets for Urengoy call for 15 new units (Kozlov, 1981).

¹³⁸Robinson (1982b).

leaders have chosen to "skim the cream" now, by forcing output at Urengoy to the maximum through the existing wells and by piping partially raw gas through the pipeline network, that amounts to an important, and perhaps even justifiable, preference for near-term results over longer-term ones. But these "choices" are probably the by-products of local dysfunctions that the leadership is trying not very successfully to control. The problems of development at Urengoy are instead probably an example of the dissipation of central purpose that is one of the classic defects of the command system. What is surprising is the authorities' apparent inability, in so visible and important a spot as Urengoy, to make more headway than they have managed to so far. In view of this record, the possibility should not be ruled out that development problems at Urengoy could eventually develop into a real brake on Soviet gas output.

V. INDUSTRIAL AND TECHNOLOGICAL ISSUES

In managing the gas campaign Soviet decisionmakers face not only the problems of infrastructural and logistical development, they must also develop a vast program of industrial and technological support to provide pipe, pipelaying and earthmoving equipment, compressors and control equipment, and drilling and gas-processing machinery. Success in raising productivity depends to a large extent on mechanization; consequently, much of the gas campaign is being waged in industrial plants throughout the country.

In implementing this part of the program, Soviet leaders face the inertia and conservatism of Soviet industrial ministries. The leaders must make sure that the high priority of the gas campaign as a whole is translated into the plans and allocation decisions of individual ministries, main administrations, *glavki*, and plants throughout the country, and, even more important, that the plans are carried out. In principle, the structure of the command economy should make it possible to execute such shifts smoothly and quickly, by communicating changes in priorities to the *collegia* of the ministries and state committees; in practice, such changes must be rammed through in the face of resistance at all levels.

To counter that resistance, Soviet leaders have four basic options: (1) Accept a slow-down of their program, or at least concentrate on the main targets; (2) retreat to a lower level of mechanization or less sophisticated technology, say by substituting more manpower or raw materials for capital equipment; (3) finesse the rigidities of their own R&D system by importing foreign equipment instead; or (4) meet resistance head-on through high-priority political intervention. The first option is addressed in several other places. Instead this section examines the tradeoffs among the other three options.

In an undeveloped area like north Tiumen', technology and its supporting logistical base have a dual relationship: On the one hand, mechanization displaces labor and other inputs and thus relieves strain on the infrastructure and the logistical system; but on the other hand, if the logistical and infrastructural support systems are insufficient in the first place—if there are not enough roads, powerlines, skilled manpower, and so forth—then mechanization and higher technological levels will not produce the results hoped for.

In the gas campaign, the infrastructure is already stretched to the limit; consequently the Soviets face a real dilemma. If they do not try

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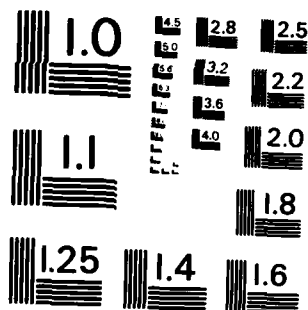
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to improve technological levels, productivity will certainly remain low and the costs of the gas campaign will be intolerably high; but if they do try to raise technological levels, they may find that the insufficiency of infrastructure prevents them from making the big productivity gains they had hoped for, so that the cost picture looks little better than if they had not made the effort in the first place. The Soviet answer has been to press doggedly ahead toward more mechanization and more advanced technologies, but they have not resolved the dilemma, for the industry's marginal return on capital has been declining all the same.¹

One of the most important reasons why Soviet leaders import Western capital equipment is to give themselves a "fast start" in new policy initiatives, so they need not wait for sluggish domestic producers to make the necessary innovations or reach the necessary output capacities and quality levels before forging ahead. Western technology helped Khrushchev to launch his "chemicalization" campaign in the late 1950s and Brezhnev to expand both automobile and truck production in the 1970s. Soviet industry is not necessarily incapable of supplying what is needed (in some of these sectors Soviet industry was already strong, in others not), but turning to the outside gives the Soviet leaders a flexibility that the command system cannot supply.

In the gas industry, Western equipment has consistently provided the leading edge of Soviet advances for over 20 years, supplying the most advanced generation of equipment, especially for transmission, as the Soviet gas industry has moved toward bigger pipe, higher pressures, and longer lines. As the targets for the first half of the 1980s were unveiled, it was evident that the Soviets planned to apply the same strategy on an even larger scale.

Relying on foreign equipment suppliers tends to inhibit domestic innovation. It takes time and additional resources to absorb it properly into the domestic economy, and while that process is going on it disrupts established lines of supply. Western equipment costs hard currency, and in the end it may not yield dramatically greater productivity, especially when operated under Soviet conditions. Above all, it exposes the Soviet economy to the uncertainties and pressures of the world economic system, including the possibility of diplomatic coercion. These, of course, are some of the reasons why Stalin opted for autarky in the first place, and why the issue of balance between domestic and foreign technologies has been controversial in Soviet

¹During the 10th Plan, marginal capital cost of developing 1000 m³ of new gas increased from 13.4 to 16 rubles, despite the move to the rich Siberian fields. This figure refers to development only (*dobycha*) and does not include transmission. See Dinkov (1983), p. 3.

policymaking ever since.² In the last few years, Soviet policy on Western imports has been under debate once again.

The gas campaign again illustrates these problems vividly. The Soviets were initially relying on Western equipment and pipe not only for the East-West export pipeline, but also for a great deal of the equipment for the six domestic 56-in. lines as well. The most striking case is that of compressors. When announced in 1981, Soviet plans appeared to call for far more compressor capacity than Soviet industry could supply, even after the pipeline program had been pared down somewhat between the draft and final versions of the 11th Five-Year Plan.³ The revised five-year targets, published in late 1981, projected 320 new compressor stations totalling 25,000 mw in capacity. This was an enormous jump. During the previous five-year plan, the Soviets had increased their installed compressor capacity by some 9400 mw, of which about one-third was imported from the West, implying a domestic five-year output of something over 6000 mw.⁴ For the 11th Five-Year Plan, the Soviets began negotiating to import 125 compressors for the East-West export line—that is, about 3100 mw. But that left some 22,000 mw to be supplied internally. Did the planners really expect their machinery industry to be able to more than triple their domestic output of compressor capacity in five years?

If Soviet planners were being overoptimistic about the ability of Soviet industry to build gas-pipeline compressors, it was not the first time. In each of the last two five-year plans the Soviets had begun in the same way, only to turn to Western suppliers later in the plan period, when they realized that their own industry would not be able to deliver as promised.⁵ Nevertheless, the gap this time was far larger than on the two previous occasions. The discrepancy was especially serious in the highest-priority portion of the program, the plan for compressors for the six major lines from Urengoy. There were to be 175 new compressor stations in all, totaling over 13,000 mw in capacity, to be distributed as indicated in Table 9.⁶ Whatever

²For a review of these controversies through 1975, see Parrott (1983).

³Dertsakian (1982), pp. 5-6. The initial draft plan called for between 360 and 374 compressor stations over the five-year period, for a total increment of between 24,300 and 25,000 mw. Although the number of stations was lowered, the total new capacity was not. The lower figure comes from Baranovskii (1981) and "Zadachi rabotnikov gazovoi promyshlennosti na 1981 god i 11.uiu piatiletku," *Gazovaiia promyshlennost'*, No. 4, 1981; the higher figure comes from "Razvitie truboprovodnogo transporta," *Ekonomicheskaiia gazeta*, No. 43, October 1981.

