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# THE U.S.S.R. FACING SIBERIAN COAL, OIL AND GAS DEVELOPMENT

P. ARMAND

J.C. PAUZE

Guy de CARMOY

THE EUROPEAN INSTITUTE OF BUSINESS ADMINISTRATION

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## INTRODUCTION

This report does not deal with an extensive analysis of both energy and developmental policy in the U.S.S.R., as its title may perhaps lead to believe.

The importance of this subject has already inspired numerous writers and, furthermore, the lack of detailed documents and data has left a considerable part to personal interpretation on this matter.

In this context, it is therefore obvious that the object of our study is limited, yet precise.

We have gathered and classified some essential information about the U.S.S.R., its energy features and its main political lines so as to enable the reader to make a synthesis of the future coal, oil and gas development in this country.

Consequently, this report as a whole tends to offer more descriptions than valuations, except in the conclusion where more personal ideas on the future are expressed.

For this purpose, we have not thought it necessary to examine every detail: some have been quoted as explanation, others omitted. Hydro-power, for instance, has just been hinted at.

Therefore, a more detailed documentation is indispensable for all those who want to study a particular aspect of the matter at close quarters.

## I - ENERGY RESOURCES

### 1. A GENERAL VIEW OF SIBERIA

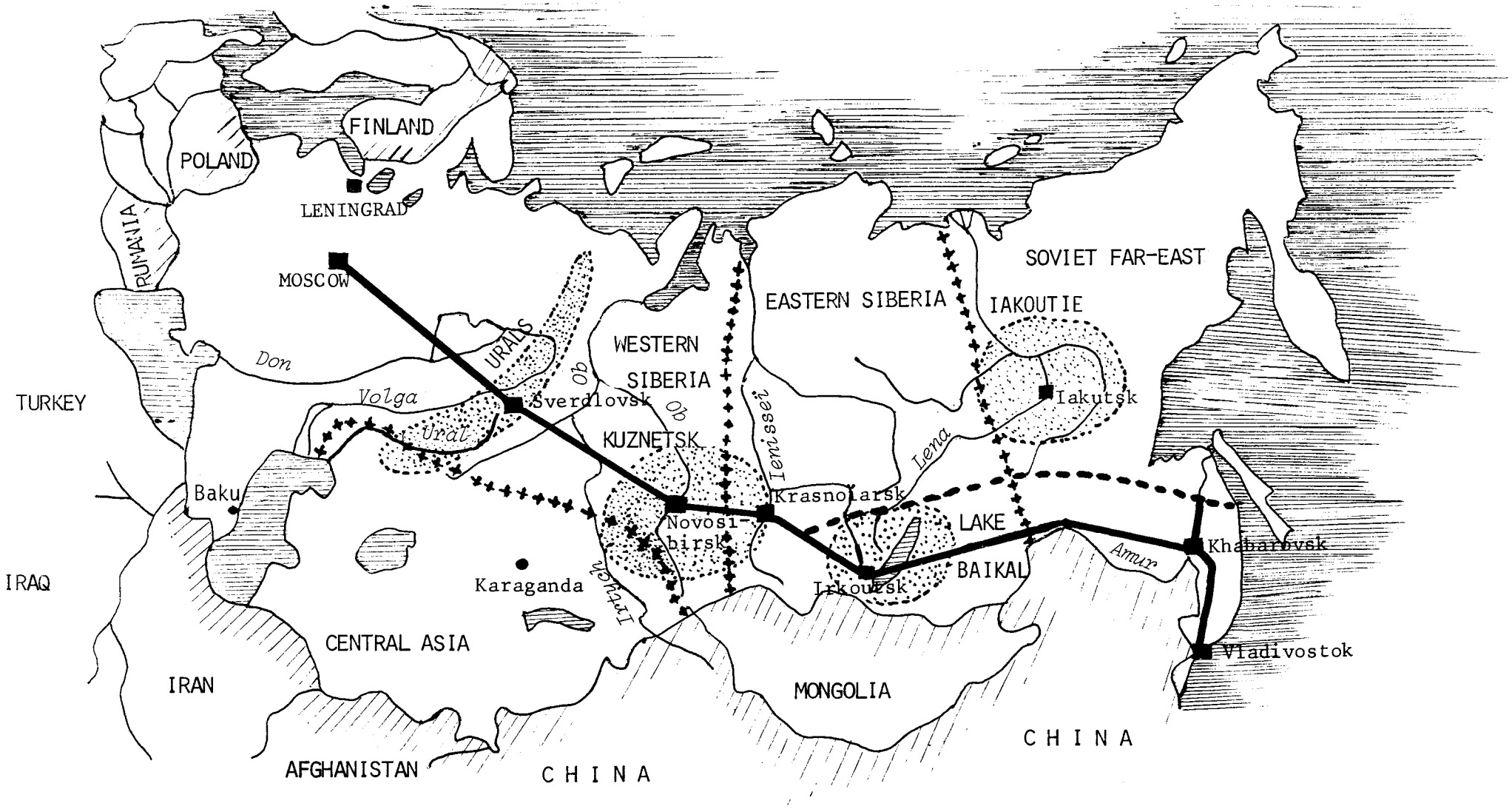
One and a half times the size of Canada, potentially even richer, Siberia is generally considered as a vast inhospitable country with inexhaustible but almost inaccessible wealth underground.

Stretching for some 12 million square kilometres, Siberia is half the area of the Soviet Union. There are about 8,000 kilometres between Moscow and the Soviet Far East. The distance is detrimental to the bureaucratic centralization of the country, totally controlled and co-ordinated from Moscow and encourages a certain spirit of independence within the three Siberian regions:

- Western Siberia, that is, roughly speaking, the Ob basin;
- Eastern Siberia, extending along the Ienissei basin;
- the Soviet Far East, i.e., approximately, the Amur and the Lena basins.

In exploiting Siberian resources, harsh climatic conditions add constraints

MAP OF THE U.S.S.R.




Industrial Area

Trans-Siberian

Scale 0km 500km 1000km

MAP No. 1

hardly insuperable to the problem of endless distances: permafrost to a great depth in Winter and vast quagmires in Summer; impassable rivers six months a year, etc.

The several industrial centres ranging from the West to the East, from the Urals to the Pacific, Novosibirsk, Krasnoïarsk, Irkutsk, Khabarovsk, are the various stages of an endless eastward route: the development of Siberia.

They are connected by the two Trans-Siberian electric railroad lines and by a highly developed air-network. 80% of the goods are conveyed by rail.

The 24 million inhabitants (only 10% of the Soviet population) are very unequally scattered along this sort of "umbilical cord". Population shift rate is very high. After three years, 50 inhabitants out of 100 went back to the West, towards more hospitable regions. Therefore, Siberia is still a region of pioneers, as is shown by its high rate of productive investments when compared to the rest of the U.S.S.R.

| | All-Union | Siberia |
|---|---|---|
| Productive Investments | 64.7% | 78% |
| Non-productive Investments | 53.3% | 22% |

*(Ref. 1)*

Thanks to these investments, in Siberia the growth rate is higher than it is in the rest of the country.

| | |
|---|---|
| All-Union | 8.4% |
| Siberia | 8.7% |
| where the Far East accounts for | 9.7% |

*(Ref. 1)*

## 2. ENERGY POLICY DEVELOPMENT IN THE U.S.S.R.

### 2.1. Present Reserves

The U.S.S.R. ranks first among all countries in energy reserves:

- 55% of world coal reserves,
- 35% of gas reserves,
- 27% of oil reserves,

where Siberia accounts for:

- 3/4 of coal,
- 4/5 of gas,
- 3/5 of oil.

The U.S.S.R. is therefore the only big industrial country in the world to be thus *"potentially"* self-sufficient in energy supplies over the next

twenty years and capable of exporting a part of its output.

## 2.2. Resource Evolution

The U.S.S.R. political and historical evolution has influenced the development of its energy structure:

1. by modifying the location of resources and consequently shifting its gravity centre eastwards;
2. by modifying deeply the share of each kind of resource within the total output.

