CHAPTER 1

Summary: Issues and Findings

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INTRODUCTION

The Soviet Union occupies the largest span of territory in the world and is abundantly endowed with energy resources. It is the world largest oil producer and a major exporter of both oil and gas. Despite this enviable position, however, controversy has arisen in the past few years over whether the U.S.S.R. itself, or the Soviet bloc as a whole, may face an energy shortage during the present decade.

This possibility has provoked a debate among U.S. policy makers over whether it is in the best interest of the United States to assist the Soviet Union in its energy development. Those who favor such a policy believe it is justified to bolster American exports; to increase the world's total available supply of energy; to obviate extensive Communist pressure on world energy markets; and/or to reduce the likelihood that the U.S.S.R. would intervene in the Middle East to acquire oil it could no longer produce in sufficient quantities at home.

Adherents of the opposing view contend that to assist in the development of Soviet energy resources would be to help strengthen the economy of an adversary and/or that such assistance may convey direct or indirect military benefits, either: 1) because it might lead to the transfer of dual-use technologies that have military application; 2) because oil itself is a strategic commodity; or 3) because it could enhance the U. S. S. R. 's ability to exert "energy leverage" over West European nations if it placed the Soviet Union in a position to threaten to withhold energy exports.

Both of these perspectives entail certain unstated assumptions. Primary among these is the assumption that it is in the power of the United States to significantly affect the outcome of Soviet energy development in the near or midterm. Thus, focusing on the issue of whether or not the United States should assist the U.S.S.R. in its energy development tends to lead to the neglect of more basic questions. Among these is the issue of what course Soviet energy production will take if present policies—in both the West and the U.S.S.R. itself—remain unchanged. This is a controversial question in the West, and perhaps within the U.S.S.R. as well. Moreover, there are the central issues of *whether, how,* and to *what extent* the United States, either itself or in concert with its Western allies, could affect the energy future of the Soviet Union.

This study, undertaken at the request of the House Committee on Foreign Affairs; the Senate Committee on Banking, Housing, and Urban Affairs; and the House Committee on Science and Technology, was designed to investigate the latter set of technical issues so that the policy debate might be placed on a firmer footing. Specifically, it addresses the following questions:

First, what opportunities and problems confront the U.S.S.R. in its five primary energy industries—oil, gas, coal, nuclear, and electric power—and what are plausible prospects for these industries in the present decade?

Second, what equipment and technology are most needed by the U.S.S.R. in these areas; of this, how much has been or is likely to be purchased from the West; and to what extent is the United States the sole or preferred supplier of such items?

Third, given the evidence regarding the previous two questions, how much difference could the West as a whole and/or the United States alone make to Soviet energy avail-

ability by 1990; and what are the implications of either providing or withholding such assistance for both the entire Soviet bloc and for the West?

As will become clear, the U.S.S.R. faces both problems and opportunities in the years ahead. On the one hand, the Soviet Union is the world's largest oil producer and it has the world's most extensive gas reserves. It has the advantage of long experience with a large and complex petroleum industry, and it also has vast yet-to-be- explored territories that may contain energy resources. On the other hand, the development of these resources is constrained by two important and interrelated problems.

The first is the cost of energy exploitation. A diminishing proportion of Soviet oil and coal reserves are located in readily accessible areas. As older deposits are depleted, the U.S.S.R. must look to increasingly remote and difficult areas for proven reserves or promising sites for new discoveries. While proven gas reserves are more than ample, production is constrained by the pipeline capacity available to transport the gas. Construction of new pipelines—in this case across Siberia—is time-consuming and expensive since most of the pipe and other equipment must be purchased from the West. In short, the development and installation of technology and infrastructure to exploit the Soviet Union's remaining energy will take some time.

The time required for this exploitation and the severity of the problem itself will be affected by the second constraint on Soviet energy development. This arises from the nature of the Soviet economy—the rigidities introduced by the system of central planning and the problems caused by price and incentive structures that inhibit efficiency and productivity in both the energy sector and its supporting industries. While nonmarket economies such as that of the U.S.S.R. do have the advantage of allowing maximum marshaling of resources in priority sectors, there is an important sense in which the major inhibitor of Soviet energy development is the Soviet economic system, which not only produces conditions under which domestic solutions to energy industry problems become more difficult, but which also limits the extent to which the U.S.S.R. is willing or able to turn to the West for assistance.

PRINCIPAL FINDINGS

ENERGY AND THE STATE OF THE SOVIET ECONOMY

The rate of Soviet economic growth over the past quarter century has generally declined, and Western experts are virtually unanimous in predicting a continued slowing in the near term. To the extent that this economic slowdown signifies stagnation or decline in the rate of growth of per capita consumption in the U. S. S. R.—i.e., in the improvement of living standards for the Soviet populace—it may create political difficulties for the Soviet leadership.