⁴Campbell (1980), pp. 215 and 218.

⁵In each of the years of the 9th Five-Year Plan, the plan for gas-pipeline compressor stations was badly underfulfilled; the highest fulfillment rate in those years was 57.6 percent (Campbell, 1980, p. 216).

⁶I have not found a source for the number of compressors on the Urengoy-Griazovets line, but since the other lines have roughly one station every 125 km, I am assuming

Table 9
56-IN. GAS PIPELINES SCHEDULED
FOR 1981-85

Line	Length	Compressor Stations
Urengoy-Griazovets	2500	(20)
Urengoy-Petrovsk	3000	24
Urengoy-Novopskov	3600	30
Urengoy-Uzhgorod	4500	41
Urengoy-Center	3400	30
Urengoy-Center	3400	30

SOURCE: Dertsakian (1982), p. 5.

reservations one may have about the American embargo of December 1981 on other grounds, it caught the Soviets with their plans down. By forcing the Soviets to use domestically made compressors to replace the West European ones, the American action meant that the export line would be less efficient and reliable than planned; by making the Soviets divert compressors from the domestic lines to the export line, the embargo could force a shortfall in Soviet transmission capacity by 1985; and by appearing to close off the Soviets' option of turning to the West later for more compressors, the embargo exposed the underlying vulnerability caused by the planners' overoptimism.

The Soviet leaders responded with a crash domestic program to boost output of domestic compressors. The Soviet political system has several traditional devices for concentrating attention and resources on high-priority tasks. One of the most important is the Party apparatus and the local Party committees located in every enterprise. When industrial plants in Leningrad were mobilized to put a domestically designed 25-mw gas turbine compressor into series production, the campaign was directed by the Leningrad *obkom*, with the personal participation of its first secretary, G. V. Romanov.

that the same is roughly true of that one as well. The estimate for compressor capacity assumes that each compressor station contains three 25-mw units. If they use 10-mw units instead, Soviet practice is to install 8 or 10 of them together to produce 75 atmospheres of pressure.

Such intervention has real costs, however, because it amounts to a deliberate disruption of the planned allocation of tasks and resources. In an economy with as little slack as that of the Soviet Union today, it causes concentric waves of unplanned shortages to ripple throughout the system, causing damage to other objectives. In the case of the American embargo, that was a price the leaders were willing to pay. Now that the American embargo has been lifted, will the leaders continue their high-priority intervention, and if so, up to what point?

The Soviet response to the American embargo was only the latest illustration that the Soviet political system has institutional mechanisms to override the "proportional balances" of its planning system when it needs to. What it does not have is any systematic way of knowing what the override is costing; or, to put the matter more broadly, there is little evidence that Soviet planners use systematic methods of striking the balance between the Western imports and domestic technology, especially if that involves reckoning in the opportunity costs of political priority, which is a scarce resource in its own right. But no refined econometric model is needed to ask, as the new political leaders surely must, how far they should continue to disrupt the plans of industrial ministries for the sake of the gas campaign. If, for example, the new leaders intend to force the pace of nuclear power construction (as they do), and one of the principal makers of nuclear reactor vessels, the Izhorskii Zavod, is drafted to help in the gas turbine effort, will the leaders continue to put national autonomy in compressors at the top of their list, or will they tell the Izhorskii Zavod to go back to its main job?

It is not yet clear how the new Soviet leaders are going to react to these questions. Much of the technological advance in Soviet gas transmission in the next ten years will depend on the answers and thus the degree of Soviet dependence on West European suppliers in this area.

SOME HARD CHOICES: IMPROVING THE PERFORMANCE OF THE PIPELINE NETWORK

Compared with the American network, the Soviet gas pipeline network does considerably less total transport work, despite a larger capacity. Robert Campbell, who has done the leading work in this area, was not able to assign definite causes from the data available, but the following appeared to be reasonable candidates: (1) lengthy service interruptions because of breaks and leaks; (2) fouling with condensate and water, as a result of failure to clean the gas adequately before shipment; (3) low availability of pipeline compressors; (4) excessively

high seasonal variations in transport work because of a lack of adequate storage capacity at the delivery end of the line; and (5) inefficient Soviet compressors. Campbell concluded that a major part of the Soviet problem was due to the low technological level that Soviet pipe and compressors impose on the pipeline network.⁷

Soviet writings show growing concern about the efficiency and reliability of the pipeline system. Every one of the possible causes mentioned by Campbell recurs in Soviet sources as well, but they add that a large part of the problem arises from poor infrastructure. The lack of proper gas-cleaning facilities in the gas fields, for example, is due in part to delays caused by lack of roads, which slow down the installation of gas-processing capacity. Although breaks and leaks in the pipelines may result from poor-quality pipe (a technological problem) they have severe effects because they must be repaired by helicopter-borne service units (a logistical problem); consequently, leaks take a long time to repair and each one causes a large drop in pressure and a major loss of gas. As a final example, the performance of piston compressors and electric compressors in the gas pipelines is worsened by fuel shortages (a logistical problem) and by the poor reliability of the portable electric generators that power them (a technological problem), which are used in the first place because there are no power transmission lines to bring in cheap central power (a logistical problem). In sum, we see that in explaining the low transport output of the Soviet pipeline, technological/industrial and logistical/infrastructural problems interact in multiple ways. As a result, plans to upgrade the technological level of the Soviet network are repeatedly revised downward.⁸

Increasing the Useful Throughput Capacity of the Pipeline Network

When the Soviets talk about upgrading the technological level of the network, they have in mind mainly a mixture of cooling the gas; raising the pressure; using better pipe, particularly multilayered types; and using better compressor stations (rather than, say, simply putting more stations closer together).

Cooling the Gas. As the Soviet gas industry moves toward higher operating pressures and builds pipelines over permafrost, it becomes necessary to provide refrigeration, lest the warming of the pipes caused by high compression cause the permafrost to melt and the

⁷Campbell (1981).

⁸See Campbell (1981) for illustrations.

pipeline to float and drift. Cooling the gas has the added advantage of making it denser, which in turn makes it possible to ship 7 to 10 percent more of it through the same pipe. Refrigeration is planned for all six of the major Siberian pipelines in the current five-year plan.⁹

Soviet officials say that cooling should have begun several years ago. The main reason it was not is that there was not enough electrical power available.¹⁰ To supply more electrical power, however, would require running transmission lines down the length of the pipeline, starting from a gas-fired powerplant at Urengoy.¹¹ Although such a plant is under discussion, it has apparently not yet been officially adopted.

A more fundamental obstacle is a lack of suitable domestically produced refrigeration units. In mid-1982 *Pravda* described existing Soviet models as cumbersome, inefficient, energy-wasteful, and complicated to operate. Each unit weighs 40 tons.¹² Moreover, their principal manufacturer, in order to supply the pipelines, must be diverted away from its normal mission, which is to produce commercial refrigerators for the food industry.¹³ For the East-West export pipeline, the Soviet gas industry bought 19 refrigeration stations from the French firm Creusot-Loire, at a cost of \$225 million. For the domestic lines, new special-purpose models are being developed, but the first demonstration model has only recently been shipped to Urengoy for testing, and series production is still far away.¹⁴ Consequently, most discussions of cooling in the Soviet press occur in the context of plans for the next generation of pipelines, which will operate at higher pressures than the present 75 atmospheres.

