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ENERGY: PROSPECTS AND POLICY ISSUES
IN INTRA-CMEA RELATIONS

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ENERGY: PROSPECTS AND POLICY ISSUES
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Witold Trzeciakowski

This paper presents an exploratory review of publications dealing with past trends and projections concerned with energy in intra-CMEA relations.

The research should be useful in the identification of directions for IIASA's research on "Mineral Markets and Trade". I hope that the collection of materials presented here may also be looked upon as the first stage of a study of energy-related issues in intra-CMEA relations.

Due to the strict time-limit imposed on this work, it was not possible to review all of the non-CMEA publications listed in the bibliography. However, the main weakness of this research lies in the lack of information from CMEA countries. This could possibly be overcome by collaborating directly with institutes in CMEA countries. Without this information, this review should be regarded as an incomplete working draft.

I. Assessment of CMEA and World Reserves* of Basic Fuel Minerals

Table I-1. The Structure of Petroleum Reserves and Their Exploitation (January 1, 1978). Source: Oil and Gas Journal, Dec. 26/77.

Region	Estimated Reserves Billions of barrels	Estimated Production 1977 Billions of barrels	Reserves/Production Ratio
US and Canada	35.50	3.51	10.1
Central and South America	40.37	1.67	24.2
Europe (excl. CMEA)	26.8	0.50	53.6
Africa	59.20		
Middle East	366.17	7.98	45.9
Asia-Pacific (excl. China)	19.75	1.01	19.6
USSR	75.00	4.00	18.8
China	20.00	0.66	30.3
Other CMEA	3.00	0.15	20.0
Total World	645.85	21.73	29.7

Table I-1: The Structure of Petroleum Reserves and their exploitation (January 1, 1978). Source: Oil and Gas Journal, Dec. 26/77

*Under reserves are meant identified deposits of minerals known to be recoverable with current technology under present economic conditions.

Table I-2: The Structure of World Natural Gas Reserves (January, 1, 1978). Source: Oil and Gas Journal, Dec. 26/77

Region	Estimated Reserves billions of cubic feet
US and Canada	268,000
Central and South America	108,580
Europe (excl. CMEA)	138,190
Africa	207,504
Middle East	719,660
Asia-Pacific (excl. China)	122,725
USSR	920,000
China	25,000
other CMEA	10,000
Total World	2,519,659

Table I-3: The Structure of Total World Solid Fuel Reserves. Source: World Energy Conference, Survey of Energy Resources, 1976.

Region	Reserves billions of short tons	Energy Content quadrillion Btu
Africa	19	398
Asia	130	3.147
Europe	192	3.270
USSR and CMEA	151	2.328
North America	229	5.478
South America	7	128
Oceania	58	822
Total	786	15.572

As can be seen from tables I-1, I-2 and I-3 the CMEA disposes of substantial reserves in fuel minerals. However, the ratio of estimated reserves to production in oil indicates the danger of depletion and the importance of changes of the structure of future energy consumption (there is a strong potential for fuel substitution in energy consumption).

II. Past Trends in Energy Consumption--NMP (Net Material Product)

In order to relate energy consumption with NMP, let us start with the ordering of average annual growth rates in the consecutive five-year plan periods:

Table II. Column 1: Total Energy Consumption (Average Annual Growth Rates. Source: UN Department of Economic and Social Affairs, World Energy Supplies (ST/STAT/SER.J).

Column 2: Average Annual Growth Rates in NMP of CMEA-6.*

Column 3. Coefficients of Energy Elasticities. Calculated as the ratio of the rate of energy consumption growth (Column 1) to the NMP growth (Column 2) respectively.

	<u>1961-65</u>			<u>1966-70</u>			<u>1971-75</u>		
	1	2	3	1	2	3	1	2	3
Bulgaria	15.8	6.6	2.4	9.7	8.6	1.1	3.7	7.9	0.5
Czechoslovakia	4.7	1.8	2.6	3.0	7.1	0.4	2.4	5.6	0.4
GDR	3.0	3.5	0.9	2.3	5.4	0.4	3.3	5.4	0.6
Hungary	6.8	4.1	1.7	3.7	6.8	0.5	3.4	6.5	0.5
Poland	3.8	6.1	0.6	4.7	5.9	0.8	4.3	9.7	0.4
Romania	10.1	8.9	1.1	9.0	7.7	1.2	5.8	11.5	0.5

* Under CMEA-6 are understood Bulgaria, Czechoslovakia, the GDR, Hungary, Poland and Romania. CMEA-countries encompass CMEA-6 plus the USSR. Members of CMEA outside Europe are excluded from the analysis.