Easily accessible and abundant energy played an important role in generating high growth rates in the past. The U.S.S.R. now faces the possibility of a plateau or even decline in oil output. The latter would certainly cause Soviet economic growth to slow even more, although the magnitude of such a slowdown is difficult to calculate. The impact of falling energy supplies will depend on a system of complex interrelationships in the economy and on Soviet policy regarding the composition of future energy balances and foreign trade patterns. Every policy option carries with it some costs and benefits to the Soviet economy.

If the U.S.S.R. is able to maintain levels of energy production close to the "best" cases posited here (stable or slightly increased oil production, and large increases in gas output), the Soviet economy could continue to

grow at the modest rate of the past 5 years; to supply Eastern Europe with energy at 1980 levels; and to increase the amount of oil and/or gas available for export to the West for hard currency. Under "worst" case assumptions, Soviet economic growth would slow considerably, and the ability of the U.S.S.R. to increase its real nonenergy imports from the West would be seriously impaired. This would negatively affect the overall growth prospects for East-West trade and would place further strains on the Soviet economy. Actual conditions will probably fall between these extremes.

In constructing best and worst case scenarios for 1990, OTA assumed that Western assistance in the development of Soviet energy resources would have its greatest quantitative impact on production after 1985. With extensive Western assistance in energy (particularly gas) development, Soviet hard currency earnings could rise substantially by the end of the decade. In the worst case scenario, with little or no Western assistance, Soviet exports of energy for hard currency would disappear by 1990.

If these cases are indeed close to the range of plausible outcomes, it appears that the simultaneous maintenance of a politically feasible rate of economic growth in the U. S. S. R., the further expansion of real energy exports to Eastern Europe after 1985, and a reasonably high rate of growth of East-West trade may hinge importantly on whether or not the West plays a significant part in developing Soviet gas resources in the 1980's.

SOVIET ENERGY POLICY

Despite the centralized nature of the Soviet system, policymaking takes place in a political context in which individuals and groups compete for resources and influence. There is ample evidence of debates over the relative priority that should be accorded different energy sectors. While the decisions made have naturally reflected the choices of the Communist party and its ruling executive committee (Politburo), a number of state Planning and administrative organizations, and ministerial, regional, and scientific groups also play identifiable roles in the formulation of energy policy, and are critical to the implementation of policy once formulated.

At one time, Soviet leaders placed some stress on the importance of the coal industry, and there were indications that it would receive priority in investment. This may at least partly have been due to the influence of the late Premier Kosygin, an advocate of coal development. The current Five Year Plan (FYP) indicates that this is no longer the case. Emphasis has now been placed on gas production and, to a lesser extent, on development of the nuclear industry. However, the energy debates of the past few years suggest that competition for resources among energy sectors may well reappear, particularly when the impending change in the aging Soviet leadership takes place.

THE ENERGY SITUATION OF EASTERN EUROPE

While Eastern Europe is much less dependent on imported energy than is Western Europe, these nations are constrained by geologic conditions that offer only limited prospects for increased domestic energy production, relatively energy-intensive economies, and limited ability to increase hard currency exports to pay for energy on world markets, In the past, heavily subsidized exports of Soviet oil have been crucial to East European economic development. If this subsidy were abruptly removed, the impact on Eastern Europe as a whole would be disastrous. The U.S.S.R. does appear to be beginning a transition, however; it has already announced that its oil exports to Eastern Europe will remain at 1980 levels, and it seems to be increasing the level of exports of gas priced at world market rates.

If the countries of Eastern Europe succeed in their plans for increased domestic production of coal and nuclear power (plans that may well engender growing environmental concerns) and for energy conservation and substitution measures, *and* if the

U.S.S.R. continues its oil exports at 1980 levels, Eastern Europe could make it to the end of the decade without a major energy-driven crisis. In the more likely case that these programs are only moderately successful, there will be pressure on the U.S.S.R. to increase its energy exports to Eastern Europe. In the absence of such assistance from the Soviet Union, pressure for economic reform within Eastern Europe could be expected to grow.

However, it is a mistake to think of Eastern Europe as a monolith. The situations of the six countries examined in this study vary significantly, and range from that of Romania, which appears to be facing the most difficult economic prospects even assuming a number of "optimistic" developments with respect to its energy situation, to Hungary, which would seem to be best able to withstand even a number of "worst case" conditions. The case of Poland is also noteworthy. Polish coal production has allowed it to be Eastern Europe's sole net energy exporter. To the extent that the present political and economic difficulties in Poland constrain coal output, the adverse repercussions on the energy situation of the region as a whole could be significant.