Raising the Pipeline Pressure. Transmitting gas at 100 or 120 atmospheres instead of 75 makes it possible to send 30 percent more gas through a single pipeline. The Soviet gas industry plans to move up to the higher pressures in the next five-year plan, and there is good evidence that Soviet planners would have liked to use the East-West export pipeline as a demonstration project to gain experience with the higher pressures. In the early rounds of negotiations with the West Europeans the Soviets initially presented a plan to build a single line operating at 100 atmospheres.

⁹*Oil and Gas Journal*, June 21, 1982, pp. 112-113.

¹⁰Altunin (1979), p. 19.

¹¹Trofimov (1981), p. 53.

¹²Lisin and Parfenov (1982b).

¹³The manufacturer in question is the Mariiskii Zavod in Ioshkar-Ola (*Pravda*, February 26, 1983).

¹⁴"Kholod—gazovoi reke," *Pravda*, January 25, 1983.

Why was the plan dropped? The way the Soviet press tells the story, "some foreign firms" (this could only have been Mannesmann, because that firm was the only one manufacturing such pipe)¹⁶ offered a single-walled, straight-weld pipe with walls 20 mm thick. To withstand Siberian cold, this pipe would have had to be made from "very expensive" special steels.¹⁶ Soviet economic studies showed that moving up to 100 atmospheres would not be cost-effective unless a new generation of lighter, cheaper pipe became available.¹⁷ Consequently, in the fall of 1980 the State Planning Committee, which had been defending higher pressures against a reluctant Ministry of Gas, dropped its position,¹⁸ and the Soviets proposed a 75-atmosphere concept to the West Europeans instead. MNGS officials were evidently in favor of the higher pressures too, because even as late as January 1981 the chief of that ministry's technical department was quoted in favor of the 100-atmosphere concept.¹⁹

Using Better Pipe. Soviet planners remain committed to moving up to higher pressures in the second half of the 1980s. The key to their plans is a domestically produced multilayered pipe, which has been under development for several years. In the spring of 1981 the Soviets completed tests of a second generation of this new pipe, and it was supposed to enter production at the Vyksa Metallurgical Plant (located in Gor'kii province) at the end of 1981. The output capacity of the new facility's first phase is to be 250,000 tons a year, and by the end of the 11th Plan output from the plant is to reach one million tons a year. An initial trial stretch of 3 km was to be laid in Siberia in the first half of 1982,²⁰ and 300 km of the East-West export line are to be built with the new pipe.²¹

The program has fallen behind, however. The first trial stretch of the new pipe was welded into place on the East-West line in July 1982,²² but the testing schedule has slipped. The Vyksa plant, which was supposed to produce 80,000 tons of multilayered pipe in 1982, managed to send off only "a few" thousand instead.²³ Its output plan for 1983 is "tens of thousands" of tons—not noticeably closer to the

¹⁶*New York Times*, July 5, 1980.

¹⁶"Vesomoe dostizhenie," *Pravda*, August 27, 1982.

¹⁷N. Kurbatov, head of Glavsibtruboprovodstroi, quoted in "Ratsional'noe ispol'zovanie material'nykh i trudovykh resursov na stroitel'stve magistral'nykh nefte-i gazotruboprovodov," *Planovoe khoziaistvo*, No. 4, 1981, p. 55.

¹⁸This at least is the version gathered by the *Financial Times*. See Cheeseright, Done, and Dodsworth (1981).

¹⁹Oleg Ivantsov, quoted in *Wall Street Journal*, January 23, 1981.

²⁰"Tsentral'naia stroika piatiletki," *Trud*, February 9, 1982; and "Ural'skoe plecho," *Ekonomicheskaya gazeta*, No. 13, March 1982, p. 9.

²¹"Tiumenskoe uskorenie," *Stroitel'naia gazeta*, July 25, 1982.

²²*Izvestiia*, July 31, 1982.

²³"Est' mnogoeloinye truby!" *Sotsialisticheskaya industriia*, August 21, 1982.

250,000 tons it is supposed to reach,²⁴ and the press reports problems in completing parts of the new plant.²⁵

The Soviet strategy is evidently to free themselves from dependence on Western pipe by jumping ahead to the next generation of transmission technology. This reflects long-standing problems with domestically made, single-walled pipes. At the end of the 1970s all Soviet pipelines operating at 75 atmospheres were made of imported pipe, and the small amount of 56-in. pipe produced in the Soviet Union could not be relied upon for use at more than 55 atmospheres.²⁶

Evidently this pattern continues in the current five-year plan, as the following calculation will show: If one takes as a rough rule of thumb a weight of 600,000 tons per 100 km of 56-in. pipe,²⁷ then the 21,000 km of 56-in. pipeline scheduled for the gas program require between 12 and 13 million tons. A survey of the world press shows that the West Germans have been supplying between 600,000 and 700,000 tons of large-diameter gas pipe to the Soviet Union each year, and Italy about 400,000. In 1981 through 1983, German sales remained at approximately the same level as they had been before. Japan has supplied about 700,000 tons a year in the recent past, but could increase its annual rate to 1,000,000 tons if credit questions are worked out.²⁸ (See the appendix on pipe sales.) In overall terms, then, Soviet purchases have remained roughly constant at under 2 million tons per year.

These figures suggest that, for the 11th Five-Year Plan, the Soviet Union is still relying on foreign imports for much of its needs for 56-in. pipe. A Soviet official indirectly confirms this when he observes that foreign pipe constitutes "only" 20,000 km of the 220,000 km of gas pipeline laid in the Soviet Union, exactly the amount of 56-in. pipe currently in place in the Soviet gas network. Soviet pipe for the new 56-in. lines is mentioned occasionally in small news items: a plant on the Volga and another at Khartsyzsk in Donetsk province are the two sources,²⁹ the latter producing 500,000 tons in the first half of 1982.³⁰

²⁴"Pervaia proba," *Pravda*, January 28, 1983.

²⁵"Vinovat i zakazchik," *Sotsialisticheskaya industriya*, January 28, 1983.

²⁶See Campbell (1980), p. 212.

²⁷The East-West line, for example, requires 2.7 million tons of pipe for 4451 km ("Vstupaiia v tretii god piatiletki," *Stroitel'stvo truboprovodov*, No. 1, 1983, p. 2).

²⁸The Japanese, who have been aggressive and successful exporters of steel pipe throughout the 1970s, have evidently been hampered by the Japanese Eximbank's insistence on sticking to the OECD's consensus rate; and although they have been negotiating for several years to increase their sales, the Soviets apparently have given the additional business to West Germany instead, whose manufacturers may have offered more attractive export credit terms.

²⁹News item in *Stroitel'stvo truboprovodov*, No. 1, 1983, p. 18.

³⁰News item in *Sotsialisticheskaya industriya*, July 25, 1982.

The bill for imported pipe appears to be running at about \$1.25 billion annually, but relief will not come during the current five-year plan. Even once the Vyksa plant reaches full capacity it will supply less than half the gas industry's needs (assuming the Soviet Union keeps on building pipelines at the present rate). Still, over the last 20 years Soviet steel pipe producers have been vigorous and fast-growing,³¹ and by the end of the decade they may end Soviet dependence on the West for high-performance pipe.

CAN THE SOVIETS MEET THEIR NEEDS FOR COMPRESSORS?

The American embargo of December 1981 had one immediate and important consequence: It blocked the General Electric Company from exporting to its West European licensees key components for the gas turbine compressors that the Soviets had ordered for their export pipeline. This appeared to throw a wrench into the Soviets' plans, because all but one of GE's European licensees were unable to produce the needed components themselves; the lone exception, Alsthom-Atlantique of France, had only a small facility, which was fully booked up for the next three years.³² The Soviets reacted to the American ban with defiance, vowing to defeat the embargo by producing domestic substitutes. Gas turbine compressors became for a time the central issue of the gas campaign.