### 2.2.1. Coal Era

Before 1917, Donbass coal (Ukraine), together with the Baku and Grogznyi oil-fields (Caucasus), largely provided the power necessary to the Russian industry under the Czars. Baku oil, the exploitation of which was financed by the other European countries, was widely exported.

After the revolution, the emphasis was put on both energy and industrial independence. With the plan for heavy industry development, a big electrification programme was set out. Donbass and Kazakhstan coal was the key of this development which, after a halt during World War II, continued at the end of the 1950's. This coal - of the utmost importance in this period - provides 2/3 of energy resources.

However, Donbass depletion as well as the remoteness of Kazakhstan deposits increased considerably production costs. During the first few years of the post-war period, in order to safeguard employment in those regions, price was kept artificially low, and industries were compelled by the State to use coal as a source of energy.

### 2.2.2. Oil and Gas Era

This artificial situation could not last for ever, especially when two important strategical reasons rose to support the change in resource allocation to the benefit of liquid and gaseous hydrocarbons.

In fact, as a result of World War II, the U.S.S.R.:

- became aware of oil's strategic military importance as a fuel;
- and recorded the irreversible shift to the East and the Urals, out of range of any invader, of a large number of heavy industries.

The oil-field of the Volga-Ural triangle, discovered just before the War, was systematically exploited at the beginning of the 1950's in order to supply the power necessary to the new Ural industries and cope with the depletion of Baku deposits.

The importance of this field, called "Second Baku", determined the change in the Soviet energy policy, as it is clear in the 1953 Plan:

- stress on the search for new oil-fields in the East, instead of the unsatisfactory development of the old fields;
- improvement in the exploitation of gas fields, connected or not with oil-fields;

- downward revision of the coal consumption forecasts;
- re-examination of some big hydroelectric projects operating under-capacity.

As a result of the implementation of this plan, at the beginning of the 1960's, another gas and oil-field was discovered at the confluence of the Ob and the Irtych, in the Tyumen region. Anyway, this eastward expansion seems now to come to a halt, because of increased operating costs due to such detrimental factors as distance, geology and climate.

## 2.3. Resource Allocation

This change of strategy resulted in the following energy source allocation:

Table 1

BREAKDOWN OF ENERGY SOURCES

| | 1913 | 1950 | 1960 | 1970 |
|---|---|---|---|---|
| Coal | 48 % | 66 % | 52 % | 32,2 % |
| Gas | - | 2 % | 7,6 % | 23,5 % |
| Oil | 30.5 % | 19.5 % | 29.5 % | 35.9 % |
| Others (hydro-power, brown coal, lignite) | 21.5 % | 22.5 % | 10.7 % | 8.4 % |

*(Ref. 2)*

Table 2

INTERNATIONAL COMPARISON - 1972

| | U.S.A. | Western Europe | Japan |
|---|---|---|---|
| Coal | 18 % | 25 % | 25 % |
| Gas | 31 % | 10 % | 2 % |
| Oil | 46 % | 61 % | 71 % |
| Others | 5 % | 4 % | 2 % |

*(Ref. 3)*

Table 3

SIBERIA'S SHARE IN THE ALLOCATION
OF ENERGY SOURCES

| | 1950 | 1970 | 1980 (Forecasts) |
|---|---|---|---|
| Oil | 1.6 % | 9.6 % | 40 % |
| Gas | 1.6 % | 5.5 % | 35 % |

*(Ref. 3)*

### 2.4. Conclusion

It is essential to point out that *4/5 of the Soviet economy's needs lie in European Russia, but 4/5 of the exploitable resources are to be found in Siberia.*

The eastward shift of the Soviet energy gravity centre seems to be irreversible. In fact, the energy growth rate is 6 to 7% per annum, which means that needs will double within 10 years.

The exploitation of Siberian resources is therefore the indispensable condition of an independent development of the Soviet economy.

## 3. NATURAL ASSETS

### 3.1. Geographical Location

Without considering each producing field in detail, let us analyse a few groups of deposits which correspond closely enough to some areas in the Soviet economic planning. In fact, it is more interesting to refer to these entities than to the merely political division represented by the republics.

These areas are:

1. Caucasus regions and Western regions,
2. Volga-Ural region and Northern Europe,
3. Central Asia and Kazakhstan,
4. Western Siberia ,
5. Eastern Siberia,
6. The Soviet Far East.

Each area does not contain the three kinds of fuel.

3.1.1. Coal

Coal is found in the following areas: Ukraine (Donets), Northern Europe (Pechora), Kazakhstan (Karaganda), Western Siberia (Kuznets), Eastern Siberia (Irkutsk), and the Far East (Yakutsk and Kamchatka).

It is important to ascertain the shift of production. In 1960, the Western areas contributed 64% to national production, whereas at present they supply only some 55%.

Table 4

COAL PRODUCTION AREAS

| Producing Areas | 1960 | 1965 | 1969 |
|---|---|---|---|
| Western Urals | 64.1 % | 60.7 % | 57.6 % |
| Eastern Urals | 35.9 % | 39.3 % | 42.4 % |

*(Ref. 4)*

3.1.2. Oil

In view of the above classification, oil can be located as follows:

- *Western and Caucasus Areas*

These areas were the first to be developed. Production is now steady or decreasing.

- *Volga-Ural / Northern Europe*

It still holds the top position in U.S.S.R. as a producing area. It has the great advantage of being near and well connected with the industrial consumption centres.

Let us mention a few names: Tataria, Bachkirie, Perm, Orenburg. This area is sometimes called "Baku II". Deposits have been discovered in Northern Europe as well. They have been exploited for five years (Komi).

- *Central Asia and Kazakhstan*

These areas as a whole are in full expansion. The two main producing centres are: Turkmenistan and the Mangyshlak Peninsula. An old field, North of the Caspian Sea, is gradually dying out (Emba).

- *Western Siberia*

At present all the Soviet medium-term hopes rely on this area. The fields discovered record a more and more rapid increase in production. Between 1970 and 1973, it almost tripled (31 M. tons to 86 M. tons). The deposit is located in the Tyumen area. The field of Samotlor alone supplies 1/3 of the output of this area. Between Tyumen and the Artic, some traces of oil have been

already discovered. There might be considerable reserves.

- *Eastern Siberia*

Between the Ienissey and the Lena, there are some fields too, still under prospection. This area is, to a great extent, ill-known. However, the surroundings of Irkutsk, thanks to the coal and the oil pipe-line from Western Siberia, are a pole of industrialization.

- *The Soviet Far East*

In the Soviet Far East, little has been done so far about oil. Only a few pits in the North the Island of Sakhalin are exploited and their production is steady.

Some traces of oil, indicative of future discoveries, have been found in Yakutie.

As in the case of coal, an eastward shift is recorded. The following table briefly illustrates the present situation:

| Steady or dying out reserves | Reserves with slightly increasing or steady production | Proven reserves still to be estimated and surveyed | Discovered reserves still to be estimated and surveyed | Reserves still to be discovered in favourable areas |
|---|---|---|---|---|
| Trans-Caucasus<br>North Caucasus<br>Russian Fields<br>Emba | Volga-Urals<br>Sakhalin | Tyumen<br>(Samotlor)<br>Kazakhstan | Eastern<br>Siberia<br>Central Asia | Western<br>Siberia<br>The Far East |

*(Ref. 4)*

The following percentages in relation to the total output have been obtained by putting this eastward migration into figures:

Table 5

OIL PRODUCTION AREAS

| Areas \ Years | 1960 | 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|---|
| European Russia and Ural | 92.8 | 92.9 | 81.8 | 63.4 | 51.6 |
| East Ural and Central Asia | 7.2 | 7.1 | 18.2 | 36.6 | 48.4 |

*(Ref. 4)*

This movement will inevitably progress in the future. By now, research is mostly carried out in Siberia and Central Asia.

We shall consider further on the problems due to this shift, as regards the developmental policy to be undertaken.

### 3.1.3. Gas

Contrary to what occurs in other parts of the world, natural gas is found in deposits where oil is totally absent. Besides, 80% of the reserves are gathered in 20 main fields.

In the light of our previous arbitrary but simplified classification, gas can be located as follows:

- *Caucasus and Western Areas*

This group of areas accounts for more than half the U.S.S.R. gas output.