As can be seen the rates of growth of energy consumption decrease in consecutive plan periods. Yet the rates of growth were higher than those of energy consumption. As a consequence elasticity coefficients fell below unity. This can be looked upon as an indication that energy resources were utilized more efficiently. The main reason for this positive trend is the changing structure of energy consumption.

III. Pattern of Consumption of Mineral Resources on CMEA-6 Markets

The Structure of Energy Consumption.

It is well known that the use of liquid fuel and gas is more effective than the use of solid fuels. In fact, in all CMEA-6 countries there occurred a marked rising share of liquid fuels and gas consumption in time. This is illustrated by the following statistics.

Table III-1: Structure of Energy Consumption in CMEA-6 (1961-78, in million metric tons of coal equivalent). Source: Derived from the United Nations, Department of Economic and Social Affairs. World Energy Supplies (ST/STAT/SER.J), various years. Compiled by J.B. Hannigan and C.M. McMillan, Report No. 18, Institute of Soviet and East European Countries, Ottawa, 1981.

	Year	Total	Solid Fuels ²		Liquid Fuels and Gas ³	
		Energy ¹	Volume	as % of Total	Volume	as % of Total
Bulgaria	1961	11.9	9.8	82.4%	1.8	15.1%
	1965	21.1	15.6	73.9%	5.2	24.6%
	1970	34.1	20.9	61.3%	12.9	37.8%
	1975	40.9	20.6	50.4%	19.3	47.2%
	1978	44.2	19.0	43.1%	23.7	53.6%
Czechoslovakia	1961	70.0	64.8	92.6%	4.9	7.0%
	1965	79.6	71.4	89.7%	7.5	9.4%
	1970	90.8	75.8	83.5%	13.9	15.3%
	1975	102.5	74.9	73.1%	26.6	26.0%
	1978	114.0	80.7	70.8%	32.2	28.2%
GDR	1961	84.5	81.7	96.7%	2.8	3.3%
	1965	92.8	87.2	94.0%	5.5	5.9%
	1970	102.8	88.5	86.1%	14.0	13.6%
	1975	111.6	82.8	74.2%	28.2	25.3%
	1978	119.3	86.6	72.6%	31.9	26.7%
Hungary	1961	22.5	18.6	82.7%	3.8	16.9%
	1965	28.6	21.8	76.2%	6.7	23.4%
	1970	32.7	19.3	59.0%	13.0	39.8%
	1975	34.1	13.5	39.6%	20.0	58.7%
	1978	36.9	13.3	36.0%	23.0	62.3%
Poland	1961	95.3	90.3	94.8%	4.9	5.1%
	1965	110.5	102.1	92.4%	8.4	7.6%
	1970	138.8	119.9	86.4%	18.7	13.5%
	1975	169.7	141.9	83.6%	27.7	16.3%
	1978	195.8	161.7	82.6%	33.8	17.3%
Romania	1961	25.7	5.8	22.6%	19.8	77.0%
	1965	37.7	8.1	21.5%	29.6	78.5%
	1970	56.9	14.1	24.8%	42.8	75.2%
	1975	79.9	18.7	23.4%	60.5	75.7%
	1978	87.7	19.1	21.8%	67.5	77.0%
Eastern Europe	1961	309.9	271.0	87.4%	38.0	12.3%
	1965	370.3	306.2	82.7%	62.9	17.0%
	1970	456.1	338.5	74.2%	115.3	25.3%
	1975	538.7	352.4	65.4%	182.3	33.8%
	1978	597.9	380.4	63.6%	212.1	35.5%

¹Comprises consumption of solid fuels, natural gas and hydro/nuclear electricity.

²Anthracite, bituminous coal, lignite and brown coal.

³Includes liquefied petroleum gases, gasolenes, kerosenes, jet fuels, fuel oil, refinery gas, and all natural and manufactured gas.

The Absolute Level of Energy Consumption.

In spite of the improving trend in efficiency, still its absolute level was low, as the share of liquid fuels and gas in total energy consumption reached by CMEA-6 countries, was much lower than that share in the world. (In the mid-seventies around 1/3 in CMEA-6, as against more than 60% in the world.) The absolute level of energy consumption per \$1 GNP is illustrated in Table III-2.