Could the Soviets have met their needs on their own, if the embargo had been maintained? Now that it has been lifted, what are its lingering effects? Soviet designers and manufacturers have had more than a decade of experience in building gas turbine compressors for pipelines. But they have found it difficult to move up to the larger models now widely used in the West.³³ To gauge the effects of the American

³¹Since 1961 the Soviet Union has been the world's largest producer of steel pipe, and in 1980 it produced half again as much as the second-place producer, Japan (at 18 million and 12 million tons respectively). *Metal Bulletin Monthly*, No. 131, November 1981, pp. 99-101, citing figures originally published in Mannesmann's house journal *Rohrpost*.

³²For this reason, incidentally, the further tightening of the ban after the Versailles conference of June 1982 added little new, at least on the technical level: The bar on reexport added then only affected the few units that the West European contractors were able to build with the moving parts shipped before December.

³³For a review of the early history of this program, see Campbell (1980), pp. 14-20. Western imports have done more than fill the gap; they have also contributed "skills

embargo and the effectiveness of the Soviet response requires analysis of the sources of the Soviets' difficulties.

The key to Soviet plans to step up their program for domestic compressors was a 25-mw unit now beginning series production in Leningrad. In charge is the Nevskii Zavod ("The Neva River Factory"), the workhorse of the Soviet turbine industry, whose machines (the makers claim) pump three-quarters of the gas piped in the Soviet Union.³⁴ For the past ten years the Nevskii Zavod's principal gas turbine model was the GTK-10-4, a 10-mw system that first came into wide use in 1971. Since then the Nevskii Zavod has produced over 500 of these units, for a total capacity of 5000 mw.³⁵

In the 11th Plan as it stood before the embargo, the Nevskii Zavod's official assignment was to put the finishing touches on its 25-mw system and begin mass manufacturing it by 1983. Yet here too the plan was overoptimistic, because the new compressor at the beginning of 1981 was nowhere near ready for mass production. The reasons were partly bureaucratic: The 25-mw project had been caught for several years between MGP and the Ministry of Power Machinery (Minenergomash), the agency to which the Nevskii Zavod belongs. The basic dispute will be familiar to students of Soviet technological innovation. Although a prototype had been in existence since 1977, testing had been repeatedly delayed, causing the whole project to fall behind schedule. According to gas and pipeline construction officials, the culprit was Minenergomash. But the minister of Minenergomash retorted that the real source of the problem was the gas ministry, which was late in running the necessary field tests of the early models developed by his ministry.³⁶ The tests, in fact, were begun only in late 1979. The minister's tone, in late 1981, plainly suggested that the 25-mw compressors would not be in series production until late in the 11th Plan, if not in the 12th, even though the plan called for Nevskii Zavod's capital budget to double during the 11th Plan, mostly for the purpose of developing series production of the 25-mw model.³⁷

transfer" and a certain blending of domestic and foreign capabilities. According to Altunin, the Sverdlovsk and Nevskii plants (which are in charge of the 16- and 25-mw projects, respectively) have made spare parts for the imported equipment, thus "saving foreign currency and accumulating design experience for the future" (Altunin, 1979, p. 16).

³⁴The history and current activity of the Nevskii Zavod are described in a special issue of *Energomashinoströenie*, No. 12, 1981. The item above comes from an introductory article by the deputy minister of Minenergomash with apparent special responsibility for compressor stations (Kotov, 1981, p. 4).

³⁵Ibid. Campbell estimates that by 1974 about 174 such units were in service, which implies that from 1975 to the end of 1981 about 325 more such units were produced and put on line, an average of slightly more than 46 a year (Campbell, 1980, p. 213).

³⁶Kotov (minister of USSR Minenergomash) (1981), pp. 11-12.

³⁷Velikanov (General Director of Nevskii Zavod) (1981), p. 6.

The minister's accusations, incidentally, shed some light on the elements that enter into Soviet decisions to purchase abroad. The reason the gas ministry was so slow in running the necessary field tests of the domestic compressors, he wrote, was that the Ministry of Gas was biased in favor of foreign technology and that Gosplan indulged it by giving it too much money to buy foreign compressors, while allocating too few resources for the development of domestic versions.

In short, until the embargo came along, the prospects for the Soviet 25-mw machine did not seem very bright. What about the Soviet compressor program as a whole? Output of the older 10-mw model was probably scheduled to decline because, according to the director of Nevskii Zavod, the 25-mw model was to account for 80 percent of all turbine units produced by the factory by 1985.³⁸ Thus, one can only point again to the gap between plans and apparent capabilities at the end of 1981.

The immediate effect of the embargo was to galvanize Soviet decisionmakers and to sharply raise the political priority of the 25-mw compressor project. Leningrad Party officials began speaking of the task of launching series production of the 25-mw compressor as the highest priority of Leningrad industry,³⁹ and the effort was administered in the centralized style characteristic of such high-priority crash efforts, under the direct supervision of the Leningrad obkom.⁴⁰

The official goal—to produce 130 of the 25-mw turbines by 1985—did not change. But the difference is that the goal was evidently a fantasy before, and now Soviet leaders set out to put real muscle behind it. The first series model was finished at the end of December 1982,⁴¹ and one month later, the press announced that trials had been completed on the first unit and that two more were almost assembled.⁴² Some 40 Leningrad factories and institutes have been mobilized to contribute to the 25-mw program, including the Izhorskii Zavod,⁴³ the Soviet Union's leading manufacturer of nuclear reactors

³⁸Ibid.

³⁹Interview with S. Petrov, head of the heavy industry department of the Leningrad obkom, "Trudovoe sodruzhestvo," *Izvestiia*, July 4, 1982.

⁴⁰One could judge the project's high priority from the rank of the officials involved. For example, in early July a conference was convened at the obkom headquarters (located in the historic Smolny Palace), chaired by obkom first secretary G. V. Romanov and attended by the President of the USSR Academy of Sciences, A. P. Aleksandrov, to examine the "urgent tasks connected with completing, testing and speeding up mass production" of the 25-mw turbines (*Moscow Domestic Service*, reported in FBIS/SU, July 13, 1982).

⁴¹*Pravda*, December 25, 1982.

⁴²*Pravda*, January 26, 1983.

⁴³"GTN-25: seriia nachinaetsia," *Leningradskaiia pravda*, July 9, 1982. The fact that this plant was drafted to contribute to the gas turbine program, however peripherally, was a measure of the Soviet leaders' determination to bring the 25-mw turbines on line

and powerplants. The Leningrad Metallicheskie Zavod (which since the beginning of 1981 has also been producing the 10-mw turbines)⁴⁴ has been making turbine parts for the 25-mw unit, and Nevskii Zavod is responsible for the compressor parts.⁴⁵

These measures are in the purest Soviet campaign tradition, but will they enable Soviet industry to meet its compressor targets? That depends on what the main obstacle was at the time the embargo was imposed. Where the essential obstacles are administrative or psychological, high political priority applied from above can bring quick results. But if the essential obstacles are technical or scientific, then even the highest political priority cannot overcome them on command.