The two main producing centres are: North Caucasus and Ukraine. They both record a slight decrease in production.

In close proximity to both the consumption centres and the countries where gas was exported to, these energy sources were extremely profitable to the U.S.S.R.

- *Volga-Ural*

This territory contains gas, too, but its contribution to the total Soviet gas output is small (some 10%).

- *Central Asia and Kazakhastan*

These areas have been acquiring increasing importance since 1965, as regards gas supply. At present, they cover 30% of the total output. Two fields are particularly important: Gazli and Shatlik.

- *Western Siberia*

As in the case of oil, all the efforts in production will converge on this area over the years ahead. The Tyumen area contains both gas and oil. In addition, a huge deposit has been discovered in the Ienissey basin, containing three times as much gas as that of Groningen.

Presently, it produces 12% of the total output.

- *The Soviet Far East*

This area is still to be explored. However, it is certain that the territories near Yakutz contain gas.

This fuel records an eastward shift, too. It can be said that it is so far more of a shift toward Central Asia than eastward; anyway, the intense exploitation of Tyumen fields will accentuate this eastward shift.

The following figures are indicative of this migration:

Table 6

GAS PRODUCTION AREAS

| | 1960 | 1965 | 1969 |
|---|---|---|---|
| Europe and Ural | 97.6 | 85.5 | 72.4 |
| East Ural and Central Asia | 2.4 | 14.5 | 27.6 |

*(Ref. 4)*

## 3.2. Potential / Existing Resources

In this context, a classification of the notions of "proven recoverable resources", "estimated resources" and of the simple fact that immense areas are geologically favourable to the existence of such fuels, would be appreciated.

As for us, we shall limit our study to two categories: the proven and estimated resources and the potentialities, in the broadest sense of the term.

### 3.2.1. The Proven and Estimated Resources

#### 3.2.1.1. *Coal*

The U.S.S.R. accounts for about 2/3 of the world recoverable reserves. Coal alone contributes 88.5% to all the domestic energy reserves.

Most coal reserves (90%) are found east of the Ural and are suitable for open-cast mining. The cost per ton at the energy source is low, but transportation raises the total costs of production.

Before quantifying coal resources, it is to be pointed out that "coal", in administrative terms, means: hard coal, lignite and brown coal, thus implying a distinction between the given figures.

The following estimates are therefore liable to improvement. Anyway, the orders of magnitude are correct.

- *Table 7 on next page* -

Table 7

COAL RESERVES

*(million tons)*

| | Measured Resources | Total Resources | % in the World Total |
|---|---|---|---|
| Hard Coal | 145,123 | 4,121,603 | 64.4% |
| Lignite / Brown Coal | 104,354 | 1,406,380 | 67% |
| Total | 249,477 | 5,527,983 | |

*(Ref. 5)*

3.2.1.2. *Oil*

As regards oil, figures are far more risky than for the other fuels.

Actually, U.S.S.R. available data in this connection relate to World War II. Economists and politicians refer to four kinds of reserves: proven, semi-proven, probable and potential.

We have the following data for the first three kinds of reserves:

| | |
|---|---|
| 1957 | 3,280 M tons |
| 1970 | 8,750 M tons |
| 1971 | 5,600 M tons* |

*(Ref. 6)*

These proven reserves are found at easily approachable depths: 82% of them above 2,000 metres (6,000 feet).

Whereas this crude contains much sulphur (2% on average) and the Volga-Ural product even more, West Siberian oil is of better quality.

3.2.1.3. *Gas*

The U.S.S.R. is considered as the country with the higher volume of gas in the world. The prospected resources reach 18,000 billion cu. m., 80% being found in the area beyond the Ural, and 60% in Eastern Siberia.

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* This figure refers to the proven reserves alone.

Soviet reserves account for about 35% of world reserves. In 1972, the Reserves/Production ratio was 68 for the U.S.S.R., 10 for the U.S.A., 58 for the Netherlands.

These reserves are more specifically found (than they are in the case of the other fuels) in particularly barren areas, accessible only during a few months per year.

It has been estimated that the U.S.S.R. owns 40% of the lands in the world susceptible of containing gas.

#### 3.2.2. Areas with Great Potentialities

This brief paragraph will provide information without figures. Nevertheless, it is interesting to analyse the long-term developing axes mentioned by the Minister of the Oil Industry.

- *Eastern Siberia*

This area has been hardly explored. During the 1972-1975 period, the drilling of 470,000 metres is contemplated whereas the Minister himself would envisage a figure of 1,000,000 metres.

However, it has been ascertained that there exist huge gas reserves.

- *The Caspian Sea's Depression*

The exploration of this area requires technological notions unknown to the Soviets: off-shore and great depth. Nevertheless, all this part is full of promises.

- *The Siberian Continental Plateau*

The immense Siberian Continental Plateau, the largest in the world, enjoys favourable geological structures, and still is the only area in the world (as appears in a study carried out by B.P.) where there might be reserves equal to those existing in the Middle East.

### 3.3. Production Rate

After having located the production centres and outlined their contribution to the total output together with an estimate of the resources, let us analyse now some data on production and its growth rate.

#### 3.3.1. Coal

There are hereafter two lists of rather different figures, one made available by the U.N.O. and the other extracted from the Soviet year-books. The gaps well illustrate the problem which an outside observer is confronted with.

These two statistics dovetail in predicting that the U.S.S.R. would produce, by 2000, some 1,000 million tons of coal.

Table 8

COAL PRODUCTION

*(million tons)*

| Year | U.N.O. | Soviet Year-Books |
|---|---|---|
| 1951 | 229 | |
| 1955 | 334 | |
| 1960 | 400 | |
| 1965 | 430 | 577.7 |
| 1968 | 447 | |
| 1969 | | 607.8 |
| 1971 | 460 | |
| 1975 | | 685 |

*(Ref. 5)*

Apart from the disparity of figures, we see that they are both indicative of a highly fluctuating production growth rate, thus proving the difficulties encountered in exploiting.

Table 9

COAL PRODUCTION GROWTH

| Year | 1960 | 1961 | 1965 | 1966-67 | 1968 | 1970-71 |
|---|---|---|---|---|---|---|
| Rise in the growth rate (percentages) | +1.3 | -0.6 | +4.3 | +1.5 | -0.2 | +2.5 |

*(Ref. 4)*

Over the coming years, it is hoped that production will increase at a slightly higher rate than the initial one: 10 to 11% against 8%.

The quality of the coal mined is more or less unchanged. After a decrease, the average calorific power is homogeneous again. A constant and sizable rise in coking coal production (25 to 30%) has been recorded.

Considering the problems of infrastructure and productivity (lower than in the West) in broad outline, it can be noticed that open-cast

production is about to cover 50% of the total output.

Now that mechanization seems to be widespread, the U.S.S.R. has recovered from the technological backwardness (12 years) it suffered from, if compared to the West.

### 3.3.2. Oil

The overall data on oil production are:

Table 10

OIL PRODUCTION

| Year | 1955 | 1960 | 1965 | 1970 | 1972 | 1975 | 1980 | 1990 |
|---|---|---|---|---|---|---|---|---|
| Production *(million tons)* | 70.8 | 148 | 243 | 353 | 395 | 496 | 640 | 900/950 |
| Growth percentage in relation to the preceding year | | *14%* | *8.6 %* | *7.6 %* | *5.6 %* | *7.6 %* | *5 %* | - |

*(Ref. 6)*

It can thus be observed that the growth rate has progressively decreased over the last few years.

Several factors contribute to the slowdown of this growth:

- The Soviets wish to exploit their reserves at a twenty-year ratio (reserves/production).
- The newly exploited areas are more and more inhospitable, and the fields deeper and deeper.
- Production in the Volga-Ural area, which must continue to ensure most supplies in the years to come, can be maintained only by adopting stimulation techniques (water, gas, etc.).
- Nevertheless, production in some areas (e.g., Byelorussia, Lituania) will be largely profitable to the U.S.S.R. Being well located, its products have a low rate of sulphur.