SOVIET ENERGY PRODUCTION IN THE 1980'S

Figure 1 summarizes Soviet primary energy production over the past 30 years and Soviet plans for 1985. The pattern exhibited here shows that for many years the bulk of energy output was in coal. The rate of growth in coal production began to decline in the 1960's, when oil overtook it as the predominant fuel. Coal production is now virtually stagnant, and the rate of growth in oil has markedly declined from that of the previous two decades. The fuel of the future is clearly gas, production of which, according to the U. S. S.R.'s own projections, will nearly equal that of oil in energy value by 1985. The following sections examine in more detail the current state of and prospects for Soviet energy industries in the present decade.

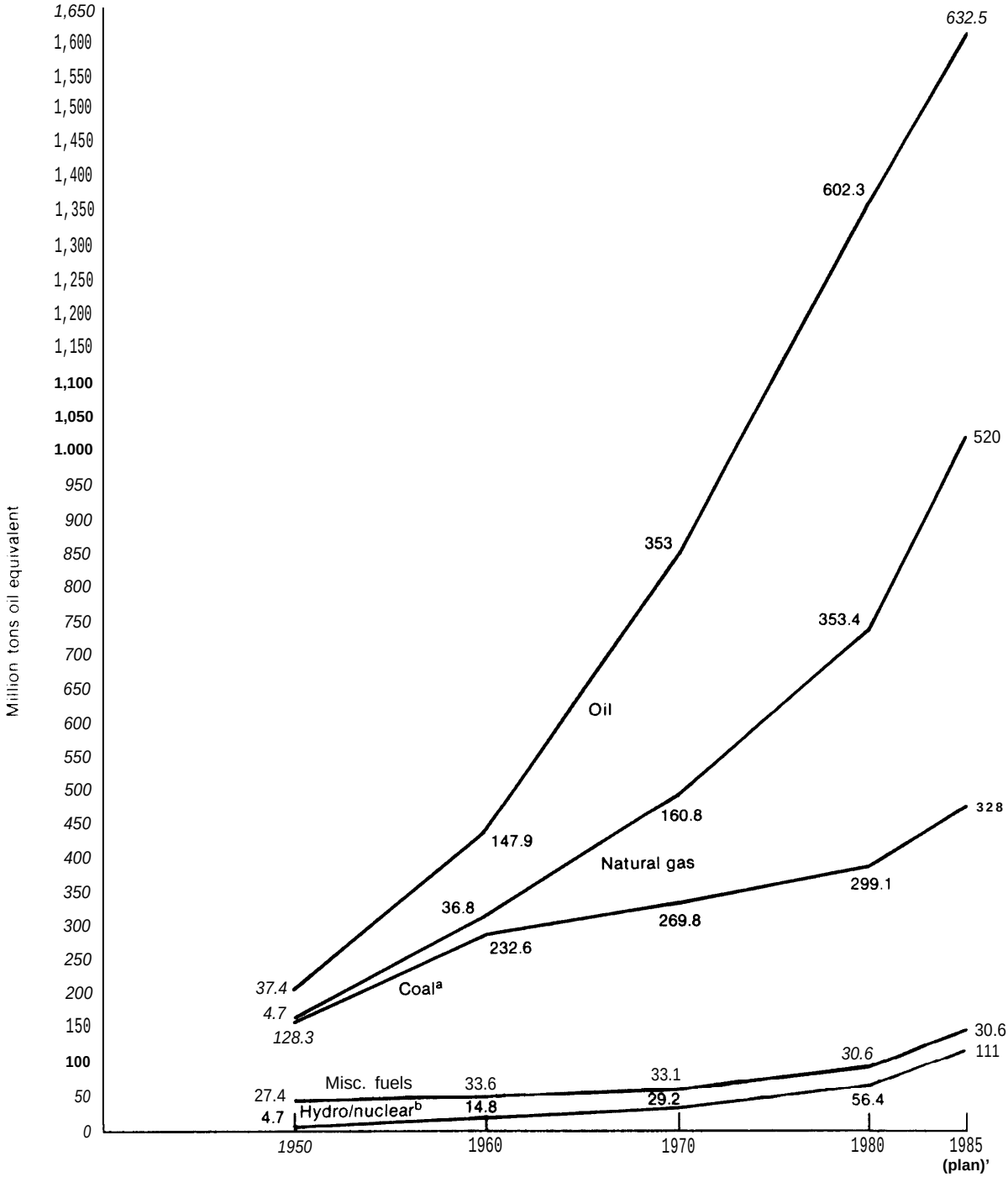
Oil

Projections of Soviet oil production in 1985 span an enormous range (see table 1). The Central Intelligence Agency's (CIA) most recent forecast maintains that output could decline by nearly 17 percent, while increases of roughly the same magnitude have been foreseen by the British Economist Intelligence Unit. The U.S.S.R. itself in its current FYP envisages slightly increase production, and the U.S. Defense Intelligence Agency endorses the feasibility of the Soviet target. The disparities among forecasts for 1990 are even more striking. CIA believes production will decline more than *40* percent from 1980 levels, while others contend that the Soviet oil industry could actually produce 25 percent more oil in 1990 than it did in 1980.