In the case of the 25-mw compressor, some of the obstacles were indeed administrative, but some were clearly technical too, because the new compressor contains several new technologies. The blades require coatings applied by electron beam; the rotors need electron-beam welding; the parts that operate at the highest temperatures (such as the combustion chamber) require new heat-resistant alloys; and for the first time, much of the fabrication is being done with numerically controlled machine tools and automated process controls.⁴⁶ As the Nevskii Zavod retooled for the 25-mw compressors, it needed to replace or modernize over 500 major pieces of production equipment.⁴⁷ This may help to account for the fact that testing of the first prototypes, when it finally began in earnest in late 1979, lasted well into 1982.⁴⁸ Following the testing, numerous changes were incorporated into the series models, which in some components (such as rotor disks) have more exacting tolerances than the prototypes did. The first series model took six months to complete,⁴⁹ whereas the last prototype had only taken four.⁵⁰

Perhaps because of these problems, Soviet commentators have grown more cautious about the number of new compressors Nevskii Zavod is likely to be able to complete in 1983. Earlier one could read target figures of 13 or 17, but later the press would say only

quickly, because the Soviet nuclear program was then badly behind schedule and presumably could ill afford any diversions.

⁴⁴"Trudovoe sodruzhestvo," *Izvestiia*, July 4, 1982.

⁴⁵"S operezheniem grafika," *Komsomol'skaia pravda*, September 9, 1982.

⁴⁶At one point in the fall of 1982, the press reported that the machining of some important components was being held up by a lack of software programs for the numerically controlled machine tools ("Nash pervenets—GTN-25," *Leningradskaiia pravda*, October 24, 1982).

⁴⁷*Energomashinostroenie*, No. 12, 1981, pp. 8-10.

⁴⁸*Ibid.*, p. 13.

⁴⁹*Pravda*, December 25, 1982.

⁵⁰"Trudovoe sodruzhestvo," *Izvestiia*, July 4, 1982.

"several."⁵¹ In short, the crash application of political priority may have loosened the 25-mw project's bureaucratic problems, but it may not have been enough to overpower the many technological problems that remained. The 1985 goal of 130 25-mw compressors still looks elusive.

Even if that target were met, the gas industry would not be home free. In such a newly developed model many reliability problems will have to be ironed out. The earlier 6.3-mw aircraft-engine compressors, for example, had a mean time to failure of 200 hours when they were first introduced in 1975, before reaching 1970 hours by 1978 and 3170 by 1980. (These are still very poor figures by the standards of Western firms, which advertise 25 to 40 thousand hours of continuous service.)⁵² Similarly, the 10-mw gas turbine had a troubled operating history during the first years after it was introduced.⁵³ It would be surprising, given this past history, if the new 25-mw model did not encounter similar problems.

Now that the American embargo has been lifted, the new Soviet leaders may well reevaluate the entire compressor program. Their problem has now changed shape: With the embargo gone, they can direct all of their domestically produced compressors to the three still-unfinished domestic lines. Does that mean that they can afford to relax the pressure on Nevskii Zavod and on the other Leningrad enterprises involved in the 25-mw program?

The answer depends partly on what other sources are available. Production of the older 10-mw model has continued at both Nevskii Zavod and Leningrad Metallicheskie Zavod, and there has been no further talk lately of slowing down their output during the 11th Plan.⁵⁴ This naturally adds to the strain on both enterprises. In 1982 the Nevskii Zavod was supposed to increase its output level by 28 to 30 percent, a pace that even the official press described as "remarkable."⁵⁵ But other plants are being equipped to produce the 10-mw compressors too. In Kazan', an engine-building plant is to produce four gas turbines (though not compressors) a month, starting in the fourth quarter of 1982.⁵⁶ The Turbomotorny Zavod in

⁵¹Gerasimov (1982a and b and 1983).

⁵²Campbell (1980), p. 218.

⁵³See details in *Energomashinostroenie*, No. 12, 1981, pp. 11-12.

⁵⁴"Nash pererenets—GTN-25," *Leningradskaia pravda*, October 24, 1982.

⁵⁵"Trudovoe sodruzhestvo," *Izvestiia*, July 4, 1982.

⁵⁶"Vazhnyi zakaz—dosrochno!" *Sotsialisticheskaia industriia*, July 6, 1982. One must be careful to keep in mind the different elements of the compressor technology, because they are frequently handled by different organizations. The gas turbine (*gazoturbinnii privod*) is the power source for the compressor proper (*nagnetatel'*); the combination of the two forms the compressor assembly (*gazoperekachivaiushchii agregat* or *ustanovka*), which is then the working core of the compressor station (*kompressornaia stantsiia*).

Sverdlovsk produces a 16-mw gas turbine compressor system,⁵⁷ the first two series units of which came off the line in 1982, to be followed by perhaps six or more in 1983.⁵⁸ Another plant in Khar'kov also produces gas turbine compressors.⁵⁹ These plants have stepped up their output targets, but they are dependent on the Leningrad turbine-building plants for parts.⁶⁰

Other technologies and other ministries are being mobilized as well. In most cases the plants involved had produced earlier generations of the same equipment. The Ministry for Chemical Machine-Building (Minkhimmash) has started series production of a new model of 16-mw compressors, using converted airplane engines from the Tupolev-154 and the Ilyushin-62.⁶¹ The plan calls for 55 units in 1983,⁶² although only five prototypes were produced in 1982. The enterprise concerned, located in Sumy, in the Ukraine, earlier produced a 6.3-mw unit that may still be in production. A follow-on model is now being designed, using engines from retired Ilyushin-86s.⁶³ A similar 16-mw model, using engines adapted from Tupolev-154 airliners, has been in series production in Perm' since the fall of 1982.⁶⁴ There is also talk in the Soviet press of using converted marine engines on the Urengoy-Petrovsk line, which is scheduled to reach full capacity by the end of 1982.⁶⁵ Finally, the Soviets continue to produce large numbers of compressors powered by electrical motors. The gas industry dislikes them, at least for service in Siberia, because large-scale power supply is lacking and the small generators used instead are frequently out of service.⁶⁶ Now, however, a 25-mw unit is being designed for service in developed areas, where ample power can be had.⁶⁷

What does this information add up to? Will compressors still be a bottleneck for the Soviet gas campaign, even now that the American

⁵⁷"Uskorim postavki sovremennoi tekhniki," *Ekonomicheskaya gazeta*, No. 29, July 1982, p. 3. The Sverdlovsk plant is mentioned in *Energomashinostroenie* (No. 12, 1981, p. 13) as the developer of an earlier-generation 6-mw model. See also an article by the minister of Power and Energy Machinery, Krotov (1982).

⁵⁸"Ural'tay ne podvedut," *Sotsialisticheskaya industriya*, September 25, 1982. An earlier report says the 1983 target is fourteen units ("Ural—gazovoi magistrali," *Izvestiya*, August 25, 1982).

⁵⁹TASS, reported in FBIS/SU, July 26, 1982.

⁶⁰"Ural—gazovoi magistrali," *Izvestiya*, August 25, 1982.

⁶¹"Shagai bystree, trassa!" *Sotsialisticheskaya industriya*, November 21, 1982.

⁶²"Stantsiya v upakovke," *Pravda*, February 9, 1983.

⁶³"Agregat dlia gazoprovodov," *Sotsialisticheskaya industriya*, July 10, 1982. The enterprise involved is the Frunze Machine-Building Industrial Association P/O. The 6.3-mw model is described in Campbell (1980).

⁶⁴"Proshel ispytaniya," *Pravda*, October 10, 1982.

⁶⁵"Gazovye trassy piatiletki" (editorial), *Sotsialisticheskaya industriya*, July 1, 1982.