### 3.3.3. Gas

- *Table 11 on next page* -

Table 11

GAS PRODUCTION

| Year | 1955 | 1960 | 1965 | 1970 | 1975 |
|---|---|---|---|---|---|
| Production ($10^9$ $m^3$) | 9 | 45.3 | 127.7 | 197.9 | 320 |

*(Ref. 7)*

These figures appear to be particularly satisfactory. Nevertheless, many expectations in this connection have been disappointed.

For instance, if we compare plans in the 1960's to the actual realization or the revised figures, we have:

Table 12

GAS PRODUCTION PLANNING AND IMPLEMENTATION

| Year | 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|
| Plans | 150 | 240/225 | 380/400 | 680/720 |
| Implementation or Revision ($10^9$ $m^3$) | 127.6 | 200 | 300/320 | 620/645 |

*(Ref. 8)*

The production growth rate is therefore still low. For the 1970-1972 period, the increase in gas production fell from 9% to 4%.

Two main factors are responsible for these unsatisfactory results:

- the production shift; and
- the lack of infrastructure.

## 3.4. Infrastructure

In this section, we shall essentially refer to the existing or projected

oil and gas pipe-lines.

It is not necessary to deal with these networks one by one. Since 1965, priority has been accorded to the construction of gas pipe-lines. On the other hand, a considerable amount of oil is still carried by rail (40%, which means a cost price three times that of pipe-line transport).

At the end of 1972, a special Ministerial Department in charge of the construction of the works necessary to the Oil Industry, was set up and from that time on, priority was reversed.

By now, most attempts converge on the construction of a large-diameter oil pipe-line (121 cm), running from Samotlor to the Ural.

The length in kilometres of the two networks increased as follows:

Table 13

OIL AND GAS PIPE-LINE LENGTH

| Year | 1955 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oil *(km. $10^3$)* | 10.4 | 17.3 | 20.5 | 21.7 | 23.9 | 26.9 | 28.2 | 29.5 | 32.4 | 34.1 | 36.9 | 37.4 | 41.0 |
| Gas *(km. $10^3$)* | 4.9 | 21.0 | 25.3 | 28.5 | 33.0 | 36.9 | 41.8 | 47.4 | 52.6 | 56.1 | 63.2 | 67.5 | 70.7 |

*(Ref. 7)*

Maps No. 2 and No. 3 show the pipe-line lay-out (Cf. pp. 17-18).

Technically speaking, several problems concerning the quality of the pipes as well as the lack of complementary materials (such as pumps, sluice-gates, etc.) are to be faced when executing these works.

In fact, the pipe-line performance is far lower in the U.S.S.R. than in the Western countries.

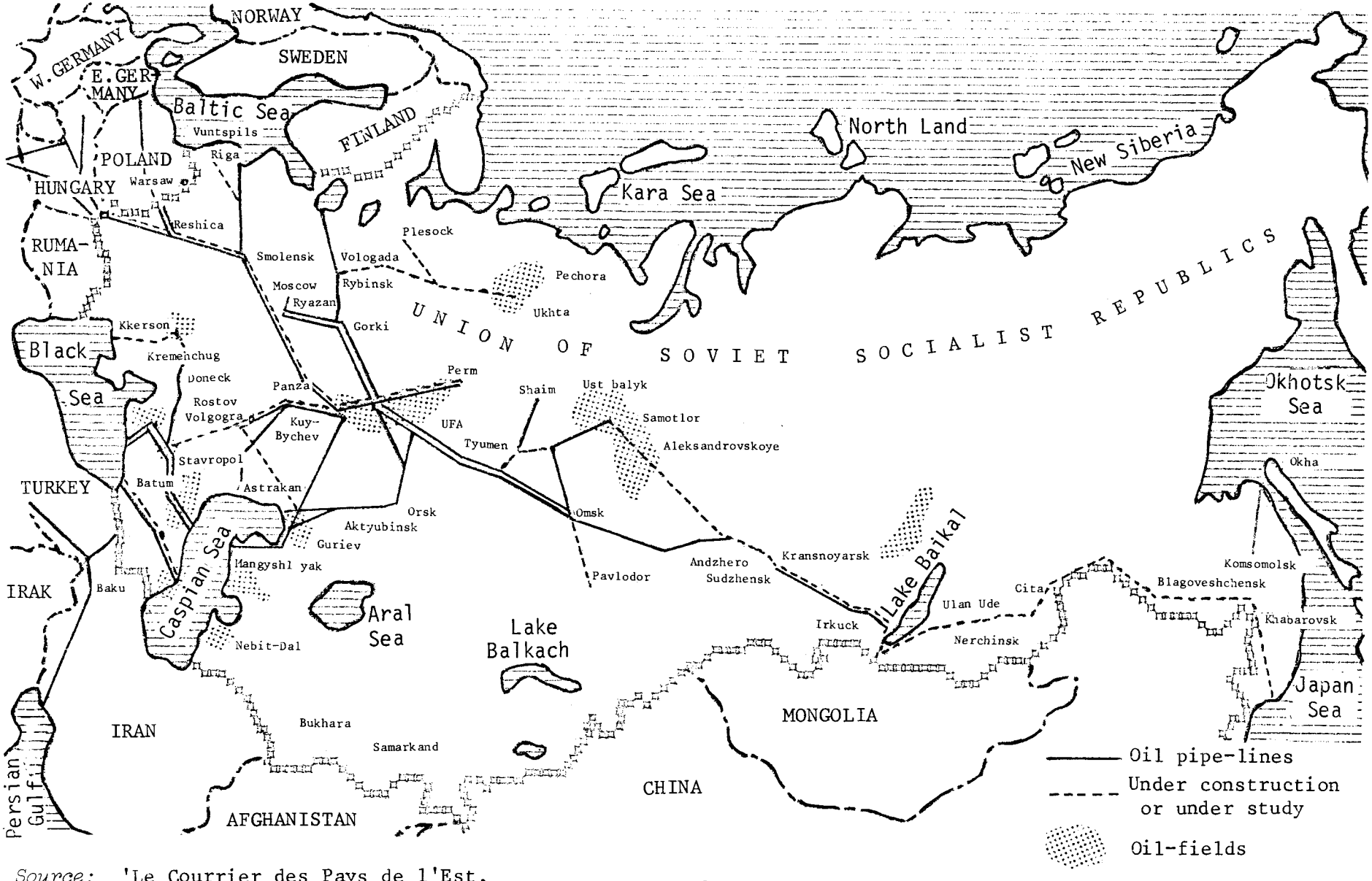
The same problem applies to coal. Railroad transportation alone, over a distance of, say, 2,000 km, costs 5 roubles per ton.

The average total cost of coal in European Russia is estimated at 15 roubles. Therefore, the U.S.S.R. is supposed to lose money when it sells coal to the West.

The following indices of transportation costs for each fuel are indicative enough of the importance of an energy reconversion.