These predictions are all based on different interpretations of fragmentary Soviet information, different subjective evaluations of Soviet oil industry practice, and different judgments about the future of the Soviet economy and its capabilities. OTA does not believe that it is a useful exercise to attempt to determine which, if any, of these predictions is "correct." Indeed, given the poor record of forecasters even of U.S. production, it seems foolish to attempt to assert with any degree of assurance the outcome of complex processes in the U.S.S.R. 10 years hence.

OTA has instead attempted to identify *plausible* best and worst cases for Soviet oil production. These are not predictions; they are intended solely to provide a context within which the range of possible outcomes for Soviet energy availability in this decade can be discussed. OTA finds the upper range of the U. S. S. R.'s own target—which sets a goal of modest growth by 1985—to be a not-unreasonable best case. On the other hand, given that many things can simultaneously go wrong in the Soviet oil industry, it is reasonable to base discussion of worst case outcomes on the upper end of the CIA range. For 1990, even using best and worst case projections as a basis for analysis is a highly tenuous exercise. OTA has chosen as a best

Figure 1 .—Soviet Primary Energy Production (1950-80)



[a]Coal for 1980 716 MT • 67 Standard Fuel • 9091 MTHC • 6859 MTOE

[b]Hydroelectric and nuclear electricity are converted at fuel rates for central thermal stations

[c]Midpoint of plan range is plotted

SOURCES: L. Dienes and T. Shabad, *The Soviet Energy System* (Washington, D.C.: V. H. Winston & Sons), 1979, p. 32; and the Office of Technology Assessment.

Table 1 .— 1985 Soviet Oil Production Forecasts[a]

Million tons	Million barrels per day	Date of forecast
1.500-550	10-11	April 1981
2 . 5 6 0 - 6 1 0	112-12.2	June 1981
3 600	12	1979
4.605-655 . ..	121-13.1	1979
5 . 6 1 2 - 7 1 3	12.3 -14.3	1978
6.620-645	12.5 -12.9	1980
7 6 2 0 - 6 4 5	12.5 -12,9	August 1981
8 650-670	13-13.5	1979
9 7 0 0	14	1980

[a]Soviet 011 production in 1980 was 603 million tons.

SOURCES
1 CIA, as reported in Joseph A Licari Linkages Between Soviet Energy and Growth Prospects for the 1980's. paper presented at the 1981 NATO Economlcs Directorate Colloquium, Apr. 8-10, 1981 These numbers replace the 1977 estimates of 400 to 500 mmt.
2 OECD, Committee for Energy Policy, 'Energy Prospects of the U S S R and Eastern Europe, " June 26, 1981
3 Robert Ebel, "Energy Demand in the Soviet Bloc and the PRC," June 1979
4 Leslie Dienes and Theodore Shabad, The .Soviet Energy .System (Washington, D C V H Winston, 1979), table 53, p 252
5 Herbert L Sawyer, "The Soviet Energy Sector Problems and Prospects, " Harvard University, January 1978, quoted in George W Hoffman, "Energy Projections —Oil, Natural Gas and Coal In the U S S R and Eastern Europe, Energy Policy, pp. 232.241
6 Soviet Eleventh FYP target
7 U S. Defense Intelligence Agency, "Allocation of Resources in the Soviet Union and China— 1981 Statement of Maj. Gen. Richard X Larkln before the Joint Economic Committee, Subcommittee on International Trade, Finance, and Security Economics, Sept. 3 1981
8 Jeremy Russell, Shell 011
9 David Wilson, Soviet 0il and Gas to 1980, Economist Intelligence Unit Special Report No 90. This report was published just after the Soviet plan target was released In a foreword, the author reasserts his belief that 011 production of 700 mmt is achievable and attributes the lower Soviet plan to an apparent decision to divert resources from 011 to gas production

case hypothesis oil production remaining stable at the Soviets' own 1985 production target, and as a worst case, production declining, but remaining at a level above the 40 percent drop forecast by CIA.

Gas

Given the problems in the oil industry, and the fact that it is possible—indeed likely–that oil production will not rise greatly, gas is the key to the Soviet energy future in this decade. This is the energy sector with by far the best performance record in the past 5 years, and it appears to have been given priority in investment in the present FYP.

Proven Soviet gas reserves are tremendous; they may be likened to the oil reserves of Saudi Arabia. Gas, therefore, has a good potential for replacing oil both in Soviet domestic consumption and as a hard currency earning export. Gains in gas output could more than compensate for the apparent slowing of growth in oil production. The extent to which the U.S.S.R. can capitalize on its gas potential will depend on its ability to substitute gas for oil. This in turn rests on two factors: its ability to convert to gas in boiler and industrial applications, and its ability to add to the gas pipeline network. The rate of construction of new pipelines, both for domestic use and for export, will be the most important parameter in determining the extent to which Soviet gas can be utilized.