⁶⁶Altunin (1979), p. 19.

⁶⁷TASS, in FBIS/SU, October 19, 1982.

embargo has been lifted? The difficulty is that Soviet sources are very discreet about whether the new units are in actual production and how many of them are likely to be produced. The official plan, as of the spring of 1982, was to build a total of 145 16-mw and 25-mw compressors on the six main lines from Urengoy by 1985.⁶⁸ Since the bulk of those were not available during the first two years of the current five-year plan, the first two 56-in. lines, now complete, were probably built mainly with older and smaller domestic compressors.⁶⁹ That leaves three lines, or the equivalent of 270 25-mw units for a total of 6750 mw, to be installed between early 1983 and the end of 1985, not counting what may still be needed to bring the first three lines up to full capacity. That still seems like a difficult assignment.

The case of the gas turbine compressors suggests several points about what Soviet decisionmaking may have been, both before the embargo and after. First, for the export pipeline, the Soviets intended to use Western technology to make up for the quality and reliability that their own industry could not supply. As in the last two five-year plans, they appear to have been overoptimistic about their domestic capabilities, especially in view of the classic problems that the new 25-mw compressor was encountering. Soviet planners may have been jostled by the suddenness of the political leaders' decision to launch a big gas program in 1981; to remedy the overoptimism of their pipeline targets, they may have been counting on returning to Western suppliers later in the 11th Plan. The American embargo, while it lasted, closed off that avenue. However, what was threatened was not the Soviets' ability to meet their export commitments to the West Europeans, but the completion of their domestic program.

The American ban may have supplied the impetus to Soviet decisionmakers to straighten out the inconsistencies in their compressor program and to cut through the bureaucratic turf wars that were contributing to delaying it. But the added political priority stimulated by the American embargo would not have speeded up series production of 16- and 25-mw compressors enough to offset the lack of West European compressors if the American ban had been maintained. Now that the embargo has been lifted, its lingering result is that the accelerated compressor development program apparently remains in effect, with consequences that will be felt mainly in the next five-year plan. In a statement published in December, MNGS minister Shcherbina vowed that, as a result of the emergency measures undertaken to

⁶⁸*Oil and Gas Journal*, June 21, 1982.

⁶⁹Gas minister Dinkov (1983, p. 2) confirms as much.

defeat the embargo, the Soviet Union would be "freed from [compressor] imports by the end of the current five-year plan."⁷⁰ But it remains to be seen whether the new Soviet leaders will wish to pay the price of high priority political intervention now that the immediate emergency is over.

⁷⁰Shcherbina (1982b), p. 7.

VI. CONCLUSIONS

The core of Soviet problems in economic decisionmaking is the malfunctioning of the planning system. It fails to provide policymakers with a clear and integrated picture of the choices before them and to provide implementers below with a coherent and realistic blueprint of what they are supposed to do.

The gas campaign itself was in several respects badly planned. The targets were set and the work launched before the planners had figured out where the necessary equipment would come from or how much money would be spent on it. The amount of gas the campaign would produce was more than the economy was likely to be able to absorb; and the planners devoted more resources to producing gas than to making the adjustments necessary to consume it. The hard-currency earnings the gas program was supposed to yield depended on an export pipeline whose basic concept had not been decided or negotiated when the campaign began. Which of two major fields the gas would come from had not been decided either, and in any case both lacked the necessary infrastructure.

Deficiencies in planning were compounded by problems of organization. The Soviet Union has no single ministry of energy or state committee with jurisdiction; neither is there a single staff or group that acts as a formal "czar" for energy policy in all its major aspects. Something like unified control comes only because the energy sector has been the object of the Kremlin's direct daily attention, but Soviet energy policy has suffered for the last decade from poor information, divided advice, interagency competition, and indecision.

At the level of implementation, even high-level supervision and support have not spared the gas industry three of the classic problems of Soviet management. First, most Soviet industrial ministries, being large, vertically integrated hierarchies, do well at focusing effort on their major targets but poorly at meshing horizontally with other ministries. Second, the incentive system in which Soviet ministries must operate encourages them to concentrate on intermediate indicators of performance, often to the detriment of the final goals desired by leaders. Third, the targets are too numerous and demanding for Soviet managers to hope to meet them all. They respond by putting first things first, which usually means the gross output target or some functional equivalent to it. But that also means putting second such things as product quality and reliability, spare parts, or "auxiliary" outputs—e.g., housing for workers.

To wrestle with these problems in the gas campaign, all of the traditional administrative devices have been deployed, but in addition there have been some new ones. One of these is a special division of the State Planning Committee devoted to coordinating the West Siberian oil and gas complex and located directly in Siberia. Despite the publicity given to this new division, it has had only a small effect. Local Party officials declare that the Moscow offices of the major ministries continue to call the shots and that the problems of horizontal integration are as severe as ever.

Consequently, much of the job of providing coordination and integration in West Siberia falls on the shoulders of the Party apparatus, much as it has traditionally done. Indeed, the local Party apparatus may have given a cold reception to the new Gosplan department as an unwelcome competitor. The local Party apparatus plays a prominent role in policy debates over the implementation of the gas campaign and has succeeded on several occasions in promoting changes—for example, in the crucial decision to save manpower and supplies by building the remaining new pipelines along a single corridor. Many of the officials are oil and gas professionals who have crossed over to the Party apparatus in mid-career.

Three main themes emerge from this investigation of the recent evolution of Soviet energy policy. First, Soviet energy policy has been highly changeable over the past decade and could well change again, if the new leaders depart from the "crisis mode" of the last five years. Second, ever since the beginning of the gas campaign there have been signs of strain over the immense rerouting of resources required, and as a result the gas industry may not actually be getting the resources that were originally projected. Third, the administrative and technological burdens of the gas program, compounded by the pressures imposed by the American embargo, have led to high costs and distortions in the implementation of the gas program.

The present policy began in late 1977, when Brezhnev launched a crash program to speed up West Siberian oil output. Two years later, the emphasis in Soviet policy began to shift to gas. Twice before during the 1970s, the leaders had examined and rejected an energy policy centered on natural gas, before finally accepting it in 1980-81. However, the earlier hesitations were reasonable, because it was not until the end of the 1970s that a big gas program became economically justifiable.

Even so, gas investment did not stand still: It grew rapidly from 4.05 billion rubles in the 8th Plan (1966-70) to around 21 billion in the 10th. For the 11th Plan no official investment totals have been announced, which suggests continuing disagreements and struggle over scarce capital. Indirect statements by industry officials indicate

they expect gas investment to be around 40 to 45 billion rubles. Tentative evidence suggests that actual annual outlays are less than that. At present rates, the gas program will receive only about 35 billion rubles. It is not possible to tell at this point whether the shortfall is due to political competition for funds or the inability of the gas industry to absorb more. There is some evidence for both.

Pipelines are getting 70 percent or more of the new investment in gas. This concentration of effort is forcing the gas industry to hold back investment in gas fields and distribution networks, as well as long-term preparations for future production. At Urengoy, housing development, road and port construction, fuel and power development, and growth of urban infrastructure are all lagging behind basic needs and may slow the output growth of West Siberian gas fields. Similar pressures have led the gas industry to focus its attention on its largest gas field, Urengoy, and slow down development of the next super-giant, Yamburg.