- *Table 14 on page 20.*

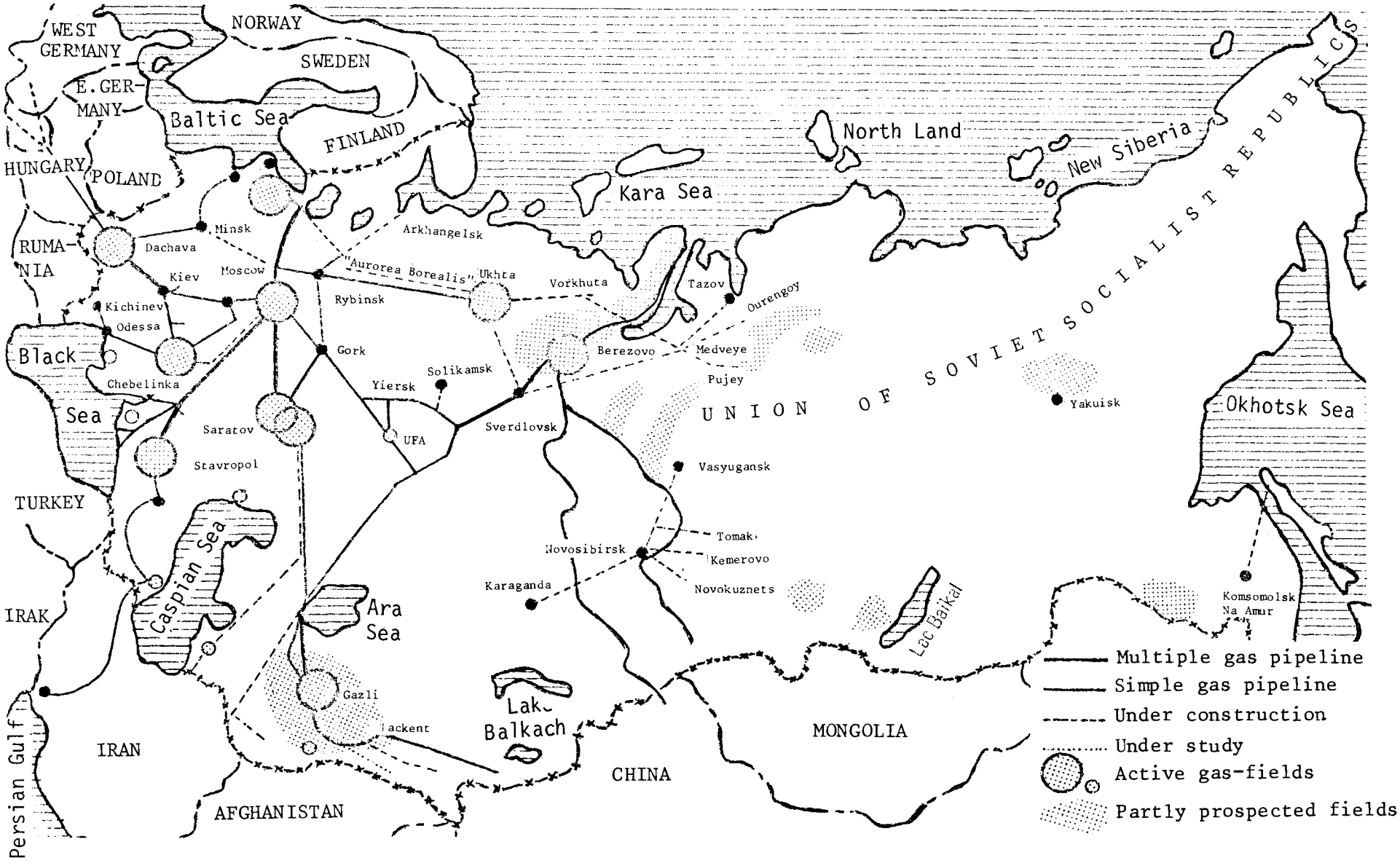
U.S.S.R. OIL PIPELINE NETWORK




*Source:* 'Le Courrier des Pays de l'Est, March 1972, No. 150 - "L'énergie en U.R.S.S. : 1970-1980".

MAP 2

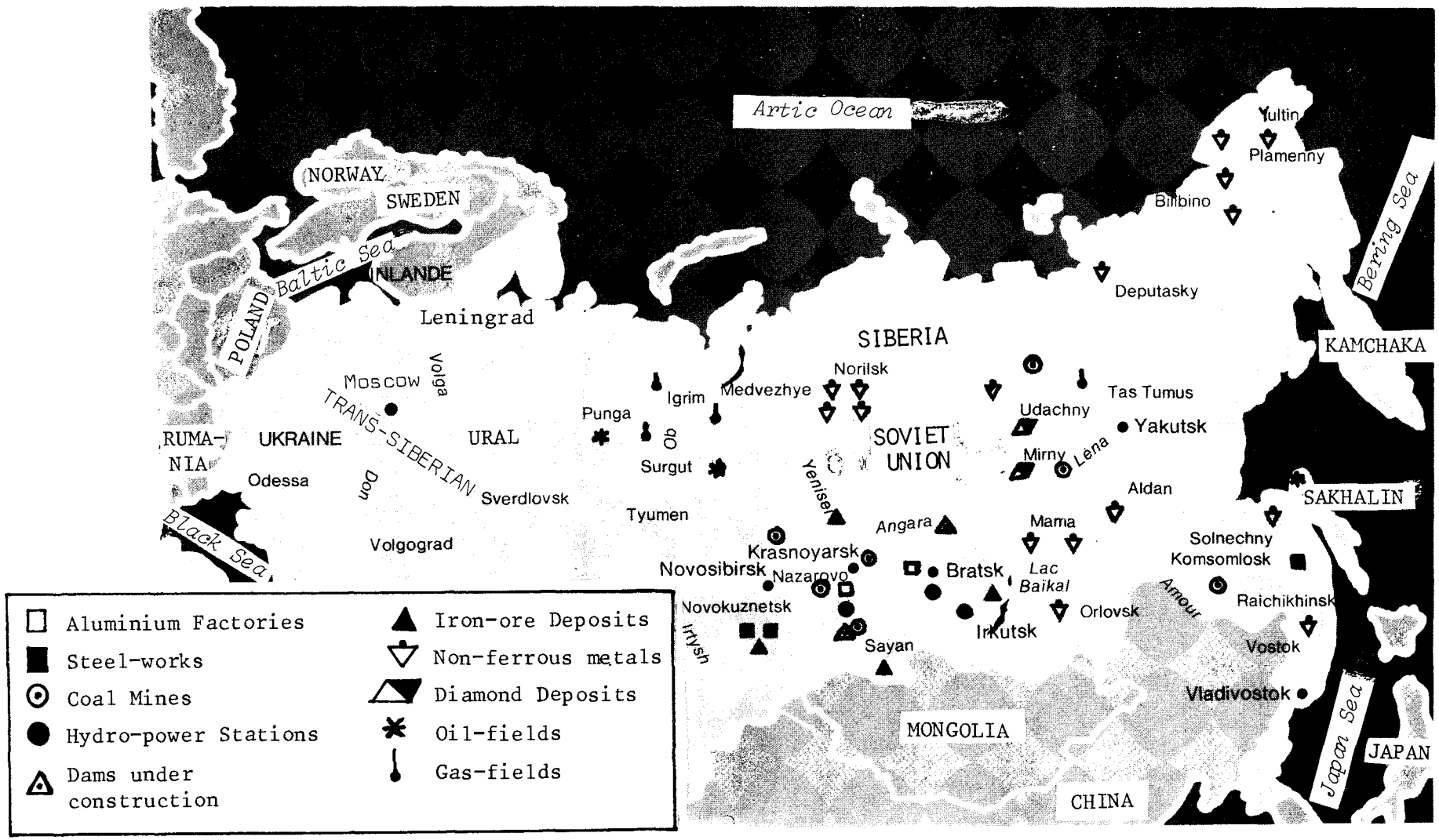
U.S.S.R. GAS PIPELINE NETWORK




*Source :* Le Courrier des Pays de l'Est, N° 150, Mars 1972 - "L'Energie en URSS : 1970-1980".

CARTE N° 3

MINERAL RESOURCES AND ENERGY DEVELOPMENT IN U.S.S.R.




*Source :* Entreprise No. 942 - 28 September 1973.

MAP No. 4

Table 14

TRANSPORTATION COST INDICES

| Oil | Gas | Coal | Electricity (from Tyumen) |
|---|---|---|---|
| 1 | 3-5 | 7-12 | 4.5-7.5 |

Actually, the major current problem is the increase in transportation capacity between Tyumen or Central Asia and Europe.

In view of a correct infrastructure, some measures have been taken to check energy demand in the West and to shift the consumption centres eastwards.

## II - SIBERIAN DEVELOPMENT

### 1. FUTURE ENERGY DEMAND IN THE U.S.S.R. - (HORIZON 1975)

When assessing future energy demand in the U.S.S.R., not only domestic demand but also the anticipatory export and import flows are to be taken into account.

#### 1.1. Domestic Demand in 1975

In a country, economic growth and energy consumption are interrelated. It is therefore necessary, in order to estimate the energy demand in the U.S.S.R., to refer to the economic growth prospects and particularly to those envisaged by the plan.

Between 1965 and 1970, the rate of elasticity between the National Revenue and the energy consumption growth has constantly decreased in the Soviet Union, thus revealing the trend peculiar to all big industrially developed countries to consume less energy than before in order to increase their activities. Over the last few years the elasticity rate seemed to have reached an equilibrium.