Photo credit TASS from SOVFOTO

Coal-loaded trains leave Karaganda

Coal

High-quality, easily accessible Soviet coal reserves have become depleted, and the volume of coal output in the last several years has actually declined. Even the relatively modest coal production targets in the

Eleventh FYP seem excessively optimistic, and gains in overall coal production will be offset to some degree by the fact that the quality of much of the new coal being mined is low, In fact, the quantity of coal mined could increase at the same time as the total energy derived from it (its standard fuel equivalent) actually declined.

The difficulties facing the Soviet coal industry are compounded by the fact that a number of problems must be addressed simultaneously if production is to increase meaningfully. These problems include low labor productivity, lagging additions to mine capacity, insufficient quality and quantity of mining equipment, insufficient coal transport capacity, and inability to use the low-quality Siberian coals that are making up an increasing share of production. Massive investment in the coal industry would be required to achieve gains in most or all of these areas, and even then success in terms of dramatic production increases could not be assured. This point underlines the relative cost effectiveness of relying on gas, rather than coal, as a substitute fuel.

Nuclear

Soviet nuclear power production has increased greatly in the past 5 years, and the U.S.S.R. is committed to an ambitious nuclear program. It foresees nuclear energy contributing as much as 14 percent of electricity production by 1985, and perhaps 33 percent by 1990. But Soviet targets for installed nuclear capacity, while attainable in principle, are probably overly optimistic.

More than in any other energy industry, progress here will depend on the efficiency and production capacity of equipment manufacturers. The growth of Soviet nuclear power will not be constrained by lack of know-how, nor is it likely to be inhibited by the kind of safety and environmental concerns so prevalent in the West. Very little is known about available Soviet uranium supplies, but it is probably safe to assume that these are adequate to support the nuclear growth that the Soviets themselves envisage, even given the competing claims of the military sector. Thus, the critical variable for the success of the Soviet nuclear power program will be the ability of support industries to construct nuclear power stations and of reactor and other equipment manufacturers to deliver on time and in sufficient quantities.

Electricity

To a great extent, the performance of the electric power industry in the present decade will be tied to the success of the nuclear program. Should planned additions to installed nuclear capacity fall seriously behind schedule—not an unlikely eventuality—fossil-fired generation will be called upon to cover the shortfalls. This prospect raises potential difficulties. Although, on the face of it, the industry appears to be sufficiently flexible, the extent to which fossil-fuel capacity can serve as a buffer for nuclear capacity is limited, to an unknown extent, by the degree to which low-quality Siberian coal can be utilized and absorbed by the electric power system, and by Soviet ability to complete the Unified Power System, which eventually will link all of the nation's regional electricity grids. The fate of the grid will be tied to the future of long-distance electricity transmission. The U.S.S.R. has amassed great experience in power transmission, including long-distance, high-voltage (250 to 1,000 kV) direct current transmission. However, Soviet power engineering is moving into a relatively new field—ultrahigh voltage transmission (over 1,000 kV)–which, at least initially, will entail high investment and operating costs.

Despite these problems, the evidence suggests that the U.S.S.R. will have sufficient reserve capacity in its power generation system in the 1980's and will be able to compensate for some shortfalls in nuclear capacity—provided that the necessary fuel supplies are available. Given the problems of the coal industry, however, meeting the latter condition cannot be taken for granted-unless gas can be used much more extensively.

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THE CONTRIBUTION OF WESTERN EQUIPMENT AND TECHNOLOGY TO SOVIET ENERGY INDUSTRIES

Oil and Gas

There is no question that Soviet oil production has been assisted by American and other Western technology and equipment, although the impact of this assistance is impossible to quantify. In 1979, the Soviet Union devoted approximately 22 percent of its trade with its major Western trading partners (some $3.4 billion) to energy-related technology and equipment. The vast majority of these purchases—about $2.7 billion—was destined for the Soviet oil and gas sector (and most of this was for pipe and pipeline equipment). Western exports in the past have helped to compensate for shortfalls in the production of Soviet domestically produced equipment, and for the fact that the quality of equipment is usually inferior to that which can be obtained in the West.

It is also true, however, that the impact of Western assistance has been lessened by at least two important factors. First, whether for lack of hard currency, a lack of perceived need, or a fear of dependence on the West, the U.S.S.R. has never imported *massive* amounts of oilfield equipment. Second, imported equipment and technology is usually less productive in the U.S.S.R. than it would be in Western nations. This may be due to a combination of factors. The Soviet Union has not often allowed hands-on training by Western suppliers to be carried out in the field, and suppliers themselves may be unwilling to meet Soviet conditions for the supply of spare parts, maintenance, or training services. In addition, Soviet maintenance and production practices are often not conducive to prolonging the useful life and promoting the efficiency of imported equipment.