Table III-2: Energy Consumption (1978). Source: R.A. Watson, The Linkage Between Energy and Growth Prospects in Eastern Europe, 1981 (time period 1968-1978).

Country	per capita in kg/coal equivalent	per 1\$ GNP in kg/coal equivalent
Bulgaria	5.020	1.6
Czechoslovakia	7.531	1.6
GDR	7.121	1.3
Hungary	3.451	1.0
Poland	5.596	1.5
Romania	4.042	2.3
U.S.S.R.	5.582	1.5

*The comparative analysis of levels of energy used per \$1 GDP shows that the corresponding figures for region II (CMEA) were much higher than those for region I (US) and III (OECD).**

* Energy in a Finite World, Executive Report 4, IIASA, Laxenburg, Austria, October 1981, p. 35.

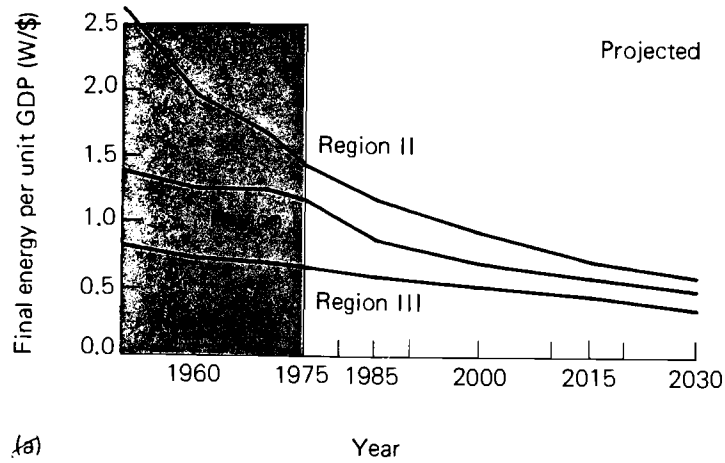


Figure 1. Final Energy per unit of Gross Domestic Product

This indicates that there exist large potential reserves in CMEA countries in the growth of efficiency, provided the structure of energy consumption could be further improved.

IV. The Structural Dependence of CMEA-6 Market on Oil and Gas Deliveries from the USSR

The dependence of individual CMEA-6 countries on energy in global terms may be characterized by the "self-sufficiency" indicator (figures for 1978):

Poland	106.7%
Romania	89.3%
Czechoslovakia	69.6%
GDR	67.5%
Hungary	51.6%
Bulgaria	28.3%

The main supporter of energy is the USSR.

In order to cover the rising demand for oil and gas the CMEA-6 concluded several long-term bilateral and multilateral agreements with the USSR. Statistical data show the very high dependence on Soviet supplies of oil and gas. In 1979 the share of CMEA-6 crude oil imports from the USSR as a percentage of total oil imports amounted to 90%, and that of gas to 97% (excluding Romania).

In terms of overall CMEA-6 (excluding Romania) oil and gas imports from the USSR as a percentage of total energy consumption there occurred a steady rise in dependence: from 5.6% to 27% (see Table IV).^{*} It is also interesting to note that the value of imports of Soviet oil and gas as a percentage of value of total imports from the USSR rose from 10.6% in the early '60s to 34.3% in 1979.

The dependence on Soviet supplies of oil and gas looks differently from country to country. Romania is excluded from the statistics, as it did not import oil and gas from the USSR until 1979. The main differences occur in the share of oil and gas imported from the USSR as a percentage of total energy consumption. Individual statistics by country are presented Table IV.

^{*} Table IV, as well as the disaggregated tables by country were compiled by J.B. Hannigan and C.M. McMillan in Research Report, No. 18, Institute of Soviet and East European Studies, Carleton University, Ottawa, 1981.

Table IV. Volume and Value of CMEA-6 and Individual Countries' Imports of Soviet Oil and Gas: 1961-1980 (excluding Romania). Source: Statisticheskii Ezhegodnik Stran-Chlenov Soveta Ekonomicheskoi Vzaïmopomoshchi, Moskva: Statistika, various years; Vneshniaia Torgovlia SSR: Statisticheskii Sbornik, Moskva: Statistika, various years; United Nations, Department of Economic and Social Affairs, World Energy Supplies (ST/STAT/SER.J), New York, various years; and National Foreign Assessment Center, International Energy Statistical Review, Washington, DC.