Most of the very large increases of investment in oil and gas in the 11th Five-Year Plan are going to West Siberia. This creates interregional strains that may emerge into the open now that the American embargo has been lifted and Brezhnev is gone. The shift to Siberia is especially striking for gas: 57 percent of Soviet gas output (357 bcm) will come from Siberia in 1985, rather than the 36 percent in 1980 (156 bcm). More than half of the increment of 44 billion rubles scheduled for the energy sector—the bulk of the increment for Soviet industry as a whole—will go to West Siberia in 1981 to 1985, which means a policy heavily skewed away from other claimants (notably the western regions of the USSR) at a time of unprecedented shortage of investment resources.

Such a pronounced shift also has important economic consequences because it aggravates the separation between energy production, which is shifting rapidly east of the Urals, and energy consumption, which is much slower to change and remains in the European zone of the USSR. This has two further effects: First, a rapidly rising transportation burden makes necessary (at least for gas) twice as much investment in pipelines as in the rest of the gas industry—still more Siberian investment. Second, because the preferential allocation of scarce capital to energy production in Siberia slows down the investment required for conservation, fuel-switching, and industrial relocation in the rest of the country, it perpetuates the inefficient pattern of consumption that made the forced march across the Urals such an urgent priority in the first place. All these could cause the new leadership to review the rapid rise of investment in Siberian energy.

Soviet accounts of conditions in the north 'Tiumen' fields often strike the Western reader as barely controlled chaos: shortages of

manpower, housing, and roads; supply bottlenecks of every description; and lags and failures in essential services. Through emergency measures, the gas industry has managed to keep these problems at bay, but it is generally recognized that these are costly stop-gaps. Disagreement over what policies to pursue over the long term have generated constant controversy, pitting local interests in north Tiumen' (including the local Party apparatus) against those of ministry headquarters and central planners in Moscow, and the gas industry against the other major ministries involved in the gas campaign.

Four issues stand out in the Soviet press: (1) How to deal with shortages of manpower and high labor turnover? (2) How much to invest in permanent infrastructural development rather than temporary? (3) How to provide power and energy for gas development and transmission? and (4) How to provide access for supplies and personnel to a remote, hostile region?

Five years ago, the region around Urengoy was all but uninhabited. Since that time the managers of the gas campaign have had to house, transport, feed, and provide other basic services to a new population of about 125,000 people. Not surprisingly, labor turnover has been a serious problem. Overall turnover in Tiumen' province is 50 percent annually, but that figure includes the oil industry as well as gas, and the turnover rate for gas is apparently higher.

To prevent manpower shortages from becoming a bottleneck in the gas campaign, every available source of manpower is being tapped: Young Leninist League volunteers; Student Construction Brigades; workers from Yugoslavia and various Comecon countries such as East Germany, which is contributing 10,000 workers to help build the export pipeline; and oil and gas workers from all over the USSR. There is no evidence one way or the other about the use of convict labor for pipeline construction. Even if such labor is involved, it can be only a small fraction of the total. The success or failure of the gas campaigns turns primarily on attracting and retaining skilled, nonprison manpower.

Soviet policymakers are divided between two broad approaches to the manpower problem for the gas region: either to create permanent urban centers, which will help attract a settled population, or to fly in a temporary labor force. Many local officials (including the local Party apparatus) want to make a commitment to build permanent cities in the gas regions. The central authorities in Moscow and the ancillary ministries have been reluctant, by and large, but are apparently beginning to change their attitude, first because the region will be producing gas for a long time, and second because, willy-nilly, urban agglomerations are already springing up.

Nevertheless, the reluctance is easily explained. Nearly all construction materials (with the exception of wood) must be brought in from the Mainland and must therefore compete for access to crowded supply lines with pipe, drilling equipment, and other essential materials. Moreover, Moscow planners ask themselves, Is it worthwhile to develop the region's basic infrastructure if a large permanent workforce cannot be attracted to the area? The main alternative, as they see it, is to fly in manpower from outside for temporary tours of duty instead, rotating them frequently back to home bases located in developed areas, outside Siberia when necessary.

The practice of flying in temporary workers is an integral part of both the gas and oil programs in Siberia. It has been the margin of difference in preventing manpower shortages from becoming a bottleneck in the gas campaign. But local authorities claim that the fly-in system brings them the wrong kinds of workers, with the wrong attitudes. Moreover, it is hard on the workers and bad for efficiency. Finally, it is expensive. For the moment there is no alternative to it, and the number of workers being flown in is increasing. But the debate about it is revealing: What is really in conflict here is the near-term concern of the planners and gas industry officials to meet the plan targets, against the growing concern of local officials for the long-term development of the Siberian region.

All these problems add up to bottlenecks at Urengoy. Supplies and access are the crucial problems. Even though they are stretching every fiber, Soviet managers are still having a serious problem in expanding docking facilities, railroads, service roads, and helicopter fleets fast enough. Even to come close requires giving top priority to gas in the Tiumen' transportation network, to the sacrifice of important supplies for the oil industry. The necessity for continued heavy reliance on waterways for the foreseeable future means that supply will continue to be highly seasonal and therefore vulnerable to pile-ups and inflexibilities. Even within the gas industry, needs other than the most essential will have to be sacrificed, which implies that urban construction and amenities will continue to lag, and the fly-in system will remain indispensable. The final implication of all the above (which deals only with the Urengoy field and does not include the additional burden of the pipelines) is that it will be costly even to stay abreast of the supply problem.

As a result, the growth of gas output at Urengoy appears to be lagging behind schedule. In addition, there are related problems of gas quality, because problems of access have slowed the pace of construction of gas-treatment plants. Businessmen in the West believe that the Soviets cannot be fully treating all the gas they are producing at Urengoy, because the output figures do not square with imports

of gas-treatment chemicals needed to process raw gas. Running raw or partly raw gas through the pipelines will further lower the reliability and the efficiency of the network and raise the requirements for compressor capacity.

That the Soviet gas industry has performed as well as it has is a tribute to its capacity for desperate improvisation in the face of shortages and constraints. The dilemma for Soviet policymakers now is whether to press on at the same pace, accepting the resulting costs and distortions, or to moderate the pace of the gas campaign, hoping to raise its efficiency. The most recent evidence is that Soviet leaders are leaning toward the latter.

In managing the gas campaign Soviet decisionmakers face not only the problems of infrastructural and logistical development, they have also had to develop a vast program of industrial and technological support, to provide pipe, pipelaying and earthmoving equipment, compressors and control equipment, and drilling and gas-processing machinery. But in carrying out this part of the program, Soviet leaders have faced well-known problems of industrial resistance to innovation.

At the outset, Soviet planners were clearly relying on Western equipment and pipe for the East-West export pipeline, and also for a great deal of the equipment for the six domestic 56-in. lines as well. Even so, they were placing unrealistically high demands on Soviet industry. For compressors, for example, the gas program called for 25,000 mw of new compressor capacity, of which only about 3000 was to be imported, leaving 22,000 to be supplied internally, a more than tripling of output to be met in five years. Nothing in the past performance of that industry suggested that it could meet such demands.

The American embargo of December 1981 exposed the Soviet planners' overoptimism. First, forcing the Soviets to use domestically made compressors to replace the West European ones meant that the export line would be less efficient and reliable than planned; second, by making the Soviets divert compressors from the domestic lines to the export line, the embargo could force a shortfall in Soviet transmission capacity by 1985; and third, by appearing to close off the Soviets' option of turning to the West later for more compressors, the embargo exposed the underlying vulnerability in Soviet plans.