The one area in which Soviet petroleum equipment and technology purchases might be described as "massive" is large diameter pipe and other equipment (compressor stations and pipelaying equipment) for the construction and operation of gas pipelines. There is no evidence that reliance on the West in this area will lessen in the present decade. Indeed, given the crucial importance of increased gas production and gas exports to the short- and medium-term Soviet energy future, there is reason to believe that such dependence will increase.

There is no doubt that the Soviet petroleum industry will benefit from continued–and increased—infusion of Western equipment and technology imports. But the expenditures of hard currency and the extent of the hands-on Western involvement necessary to make such imports maximally effective would be unprecedented Soviet behavior. With the possible exception of gas pipeline construction, there is little evidence that the U.S.S.R. is ready to make such changes.

Other Energy Sectors

In the past, the U.S.S.R, has been virtually self-sufficient in coal, nuclear, and electric power technology and equipment. Purchases in these areas have been small and spotty and appear to have been intended to compensate for specific deficiencies in the quantity or quality of domestic equipment, rather than to acquire new technological know-how.

Should the U.S.S.R. decide to reverse past practice and begin purchasing significant amounts of equipment in these areas, these purchases might consist of surface mining equipment, complete nuclear reactors and/or plants, and computers. Although every energy sector could profit from more extensive computerization and from the availability of Western (especially American) computer hardware and software, this would be of particular benefit to the electric power industry for management and control of the Unified Power System.

THE PROSPECTS FOR ENERGY CONSERVATION AND SUBSTITUTION IN THE U.S.S.R.

Conservation should be an extremely promising policy for the U.S.S.R. It could be accomplished both through a centralized "high-investment" strategy –i.e., through industrial modernization—and through a "low-investment or housekeeping strategy— i.e., improving the efficiency of operation of equipment already in place.

Despite evidence of interest in conservation, emphasis to date has been on producing, not saving, energy. To the extent that the latter has been accorded official attention, stress has been on exhortation to industry and individual consumers to conserve, a strategy which is unlikely to produce major results quickly because of weaknesses in the price structure, the prevailing incentive system, the enforcement mechanism, and the ways in which consumption is monitored and measured. In short, the U.S.S.R. has accomplished major energy savings, and opportunities for more still exist. But rigidities in the political and economic structure have prevented Soviet policy makers from taking full advantage of them. The situation may be ameliorated somewhat by an increase in energy prices scheduled for 1982, but the extent of the impact of such a reform on energy consumption cannot at this stage be predicted.

In addition to policies that result in overall energy savings, the U.S.S.R. is interested in lowering domestic oil consumption in order to free oil for highly lucrative export to world markets. This can be accomplished by substituting other fuels for oil in domestic use. Opportunities for substitution with coal are severely constrained both by the difficulties besetting coal production and by environmental concerns. Gas is the most promising alternative fuel but, as noted, the extent to which it can be utilized domestically is limited by the internal gas pipeline network, expansion of which will encounter the same difficulties as expansion of pipelines for gas exports.

THE FOREIGN AVAILABILITY OF WESTERN TECHNOLOGY AND EQUIPMENT

The Concept of Foreign Availability

The Export Administration Act of 1979 contains the provision that decisions regarding the control of U.S. equipment and technology should be affected by the availability of similar or equivalent items in other countries. It is left to the Department of Commerce to establish the capacity to gather and assess the information upon which determination of "foreign availability" will be made. There remain serious conceptual and practical problems that must be resolved before "foreign availability" can become a viable criterion for export licensing decisions. As of this writing, these problems have yet to be taken up in a comprehensive or systematic manner by either Congress or the Department of Commerce.

There is no commonly accepted definition of "foreign availability, " nor is there a central repository of information, or system for gathering such information, in place. OTA's own judgments of the foreign availability of items of energy-related technology and equipment must, therefore, be understood to be highly generalized. The term as it is used here denotes the existence in Western Europe and/or Japan of items with similar technical parameters and capabilities as those available from firms in the United States.

Oil and Gas Equipment and Technology

The United States is not the predominant supplier of most petroleum-related items imported by the U.S.S.R. OTA has identified numerous foreign firms which supply oil and gas equipment to the Soviet Union, reinforcing the theme of the international nature of the petroleum industry. Technology devel-

oped in the United States is quickly diffused throughout the world through an extensive network of subsidiaries, affiliates, and licensees.