Assuming this equilibrium of the medium-term rate and on the basis of the national income growth rate fixed by the plan, it can be estimated that domestic energy demand in 1975 will account for some 1.5 billion T.C.E. with an annual increase of 5.6%.

#### 1.2. Energy Balance in 1975

The following table shows the plan's anticipations as regards the U.S.S.R. energy balance in 1975, and particularly how this amount of 1.5 billion T.C.E. necessary to domestic consumption, will be provided for.

Table 15

ENERGY BALANCE-SHEET IN 1975

| *(million T.C.E.)* | Production | Import | Consumption | Export |
|---|---|---|---|---|
| Solid fuel | 550 | 7 | 530 | 27 |
| Oil (average assumption) | 675 | 20 | 495 | 200 |
| Gas (average assumption) | 360 | 20 | 350 | 30 |
| Hydro and Atomic power | 125 | - | 125 | ε |
| Total | 1710 | 47 | 1500 | 257 |

*(Ref. 5)*

Table 16

SHARE OF TRADE IN RESOURCES AND USE OF ENERGY

| | 1960 | 1965 | 1969 | 1975 |
|---|---|---|---|---|
| Import/Resource | 1.27% | 0.81% | 1.06% | 2.3% |
| Export/Use | 7.10% | 10.4% | 11.80% | 14.2% |

*(Ref. 4)*

It has to be noticed that the share of imports in the resources is expected to double between 1969 and 1975, and yet imports will account only for 2.3% of the resources.

Should exports exceed 14% of use, trade will break down as follows:

Table 17

BREAKDOWN OF FOREIGN TRADE

| | Coal | Oil | Gas | Total |
|---|---|---|---|---|
| Import | - | 54% | 46% | 100% |
| Export | 7.5% | 81% | 11.5% | 100% |

*(Ref. 4)*

### 1.3. Energy Crisis in U.S.S.R. ?

Mention has been made above of a clear trend towards the slowing-down of production.

During the 1966-1970 period, the output of hydrocarbons had already been below forecasts in spite of a downward revision of the latter in relation to a twenty-year prospect set up in 1961. Likewise, the plan's targets were not reached in 1972. As regards 1973, they have been revised downwards, too. It is therefore unlikely that the 1975 forecasts will prove true.

The U.S.S.R. suffers too - so it seems - from an energy crisis since the total energy demand will not be met, or, at least, she enjoys less important *available* energy resources than it had hoped for. The reasons for this crisis lie both on an over-evaluation of reserves as in the case of oil and on technological problems slowing down the exploitation of gas-fields.

As a result of this, the Soviet Union had to re-examine the various alternatives of balancing fuel supply and demand. Anyway, before considering the future of Soviet energy policy in detail, it has to be made clear that:

- whatever the fuel or the primary source of energy, domestic output will largely satisfy domestic needs;
- consequently, variations in the energy balance will primarily concern the flows of resources coming from imports or available for exports.

## 2. CONSTRAINTS AFFECTING THE SOVIET ENERGY POLICY

### 2.1. Domestic Constraints

#### 2.1.1. Economic Constraints

##### 2.1.1.1. *The Lack of Rationalization in Consumption*

Two factors in Soviet energy consumption are indicative of a bad utilization of national resources:

- In the overall consumption of fuel and energy, the U.S.S.R. ranks second in the world after the U.S.A.
- The unit expenditure of fuel outweighs that of other industrialized countries.

Examples:

Table 18

AVERAGE CONSUMPTION OF CONVENTIONAL FUEL PER KW/H PRODUCED

| Soviet Union | Sweden | United States |
|---|---|---|
| 385 g | 332 g | 355 g |

Table 19

CONVENTIONAL ENERGY NECESSARY TO THE PRODUCTION OF ONE TON OF CAST IRON

| Soviet Union | Sweden | United States |
|---|---|---|
| 653 kg | 552 kg | 624 kg |

*(Ref. 8)*

The possible reasons for this high-consumption rate are technology, the utilization of out-of-date plants or materials where steel (and therefore energy) plays an important part in production and which, being too heavy, consume a considerable amount of energy.

Remarkable efforts have been made to increase the rate of useful energy (ratio between energy utilized in the economy and energy from the primary source). On the other hand, fuel distribution has gradually developed towards the utilization of more efficient fuels (coal being replaced by oil). Thus, between 1940 and 1965, consumption increased sixfold and production fourfold. At present, we can anticipate a greater rationalization of consumption through a campaign against waste, a greater utilization of lighter plastic materials in the moving parts and the increasing importance of hydrocarbons and hydro-power.

2.1.1.2. *The Advent of New Forms of Energy*

What share may the new forms of energy have in the U.S.S.R. in the future?

In 1972, out of 80 atomic power stations working all over the world, only three were located in the U.S.S.R. However, investments are being envisaged over the next five years so as to set up nuclear stations in areas far away from the energy supplying centres but highly populated and industrialized (e.g. Leningrad region). In the 1970-1975 period, atomic power is thus expected to rise from 1.5 to 9 million kw., with a 5% share in the total energy output *(Ref. 3)*. A plant has also been projected at Murmansk, as the prototype of plants to be set up in the North-East of Siberia.

According to Soviet experts, in 1980 the U.S.S.R. energy distribution structure will be at its best:

- thermic power 70%
- hydro-power 20%
- nuclear power 10%.

In the longer term, the Soviet will not be obliged to produce synthetic fuels from coal as their oil, and especially gas reserves, are sufficient to enable them to wait for the achievement of fast-breeder reactors firstly, and secondly of fusion reactors to which 800 million dollars have al-

ready been allocated, that is, twice the amount spent by the Americans on the research of an operational process.

Finally, mention has to be made of Soviet progress in the field of magneto-hydro-dynamics (M.H.D.), that is, the generation of electricity from a plasma of coal dust through a magnetic field, thanks to the achievement of a process improving by 20% the performance of traditional electricity production, as compared to coal.

In conclusion, it may be presumed that the improvement of new processes for the generation of energy will not lead to a slow-down in the development of Siberian resources, but on the contrary, in so far as the latter must mark time between the present day and the utilization of these new methods (fusion energy) or, better still, provide the primary energy itself (as in the case of coal and M.H.D. energy, and uranium).

2.1.1.3. *The Amount of Investments Required by Siberian Exploitation*

The eastward shift of the producing centres which will have to make up for the decline of Europe's fields and deposits, and furthermore produce additional capacities in order to meet the increase in demand, brings up the problem of the investments required for the development of such projects.

The cost of Tyumen project is estimated at 32 billion roubles and the development of the Northern Central area at 45 billion. Nevertheless, the part of investments in Siberia has been constant in twenty years: about 16% of the total investments, that is, 12 billion roubles.

In order to assess the U.S.S.R.'s effort directed to energy industry, it is necessary to bear in mind the hindrances encountered as a result of its insufficient agriculture and of the measures adopted to regain ground: 1/3 of the capital invested from 1968 to 1973 in production activities was devoted to agriculture.

It is therefore certain that investments are one of the major constraints to Siberia's development, and that the U.S.S.R. will have, somehow, to add supplementary financial means to those it already possesses.

2.1.1.4. *Technological Constraints*

These constraints can be more simply divided up into two categories: those merely pertaining to the present economic situation and which will disappear as time goes by; and the more "structural" one on which techniques will have little incidence.

- Permanent or Structural Constraints

a) Climate.- Climate is one of the major obstacles. Temperature may vary between such extremes as -50° and +40°. Soil is sometimes frozen down to 300 metres of depth. In summer, the quagmires are infested with mosquitoes.

   Any casual civil engineering work requires expensive foundations. In comparison with the European regions, construction costs 1.5 to 3 times as much. Wages exceed by 70% the maximum monthly-base wage applied in the West of the country.

b) Distances and Geographical Inhospitality.- Whatever the future technical

improvements, transportation costs will not decrease. On the other hand, it may be noticed that the problem of costs is twofold:

- investment costs are high because the materials must be transported to the side of extraction;
- exploitation costs are high, too, because it is necessary to convey fuels westwards.