CMEA-6

Year	VOLUME				VALUE (in millions of rubles)				
	Crude oil imports from the USSR ('000 metric tons)	Crude oil imports from the USSR as a % of total crude oil imports	Natural gas imports from the USSR (mln. cubic metres)	Gas imports from the USSR as a % of total gas imports	USSR crude oil and gas imports as a % of total energy consumption	Value of imports of Soviet oil (including oil products)	Value of imports of Soviet gas	Value of imports of Soviet oil and gas as a % of value of total imports from the USSR	
1961-65	11750	95%	312	n.a.	5.6%	341.9	2.2	10.6%	
1966-70	27979	95%	1586	n.a.	11.7%	514.1	21.4	11.5%	
1975	54152	91%	11291	98%	21.6%	2142.6	267.0	19.8%	
1979	70776	90%	22193	97%	25.9%	4961.9	1034.6	34.3%	
1980 ^e	71300	n.a.	30100	n.a.	27.0%	n.a.	n.a.	n.a.	
<u>BULGARIA</u>									
1961-65	1470 ^a	92 ^d	-	-	11.5% ^a	50.7	-	10.4%	
1966-70	3472	90%	-	-	18.3%	66.9	-	11.2%	
1975	9713	93%	1185	100%	38.3%	395.6	34.8	18.6%	
1979 ^e	12000	92%	4600	100%	50.7%	920.2	156.5	32.5%	
1980 ^e	12000 ^p	n.a.	6000 ^p	100%	52.7%	n.a.	n.a.	n.a.	

Table IV continued.

CZECHOSLOVAKIA

Year	VOLUME				VALUE (in millions of rubles)		
	Crude oil imports from the USSR (1000 metric tons) ¹	Crude oil imports from the USSR as a % of total crude oil imports	Natural gas imports from the USSR (mln. cubic metres)	Gas imports from the USSR as a % of total gas imports	Value of imports of Soviet oil (including oil products)	Value of imports of Soviet Gas	Value of imports of Soviet oil and gas as a % of value of total imports from the USSR
1961-65	4293	92%	-	-	96.8	-	13.1%
1966-70	8683	92%	771 ^b	100% ^b	141.5	11.4 ^b	15.1%
1975	13503	98%	3684	92%	492.5	94.1	29.0%
1979	18700	97%	6770	92%	1077.8	335.0	42.0%
1980 ^c	18500 ^p	n.a.	8200	n.a.	n.a.	n.a.	n.a.

GERMAN DEMOCRATIC REPUBLIC

1961-65	3287	95%	-	-	71.0	-	5.9%
1966-70	7587	93%	-	-	104.3	-	7.2%
1975	15097	89%	3302	100%	421.4	49.9	15.6%
1979	18500	89%	4330	100%	1036.6	218.8	29.8%
1980 ^c	15000 ^p	n.a.	6500	n.a.	n.a.	n.a.	n.a.

HUNGARY

1961-65	1640	91%	-	-	41.9	-	10.3%
1966-70	3226	93%	-	-	63.8	-	10.7%
1975	6957	83%	601	75%	308.8	17.9	19.7%
1979	8476	88%	2500	92%	818.0	126.6	34.5%
1980 ^c	7500 ^p	88% ^p	3800	n.a.	n.a.	n.a.	n.a.

Table IV continued.

POLAND

Year	VOLUME					VALUE (in millions of rubles)			
	Crude oil imports from the USSR ('000 metric tons) ¹	Crude oil imports from the USSR as a % of total crude oil imports	Natural gas imports from the USSR (mln. cubic metres)	Gas imports from the USSR as a % of total gas imports	USSR crude oil and gas imports as a % of total energy consumption ²	Value of imports of Soviet oil (including oil products)	Value of imports of Soviet gas	Value of imports of Soviet oil and gas as a % of value of total imports from the USSR	
1961-65	1629	100%	312	100%	2.7%	86.6	2.1	15.5%	
1966-70	5211	100%	970	100%	7.1%	117.5	11.1	13.4%	
1975	10882	82%	2509	100%	11.2%	524.3	70.3	24.3%	
1980	12500	81%	3993	100%	12.3%	1109.3	197.7	34.1%	
1980 ³	14050P	76%P	5600	n.a.	13.3%	n.a.	n.a.	n.a.	