There are a few items of oil and gas equipment and technology that are solely available from the United States, and a few others for which the United States is generally considered a preferred supplier. With the exception of advanced computers, however, the U.S.S.R. is either not purchasing these items, is on its way to acquiring the capacity to produce them itself, or has demonstrated that they are not essential to its petroleum industry. The United States continues to represent the ultimate in quality for some equipment, but the extent of that lead is diminishing, and the U.S.S.R. can and does obtain most of what it needs for continued development of its oil and gas resources from outside the United States. This is particularly true of what appears to be the most crucial import for this decade—large diameter pipe and pipeline equipment. The Soviet Union procures these items from Japan, West Germany, Italy, and France. Indeed, the United States does not produce the large diameter pipe that constitutes the U.S.S.R.'s single most important energy-related import.

Other Equipment and Technology

As noted above, if the U.S.S.R. reversed its present policy and began to import more extensively in its other energy sectors, one area that might receive particular attention is coal surface mining. The United States is a world leader in this field, and should the Soviet Union seek large amounts of the best and largest capacity surface mining equipment, it would be likely to turn to the American firms.

THE POLICIES OF AMERICA'S ALLIES TOWARD SOVIET ENERGY DEVELOPMENT

OTA examined the energy relations (including trade in both energy-related equipment and technology and in fuel itself) between the U.S.S.R. and five of America's principal allies—Japan, West Germany, France, Italy, and Great Britain. With the exception of Britain, trade with the Soviet Union has generally been more important for all of these nations than it has for the United States. While all cooperate in controlling the export to the Soviet Union of equipment and technology with direct military relevance, it is nevertheless true that these nations are far more inclined than is the United States to consider trade with the U.S.S.R. a desirable element in their foreign policy and commerce, and to eschew the use of export controls for political purposes.

Although trade with the U.S.S.R. makes up only a small portion of the overall trade of these countries, in 1979 energy-related exports constituted nearly one-half of Japanese, one-third of Italian, approximately one-quarter of West German and French, and about 10 percent of British exports to the U.S.S.R. The comparable figure for the United States was 7 percent. In absolute amounts, this translates into more than $1 billion worth of energy-related exports in 1979 for Japan, nearly that amount for West Germany, and almost one-half billion each for France and Italy. (This rank order has changed markedly in the past 5 years, with Japan overtaking West Germany as the U.S.S.R.'s major Western trading partner.) Most of these exports were destined for the Soviet petroleum industry, and an important part of this trade was in the large diameter steel pipe used in the U.S.S.R. for gas pipelines. Indeed, West German steel corporations are among the most vociferous in promoting such trade with the U.S.S.R. There is evidence that employment in several of West Germany's largest steel firms might be seriously affected by the loss of the Soviet market.

These nations also import energy from the Soviet Union. The most important Soviet energy commodity for Western Europe now and for Japan in the future is gas. In 1979, about 24 percent of Italy's and about 16 percent of West Germany's total gas require-

ments came from the U.S.S.R. These figures may be interpreted in several different ways, however. Italy, which had the highest reliance on Soviet energy, purchased about 10 percent of all the primary energy it used from the U.S.S.R. The comparable figures for West Germany, France, the United Kingdom, and Japan respectively were 6,5, 1, and 2 percent. In no country examined in this study did Soviet energy constitute more than 9 percent of 1979 total energy imports. But although overall "dependence" on the U.S.S.R. is low, some countries might face significant disruptions if Soviet gas became unavailable.

The most important and controversial example of West European (and possibly Japanese) energy cooperation with the U.S.S.R. is the proposed new pipeline, which will carry gas from West Siberia to as many as 10 West European nations. (This pipeline was originally planned to carry gas from the Yamburg field. The U.S.S.R. has now decided to delay development of that field and concentrate instead on further development of the Urengoy field, both for incremental domestic needs and export commitments.) The scale of this project guarantees that it . will raise the level of East-West energy interdependence in qualitative as well as quantitative terms.

Barring unexpected political or economic developments-probably even in the face of active diplomacy on the part of the United States–the gas pipeline project is likely to proceed. West Germany, France, and Italy all look to Siberia as a way to increase and diversify energy supplies while at the same time increasing energy equipment and technology exports. The latter consideration may also be important for Japan. Moreover, the pipeline project has political implications for each of the participants, and these too are important motives for proceeding. West Germany, for instance, has a vital interest in providing the U.S.S.R. with incentives to moderate its behavior in Europe and to help to foster improved relations with East Germany. Japan looks to its trade and energy relations with the U.S.S.R. as an important counterweight to its growing relationship with the Peoples Republic of China.