These constraints will be overcome only after several years. The extremely high infrastructural costs (x 3.8 per family as compared to Europe) will still account for the majority of the expenditures over the years ahead.

- Constraints Due to the Present Economic Situation

They will be faster overcome through improvement and technological transfers.

Let us quote - in order of importance - a few bottlenecks acting more or less as a brake on the best exploitation of resources:

. The lack of good quality steel pipes. Production rose by 9% between 1960 and by 6% only between 1965 and 1970. On the other hand, the steel used does not always have the required qualities and several accidents occur owing to temperature variations.

  This lack of pipes slows down the installation of pipe-lines and hinders the exploitation of 12 billion cu. m. of associated gas (that is, 37% of the output in the U.S.S.R. as against 7% in the U.S.).

. Oil prospection techniques are backward: research and drilling methods (especially below 2,500 m), lay-out of pits.

. Lastly, the lack of fuel preparation at the sites of production obliges to transport unusable burdens. This handicap depends less on technological backwardness than on the principle inherent to the Soviet planning system, insisting on quantity of production rather than quality.

All these deficiencies combined together lead to a production structure requiring a large amount of labour when this factor is perhaps lacking more in Siberia than capital is.

It also seems that the Soviets have not managed to master the achievement of large projects. Interferences with the political organization coupled with the lack of experience inevitably prolong lead times.

### 2.1.2. Administrative Constraints

The existence of a very rigid and centralized planning and of an omnipresent bureaucracy is a major drawback to Siberian development.

The quick reaction and adaptation of Soviet economy to new conditions (e.g. oil crisis) are strongly slowed down by administrative inertia.

Conveying information is made more difficult by distances and bad communications. The lack of co-ordination between Ministries prejudices the development of infrastructure. All this finally strengthens a certain spirit of independence among the population. However, the absence of strong racial minorities in Siberia hinders the development of autonomist ideas of the

kind existing, for instance, in Central Asia (Kazakhstan).

### 2.1.3. Human Constraints

In 1980, Siberian development will require 10 million more workers. At the current population growth rate and on the basis of a better utilization of labour force, only half of them will be available.

Now that mass deportations are over, the labour market in U.S.S.R. is a free one. The only way of attracting these five million workers (that is, a total of 9 million new settlers) will be to offer them acceptable living conditions and considerable financial compensating benefits. Presently, the towns are huge yards where people go to work for short periods. Collective equipment is inadequate, and the insufficient supply of consumer goods - owing to climatic and geographical conditions - causes the cost of living to exceed by 60% the European Russia average.

An attempt has been made to retain the settlers and particularly to supply female labour force with more jobs. However, wage benefits are unequally allocated and do not keep up with the increase in the cost of living in those regions.

Siberian development largely depends on the incentives adopted by the U.S.S.R. in order to attract manpower and cadres. It will not certainly be easy to launch the old dream of Siberian colonization which mobilized the young Soviets after the Second World War.

### 2.1.4. Ecological Constraints

As in the case of Alaska's development, it is difficult to value the consequences of industrial development in regions where the climatic conditions keep the level of biological activity low. The passage of a heavy caterpillar tractor can wreak permanent damage.

As in the case of North America, it remains to be seen whether ecological constraints will be crucial in relation to the needs of industrial development.

## 2.2. External Constraints

### 2.2.1. Economic Constraints: Need for Foreign Trade

Even during autarchy, after the revolution, the U.S.S.R. used its raw materials, and particularly oil, to obtain regularly on the Western markets the currencies necessary to the acquisition of machine-tools and of consumer goods (agricultural products).

At present, owing to the technological backwardness of some of its sectors, its energy sources still are a precious instrument of exchange in order to obtain the "know-how" and the products necessary to its general economic development and particularly to that of Siberia.

### 2.2.2. Political Constraints

We shall successively examine U.S.S.R. relations with COMECON members, the Arabic countries, Europe, China, Japan and the U.S., without losing sight of the energy sector.

2.2.2.1. *COMECON Members*

First of all, we notice that COMECON countries will have to face a deficit of 10 million tons of oil (Ref. 9).

With the exception of Rumania, which has a significant national output, COMECON depends on the U.S.S.R. as regards oil.

Up to the mid-sixties, Russia had met most East European needs. In consequence of the difficulties encountered in production, the U.S.S.R. left certain initiatives to its satellites. Agreements were signed between each country and the oil companies (Shell-Rumania, B.P.-Poland).

At present, Russia must choose between two options:

- either give free play to the Eastern countries in their oil supply; and this, coupled with certain signs of political independence, can be risky;
- or continue to supply these countries; and this would oblige the U.S.S.R. to increase its imports.

This second alternative, the more probable one, would lead the Eastern countries to buy Soviet supplies at higher prices and to share exploration investment costs and particularly the construction of the friendship pipeline.

For the 1971-1975 period, it is forecast that U.S.S.R. exports towards the Eastern countries will increase by 77%.

Finland might be added to the COMECON countries, as it enjoys favourable terms. Important agreements are under way. They provide for gas and oil supplies to be exchanged for equipment. U.S.S.R. interest in this country relies on its strategical situation and its role in the East-West trade.

2.2.2.2. *Western Europe*

Since the 1960's, the U.S.S.R. has been developing an exchange policy with the European countries, bringing into play gas, oil, and coal on one side and turning key plants or technical processes on the other side. Exchanges are not only dictated by economic imperatives (i.e. acquisition of foreign currencies). In fact, the U.S.S.R. sells its supplies at relatively low prices (sometimes even at lower prices than it does to the Eastern countries).

The acquisition, by the oil cartel, of several concessions in the Arabic countries during the 1950's seems to have implemented an export policy towards the capitalist countries.

The expensive balance policy adopted and developed by the U.S.S.R. obliged it to equip itself with ships and to deliver its best low-sulphur crude at low prices.

This led to the following results in its exports to non-communist countries.

- *Table 20 on next page* -

Table 20

EXPORTS TO NON-COMMUNIST WORLD

| Year | 1960 | 1965 | 1970 |
|---|---|---|---|
| Crude and finished products | 18.1% | 35.5% | 45.4% |

*(Ref. 8)*

Some countries are more closely dependent on this supply accounting for 4% of European needs:

- Finland and Iceland 80%
- Austria and Greece 30%
- Italy and Sweden 10%. *(Ref. 8)*

As a part of the technological transfer is done via Europe, exchanges are likely to be carried on and expanded.

2.2.2.3. *Arabic Countries and Iran*

In all the Arabic countries, the U.S.S.R. is trying to recover from its lags in influence recorded after the grasp of international corporations on Middle-East fields.

Contracts have been stipulated with such countries as Algeria, Iran, Iraq, and the U.A.R. At present, annual oil imports amount to 5 M.T.

As regards gas, the U.S.S.R. had to sign agreements, especially with Iran, in consequence of the failures recorded in production. By 1975, the annual import rate will be in the order of 14 billion cu. m.

These gas imports will probably be carried on over the next ten years or so. They allow a better re-allocation of energy. These contracts contribute to make up for Azerbaidjan exhaustion and to make gas available to exports towards Europe.

Thus, one can see that the Soviet supply exchange policy with the Arabic countries has not been much developed. The importance acquired by Soviet technicians in exploiting some reserves of these countries is more significant.

These co-operation contracts enable the U.S.S.R. to control production to a certain extent and to offer a fall-back bargaining position to the Arabian managers in their negotiations with the capitalist countries.

This policy of technical aid was however granted to other underdeveloped countries and enabled the Soviets to enlarge their area of influence.

2.2.2.4. *China*

After a period of exchanges, during the first years of Chinese communist government, the current relations between the U.S.S.R. and China became practically non-existent, for the following reasons:

- ideological differences;
- conflicts peculiar to relations between countries undergoing different developments;
- territorial claims.

Without underestimating the ideological differences, the development gap and especially border claims seem to be at present the most serious problems.

Actually, China has never agreed on a great part of Asia to be occupied and controlled by the Soviets.

In 1964, Mao-tse-Toung clearly expressed his opinions on such regions as Central Asia and the Far East. This has not merely to do with redefining boundaries, since a great part of Soviet strategical forces lies in these regions.