¹ 1967-1970

² Estimated

³ Projected, according to the 1980 plan

V. Specific Features of the Intra-CMEA Fuel Mineral Market

1) General Features of Intra CMEA Trade:

- The volume and commodity structure of trade is determined bilaterally or multilaterally in intergovernmental treaties.
- Long-term development strategies are coordinated multilaterally or bilaterally within the framework of the s.c. "Long-term Target Programme in Energy, Fuels and Raw Materials".
- Within these strategic "Long-term Target Programmes" five-year plans are discussed at the level of central planning bodies, and each yearly intergovernmental trade protocol determines in volume or value terms the specific mutual deliveries.
- CMEA currencies are inconvertible, hence trade is supposed to be--as a rule--balanced bilaterally. The appearance of a trade surplus is tantamount to granting a credit. Considering the very low level of interest rates charged (2%) a trade surplus amounts to subsidization.
- Within the overall balance there occurs a tendency to balance separately "hard commodities" (i.e., commodities that can effectively be sold for hard currency, e.g., "hard" oil for "hard" coal). The final structure of trade is the result of an intergovernmental matched sale bargaining process. Whereas trade with market economies consists in independent and separate decision-making in individual export transactions or import transactions, CMEA trade is characterized by matched sale treaties and matched sale transactions.
- Prices in intra-CMEA trade are based on world prices. Till 1976, these CMEA prices were fixed on the basis of each former five-year plan period for the entire next five-year period.
- pricing rules are determined multilaterally on CMEA Council sessions. Specific prices are negotiated bilaterally independently to negotiations determining the volumes and commodity structure or trade. These specific prices are not CMEA equilibrium prices.

As fuel minerals are "hard commodities" and machinery and industrial goods are usually "soft commodities", and as hard commodities are underpriced (due to the five-year average pricing), all the energy importing countries (CMEA-6) are vitally interested in getting as much fuel minerals from the USSR as possible because their industrial exports are not easily salable on western markets. As a result, there exists a steady pressure on the USSR to increase supplies in fuel minerals to CMEA-6 countries.

2) Pricing Marginal Costs and World Prices of Fuel Minerals:

In the period 1971-75, oil production in the USSR increased by 42%, whereas oil reserves grew by 30%.^{*} The continuation of these trends might lead to a relative depletion of oil reserves. Increased demand of CMEA countries for oil and gas had to be met from new sources located in remote regions east of the Urals, in the Caspian lowlands, or in Arctic areas. In order to increase productive capacities in distant regions, new large investments were required. The development of the West Siberian energy complex has been one of the largest capital investment outlay of the Soviet 1971-75 plan. Investments were needed not only to increase the exploitation of the fields, but also for infrastructural needs and for the development of transportation networks. All these developments were connected with rising marginal costs of exploitation and transportation, as well as with heavy hard currency imports of western equipment. Parallel to these rising marginal costs there occurred a quadrupling of world oil prices in 1973-74.

Under these conditions, the main fuel mineral suppliers objected to bearing the burden of increasing productive capacities on old terms. They stressed the necessity to eliminate implied subsidizing in terms of:

- opportunity costs measured in rising marginal costs and in rising world energy prices;

^{*}Melnikov, N. and Shelest, V., Toplivno-Energeticheskii Kompleks SSSR, Planovoe Khoziaistvo, No. 2, 1975.

- carrying new investments outlays exclusively by the producer.

Hence, in the course of multilateral negotiations a new set of pricing rules has been mutually agreed upon and a new pattern of exploitation of minerals has been accepted in the form of "joint investments".

3) CMEA Pricing Problems:

As already mentioned, previously intra-CMEA prices were fixed on the basis of each former five-year plan period for the entire next five-year period. These rules of price formation were supposed to eliminate the short-term speculative price movements and to facilitate decision-making in more stable external conditions. During the sixties, as long as world price trends were, by and large, relatively stable, these CMEA pricing rules worked fairly well and created a favourable framework for international coordination of CMEA cooperation. However, in conditions of external abrupt changes of world prices, especially those of energy, the old CMEA pricing rules failed to reflect the opportunity costs of rapidly rising fuel minerals suppliers.

In order to eliminate price discrepancies, one should accept current world prices as the basis of CMEA pricing. This solution, however, would introduce the principle of full flexibility of prices, which would be hardly compatible with strategic planning. Besides, it would result in a drastic abrupt change in the terms of trade in favour of the Soviet Union. In the course of multilateral negotiations new pricing rules have been formulated as a result of a compromise: since 1976, intra-CMEA prices were determined as a moving five-year average of world market prices and changed annually.

As usually in a compromise solution no one was fully satisfied:

- the producers complained that the new pricing rules did not eliminate the implied subsidization of the importing countries; they argued that these rules were not promoting exports to CMEA-member countries;

- the importers complained about the deterioration of their terms of trade and argued that annual modification of prices were damaging the stability of long-term planning and were introducing elements of short-term speculation.