If the West Siberian Pipeline is developed as currently envisaged, West Germany, France, and Italy will certainly become more dependent on Soviet gas, although this gas will to some extent replace the Soviet oil they presently import. In any case, dependence on the U.S.S.R. would still be significantly smaller than dependence on OPEC. A cutoff of Soviet gas would impact each country differently (each, mindful of the risks entailed in the deal, has made different contingency arrangements), but none would be immune from hardship, particularly in the context of a tightened world oil market or other energy crisis. Each of the three would benefit from the development of more effective contingency plans, allowing for substitution of alternative energy supplies in the event of Soviet shortfalls, and thereby diminishing the opportunities for the U.S.S.R. to make use of any sort of "gas weapon" to exert political pressure on its gas customers. The most effective contingency planning would be that undertaken by West European nations as a bloc–but as yet there are no serious prospects that this will occur in any formal sense.

FOUR ALTERNATIVE U.S. POLICY PERSPECTIVES

Suggestions for U.S. policy regarding Soviet energy development can be categorized around four alternative strategies. This section briefly sets out the basic tenets espoused by adherents of these strategies and indicates OTA findings with respect to each.

1. *The embargo perspective* seeks to severely curtail or eliminate the ability of

U.S. firms to sell energy-related (especially petroleum) equipment and technology to the U. S. S. R., either because these items may have direct military relevance or because oil and gas are considered to be strategic commodities. In this connection, it is often asserted that helping the U.S.S.R. to develop these resources is helping bolster the economy of an adversary nation.

OTA found that very few items of oil and gas technology and equipment could be diverted to direct military applications. Computers are the most important exception here, and these are already subject to both U.S. and multilateral export controls. Exercise of this policy option, justified by the inherent importance of petroleum, would be tantamount to pursuing a policy of economic warfare against the U.S.S.R. The United States attempted this after World War II. It formally abandoned the effort in 1969, in recognition of the facts that the United States was sole supplier of few of the items sought by the U.S.S.R. from the West, and that United States allies were not willing to participate in such restrictive policies. The unenthusiastic response of Western Europe and, to a lesser extent, Japan to President Carter's post-Afghanistan technology embargo against the U.S.S.R. indicates that this attitude has probably not changed. It is possible to posit circumstances under which the United States could persuade its allies to reverse their own policies, but this would likely take a dramatic change in the political climate as well as a major policy initiative on the part of the United States. The latter might have to include concrete suggestions for energy supply alternatives to Soviet gas.

2. *The linkage perspective* most closely describes present U.S. policy toward trade with the U.S.S.R. Linkage is a policy that seeks to use the prospect of expansion or curtailment of trade as a "carrot"' or "stick" to exact policy concessions from the trading partner. This perspective accommodates a number of different opinions as to how and under what circumstances linkage should be attempted, but in one form or another it has influenced U.S. trading policy with the U.S.S.R. since at least the Nixon era.

There is no unambiguous evidence regarding the effects, if any, that linkage vis-a-vis the Soviet Union has ever had on Soviet domestic or foreign policies; thus, no final determination of its success or failure can be made. In the case of petroleum equipment and technology, the effectiveness of a linkage policy would be limited by the fact that the United States is the sole supplier of very few items crucial to the Soviet oil and gas industry, and in those cases in which it is a preferred supplier (e.g., pipelaying equipment), the U.S.S.R. has available alternatives that, albeit second-best choices, could produce the desired results. The limitation of linkage are well illustrated by the fact that the import most crucial to Soviet energy development in the present decade—large diameter pipe—is not produced in the United States.

3. *The energy cooperation perspective* assumes both that American technology and equipment could make a significant positive contribution toward increasing Soviet energy availability in the present decade and that such a development would be in the interests of the United States in that it would help to reduce Western dependence on OPEC and relieve pressure on world energy markets.

OTA's findings suggest that although American technology and equipment have assisted the Soviet petroleum industry, the United States is not the only–indeed, perhaps not even the most important–Western nation to provide such assistance. For United States exports to make more of a difference, not only would the United States have to be willing to sell massive amounts of equipment and technology to the U.S.S.R. on attractive terms—probably involving export credits—but the U.S.S.R. would itself have to be willing to purchase in large amounts, to utilize the imported items in a more efficient manner, and to allow the United States and other Western firms to

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U S pipelaying equipment used in the construction of the Northern Liqhts gas pipeline

provide greater hands-on training and to participate more fully in Soviet energy projects.

4. *The commercial perspective* rests either on the belief that trade and politics should remain separate and/or on the judgment that regardless of the export control policy it adopts, the United States is unlikely to be able to significantly affect the U.S.S.R. energy situation on this decade. Those who espouse these views therefore believe that U.S. firms should be permitted to reap whatever economic benefits can be gained from selling nonmilitarily relevant items to the U.S.S.R.

Such a policy might allow significant sales for individual firms, but, unless it were accompanied by the extension of official export credits, it is highly unlikely that it would result in enough trade to have any direct impact on the overall foreign trade or competitive position of the United States. On the other hand, the lack of pronounced economic gains resulting from such a policy could be at least partially outweighed by potential political benefits derived from removing the issue of Soviet energy from the arena of conflict between the United States and its allies.