The immediate effect of the embargo was to galvanize Soviet decisionmakers and to sharply raise the political priority of a domestic 25-mw compressor project that had been lagging for several years. The effort was administered in the centralized style characteristic of such high-priority programs, through emergency mobilization of several of the leading machine-building plants of Leningrad, under the direct supervision of the Leningrad Province Party Committee.

Whether these measures will enable Soviet industry to meet its compressor targets by 1985 is not yet clear. In the case of the 25-mw compressor, some of the obstacles were administrative, but others were clearly technological. The crash application of political priority loosened the 25-mw project's bureaucratic problems, but it may not have been enough to overpower the many remaining technological problems. The 1985 goal of 130 25-mw compressors still looks elusive, and even if it is met, many reliability problems will have to be ironed out.

Other compressor models are available, however. The first two 56-in. lines, now complete, were built mainly with older and smaller domestic compressors. That leaves three lines, or the equivalent of 270 25-mw units for a total of 6750 megawatts, to be installed between 1983 and the end of 1985. That still seems like a difficult assignment.

The embargo would not have prevented the Soviets from meeting their commitments to the West Europeans, but it would have been one more factor (although not necessarily the decisive one) contributing to a shortfall in total gas output by 1985. Over the longer term, however, by forcing Soviet leaders to confront the inconsistencies in their own development program and the risks of dependence on foreign suppliers, the American ban may have led the Soviets to put their domestic development program on an accelerated rate and to keep it there.

But for the Soviets to free themselves of foreign dependence will be expensive and will take at least another five years of top-priority efforts. Soviet industry faces a dual challenge, to overcome the unreliability and low efficiency of the existing pipeline network and simultaneously to move up to the next generation of pipeline technology, which will operate at 100 or 120 atmospheres instead of the present 75. In essence, the gas industry intends to deal with the problem of low efficiency by using a new generation of pipes, thus vaulting over the problems that have forced it to rely on foreign suppliers in the past. But Soviet planners remain committed to moving up to higher pressures in the second half of the 1980s. The key to their plans is a domestically produced multilayered pipe, which has already been under development for several years and has now begun production.

Coming as it has at the juncture of two different leaderships, the gas campaign vividly expresses many of the question marks about Soviet economic decisionmaking in the 1980s. We do not know, first of all, whether the command system is capable of combining the high-priority concentration of effort characteristic of the campaign method

with increased efficiency and useful innovation. Yet the future performance of the Soviet economy will depend closely on the leaders' success, despite the demanding targets they have set for themselves, in limiting costs, in producing gains in productivity, in striking a balance between present and future, domestic and foreign, Siberia and other regions, gas and other energy sources, and finally, between production of energy and its conservation.

We also do not know if the tendencies to resort to a campaign style or to carry it to excess once it has been launched are inherent, inescapable features of a command system. One of the most interesting things about the gas campaign is that it will serve as a test of the new leaders' capacity for asking two of the most difficult and delicate questions in any political system, "What is really needed?" and "How much is enough?"

Finally, we do not know whether the 1970s marked a basic change in the Soviet Union's relationship with the world economy, or whether the leaders' historic preference for autonomy and control will now reassert itself. Energy is a crucial part of that question, of course, because it is the greatest single source of financing for whatever the Soviets undertake in foreign trade and technology transfer. How much gas and oil the Soviets choose to export in years to come, in what proportions, at what prices, and to whom, will give important clues about the new leaders' attitudes toward their country's participation (as the Soviet phrase goes) in the "international division of labor."

Appendix

SOVIET PURCHASES OF WESTERN 56-IN. GAS PIPE, 1980-PRESENT

Country	Amounts and Terms	Source
West Germany	Mannesmann and Thyssen receive order for 700,000 tons, 3/80 through 3/81	WSJ 2/21/80 FT 4/13/81
	Mannesmann and Thyssen receive order for 550,000 tons, 4/81 through 3/82	FT 7/22/81 and 4/13/81
	Mannesmann signs contract for 666,000 tons, 4/81 through 4/82	WSJ 8/26/81
	Salzgitter and Estel/Hoesch win order for 100,000 tons of high-pressure, spirally welded pipe	EW 7/24/81
	Mannesmann and Thyssen sign new order in January 1982 for 1,200,000 tons of large-diameter gas pipe.	WP 3/23/82 EW 4/15/82
	Mannesmann reported to have contracts for total of 1,200,000 tons in 1982 and 1983	FT 4/2/82 and 7/14/82
Italy	Italsider (IRI-Finsider) wins contract for 400,000 tons, for delivery in 1981 (not clear whether gas pipe)	FT 5/1/81
	Reference to Italsider contract for \$230 million worth of gas pipe	WSJ 8/31/82
	Finsider receives order for \$200 million worth of gas pipe, \$300 million more may be in the offing, "for the Soviet Siberian pipeline"	JC 12/6/82
Japan	Japan negotiating 5-year agreement to ship 100,000 tons of gas pipe annually, beginning 3/81; Soviets seeking credits of \$350 million (the deal does not appear to have been concluded)	WSJ 8/28/80

Japan negotiating 5-year agreement to supply 3.5 million tons of pipe over four years (500,000 tons in 1981 and 1 million tons in the following three years) "for the pipeline." Total cost: \$3.5 billion. Japanese also discussing sale of 500,000 tons for shipment by March 1982	FT 4/15/81 and 4/24/81
Soviets purchase 200,000 tons of gas pipe in the first half of 1981	FT 7/22/81
Soviets purchase 750,000 tons of large-diameter steel pipe, for delivery by 3/81. Cost: \$400 million, financed by 5-year loan at 7.75 percent	EW 7/9/81 FT 7/7/81 and 7/22/81 NYT 7/14/81
Reference to Soviet purchase of 825,000 tons of large-diameter pipe, for delivery between 9/81 and 3/82	WSJ 9/ /81
References to total pipe deliveries of 795,000 tons from 4/82 to 3/83, under financing arrangements totalling \$400 million at 8 percent	FT 11/1/82 and 9/7/82, JC 9/8/82
Japan agrees to lend the Soviets \$374 million to finance purchase of 770,000 tons of large-diameter pipe, to be delivered starting 4/82	WSJ 12/1/81
Basic agreement signed in early 1982: Russians will increase imports of gas pipe to 1 million tons/year, starting in 4/83.	FT 11/1/82
Japanese steel companies contract to sell 95,000 tons of large-diameter gas pipe between 1/83 and 3/83, in addition to the 700,000 tons already ordered for delivery between 4/82 and 12/82. The initial 700K ton order was financed with a \$363 million loan at 8 percent (80 billion yen) repayable in 5 years	Reuter 12/31/81 AMM 12/4/81 WGR 1/11/82
Japan negotiating to export 1 million tons of large-diameter pipe, starting 4/83 (no agreement yet reached; Soviets holding out for 7.8 percent, which they claim to be getting from the Germans).	FT 11/1/82 and 10/20/82 EW 9/9/82

Price would be about \$500 million. The Japanese firms involved are a consortium of Nippon Steel, Nippon Kokan K.K., Sumitomo Metal, and Kawasaki Steel

Cumulative Sales	Mannesmann has sold 7 million tons of large-diameter gas pipe since 1970	FT 4/13/81
	Mannesmann has sold 8 million tons since 1970	WP 3/23/82
	Japan "normally" exports 750,000 tons of steel pipe per year to the USSR	FT 4/15/81

KEY: FT = Financial Times, WP = Washington Post, JC = Journal of Commerce, WSJ = Wall Street Journal, AMM = American Metal Markets, EW = East-West Fortnightly Bulletin, NYT = New York Times, WGR = World Gas Report.

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