On another level, the slightest development of China enables her to exert a certain leadership on the Third World countries, this leading the U.S.S.R. and China to confrontations on foreign territories.

One can thus see that the differences between the two big communist countries rest on profound reasons. Moreover, the kind of Chinese economic development (agriculture vs. industry) has not required thus far a considerable quantity of energy. On the other hand, China has decided to turn to the West for the acquisition of the techniques necessary to the exploitation of natural resources.

2.2.2.5. *Japan and the United States.*

The need for examining the U.S. and Japan together when considering U.S.S.R. position in their respect is only justified in terms of energy resources.

Actually, they must both find a partner rather closely concerned in exploitation in the field. The policy differs considerably from that pursued for Europe. The Soviets seek numerous benefits in this co-operation:

- aid in technology and management;
- financial resources;
- re-balancing of the world forces since the reconciliation between China and the United States;
- sale of future surpluses: coal and gas.

Up to now, there are much more debates and newspaper publicity than actual agreements. To give a brief account of these negotiations, let us mention:

- the joint exploitation of Shakhalin with Japan;
- the preliminary agreement between the U.S.S.R. and El Paso/Occidental Oil providing for an amount of 10 billion U.S. $ to be devoted to the exploitation of the Yakutsk area (gas pipe-lines: 3,200 km).

- the negotiations with the Japanese for the exploitation of the Tyumen area (40 million cu. m. p. a.). They contemplate the construction of a pipe-line to Nakhodka. The Americans may take part in this project.

The U.S. and the U.S.S.R. had also discussed a project of $45.6 billion to be spent on the construction of a network (Northern Star) to Murmansk, allowing the exploitation of liquefied natural gas (L.N.G.). This project, being too vast, has been abandoned.

On the other hand, the Japanese are also negotiating on the Lena basin coal.

In conclusion, two constraints are inevitable:

- the items of these contracts will essentially be coal and gas;
- future relations can never be only bilateral. During the construction of the network resulting from the agreements between these two countries, the balance of American, Soviet and Chinese influences will have to be taken into account.

The Japanese will not accept to sign any contract excluding the actual intervention of the Americans. The Soviets wish a western group to come and engage itself not to dissatisfy Peking.

Thus, the problem goes far beyond the picture of a mere development of energy resources.

## 3. THE SOVIET ENERGY POLICY IN THE FUTURE

This final section aims at drawing some considerations on what the U.S.S.R. future line of conduct might be in terms of energy policy.

First of all, we shall remain objective in the false controversy between the supporters of a merely political interpretation of events and those who derive them from economic conditions. The two ways of considering things are, in fact, necessary to assess the future U.S.S.R. energy policy, the economic conditions involving some deliberate political options (the improvement of the living standard being fostered by the development of foreign trade, and, if need be, by the East-West "détente" policy) and, conversely, some political decisions resulting in economic opportunity costs (developing above all the relations between the U.S.S.R. and the Arabic countries would involve the possibility of buying from them cheaper oil than that produced in Siberia and of avoiding costly investments).

Let us then analyse, respectively, the importance of the various constraints mentioned above in order to value the extent to which they will or will not act as an incentive to Siberian development.

- *Table on next page* -

| FOR | | AGAINST | |
|---|---|---|---|
| Constraint | Importance | Constraint | Importance |
| - Increased and uncheckable domestic demand for energy. | Great | - The size of the necessary investments. | Great |
| - COMECON demand and traditional autarchy policy of this group. | Average | - Technical backwardness. | Considerable |
| - Substitute in expectation of new forms of energy. | Average | - Bureaucracy. | Great |
| - Need for foreign trade and for the acquisition of currencies. | Great | - Labour force difficulties. | Great |
| - The problem of East-West "détente" (European supply). | Great | - Environmental problems. | Average |

The balance between the "For" and the "Against" appears to be rather controversial. This accounts for a periodic change in the Soviet policy as regards Siberia, in relation to the world political and economic events. For instance, let us analyse in short the consequences of the oil crisis at the end of 1973:

- On the one hand, the rise in world prices will favour the competitive exploitation of Siberian deposits at previously prohibitive prices.
- On the other hand, the flow of the currencies acquired through exports will sizably increased, thus strengthening the idea of an autonomous financing of Siberian development.
- Finally, the East European countries, which had begun to supply themselves in the Middle East, will encounter some difficulties in maintaining these imports, owing to their scarce hard-currency reserves. They will therefore turn to the U.S.S.R., which will certainly support - for evident political reasons - the "German countries", particularly by providing them with a considerable gas surplus, thus fostering the development of prospection in Siberia.
  There is no reason whatsoever for financing these supplies at preferential tariffs. The large amount of domestic currencies and of consumer goods or equipment serving as a means of exchange, will be the direct or indirect contribution of the Eastern countries to Siberian development, which eventually leads to the increasing dependence of satellite countries vis-à-vis the U.S.S.R.

What may be, now, the consequences of other geopolitical events?

- a cut in oil prices in the months to come;
- a deep domestic change in China and the "détente" or the worsening of Sino-Soviet relations which might entail the departure of Mao-tse-Toung;

- the fulfilment of the Western countries' will of independence in terms of energy. This will consist in the considerable made in the North Sea, in the adoption of a nuclear equipment policy and of energy-saving measures.

The Soviet energy policy is also likely to be more and more differentiated in relation to the various kinds of resources.

The importance of the reserves-to-annual production ratio varies according to oil, gas and coal. Very favourable for the last two resources (68 years for gas, infinite for coal), it is 20 years for oil.

We have seen that there will be a deficit of 30 MT to 100 MT of oil for the U.S.S.R. in 1980, whether it decides or not to deliver to the East European countries.

Therefore, for oil, a decrease in exports and the maintenance of imports from the Middle East can be forecast - the latter being paid for with technical aid and weapons, which enable the U.S.S.R. to keep its influence on those regions. As for the exploitation policy, it will be strengthened in Siberia.

Thanks to the currencies acquired through exports at the new world rates, the Soviets will be able to develop a more advanced co-operative policy. Exchanges will, however, depend mostly on the international climate: détente or tension.

Instead, the U.S.S.R., rich with coal and gas surpluses, will certainly use them to better its foreign trade. It can be forecast that gas deliveries to non-communist countries will be maintained, as stipulated in former agreements and that supplies of this kind of fuel to the satellite countries will increase. The U.S.S.R. will also increase its coal deliveries. A contract signed in June 1974 provides, in particular, for the supply of large quantities of coal from Yakutie to Japan in exchange for equipment materials, to be utilized in the exploitation of this deposit.

One can wonder what the priority of development will be given to this kind of resources. The abundance of coal seems to favour it, but the exploitation of gas deposits and especially the construction of gas pipe-lines, thanks to foreign aid, will no doubt be more profitable to the U.S.S.R. for its own needs. Since the transport infrastructure has been created, the exploitation cost of new deposits or the improvement of those already existing are being reduced accordingly.

Whatever the hypotheses advanced, it must be clear that Siberian adventure is as irreversible as that of the great North or the conquest of Amazonia. Actually, each event will only contribute to accentuate for the time being the more or less rapid development of Siberia as well as an autonomous or multinational exploitation of its resources.

# CONVERSION COEFFICIENTS

## Ton Coal Equivalent (T.C.E.)

| | *Metric Ton of Conventional Fuel* |
|---|---|
| 1 ton of coal | 1 |
| 1 ton of lignite | .3 - .6 |
| 1 ton of crude | 1.4 |
| 1 ton of oil product | 1.5 |
| 1,000 $m^3$ of gas | 1.35 |
| 1,000 kw-h | 0.25 |

## Conversion Coefficients of Frequent Use

- 1 ton of coal ≃ 1,000 $m^3$ of gas

  or

- 1 million tons of coal ≃ 1 billion $m^3$ of gas.

- An output of 1 million barrels a day is equivalent to an annual output of 50 million tons.

  (1 barrel ≃ 159 litres; 1 ton of oil ≃ 7.3 barrels).

- 1 million = $10^6$.

- 1 billion = $10^9$.

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