In fact, the modified prices of fuel minerals for CMEA partners remained below world prices. To illustrate the point, examples of the Polish-Soviet trade prices in fuel minerals exports and imports are listed below.

Table V. Difference in Fuel Prices.

	Prices in zld* per ton				
	1976	1977	1978	1979	1980
<u>Polish imports:</u>					
Crude oil: CMEA	173	214	266	297	318
Crude oil: world	316	334	339	452	734
Fuel oil: CMEA	225	282	343	360	471
Fuel oil: world	367	405	423	988	968
<u>Polish exports:</u>					
Coke: CMEA	221	223	255	263	253
Coke: world	257	285	294	313	401

*US \$1=3 zld (devisa zloties)

Of course, in order to assess foreign trade profitability it is not enough to compare CMEA prices with world prices in exports, but equally in imports. This comparison must be done for all commodities within the general framework of a yearly trade agreement. Each partner then compares eventual "losses" in exports with eventual "gains" in imports. These comparisons are justified as long as they concern "hard commodities" (like

fuel minerals). However, they are questionable if one compares world prices with CMEA prices for "soft commodities", as selling them on hard currency markets may be a fictitious alternative.*

In spite of the existence of "implied subsidies" in CMEA pricing, the overall terms of trade changed drastically in favour of the fuel minerals exporters, as energy prices increased markedly under the new pricing rules, though with delay in comparison with current world prices. As a result, the USSR, as the main fuel mineral exporter granted long-term credits to the CMEA partners mostly affected by unfavourable terms of trade changes.

The choice of the actually functioning CMEA pricing variant has been influenced by pragmatic considerations, namely, the feasibility of world prices as an objective point of reference, the need to reach a compromise between the interests of the producers and the users, as well as the attempt to ensure some continuity with the former pricing rules. However, this choice has important consequences for the terms-of-trade effects on the balance of payments.

The theoretical discussions on CMEA pricing principles are still going on and are closely interconnected with basic policy issues. Should the pricing rules be derived from a CMEA optimization model, thus reflecting marginal cost, scarcity rents, CMEA constraints and world trade alternatives? ** Or should one

* To illustrate the point: The overall analysis of 16 commodity groups in Polish imports and 8 commodity groups in Polish exports resulted in a Soviet "implied subsidy" of the order of US \$7-8 billion in the plan period 1976-80. However, the analysis was based solely on raw materials, where the comparison of CMEA prices with world prices is fully justified. Other processed goods were not analysed, as the assumption that they are saleable at world market prices would be questionable and world prices would be difficult to determine due to quality differences.

** Optimization models of CMEA trade have been analysed by eastern economists in the USSR (J. Shagalov), Hungary (M. Tardos), and Poland (J. Mycielski, W. Piaszczyński).

accept the world prices, as the determinant for CMEA pricing? If so, which variant should be applied: the static and stable approach based on past five-year averages, the intermediary--based on a moving average, or the approach based on current world prices? The direction of future evolution remains to be seen. Whatever the choice will be, it will directly affect the structure of trade in fuel minerals.

4) Joint CMEA Investment Projects and Investment Coordination:

As already stated, rising CMEA-6 needs required massive investments in the field of fuel minerals exploitation and in the construction of necessary infrastructure (transportation network, housing, etc.). Hence, in order to get additional supplies of fuel minerals CMEA-6 were supposed to participate in investment expenditures: either by undertaking investment outlays on their own territory, or by supplying capital equipment, necessary materials and labour for investments on the producer's territory on credit terms. These credits were supposed to be repaid by future counter-deliveries of fuel minerals supplied by newly created productive capacities. A special CMEA International Investment Bank was established to finance joint investment projects in fuel minerals and other new materials.

Below are examples of international CMEA coordination and construction of joint investments:

- oil pipeline "Druzhba" connecting the fields in the Ural region with Eastern Europe. Constructed in 1958-1963. Each participating country was constructing the segment of the pipeline on its own territory (the USSR 3,000 km, Poland 675 km, the GDR 27 km, Czechoslovakia 836 km, and Hungary 123 km);
- the extension of the "Druzhba" oil pipeline from Almat'evsk to Mozyr and to Czechoslovakia and Hungary (1968-1970);
- oil pipeline from Polotsk to Mozejki constructed by Poland in 1978-1979 for counter deliveries of 800,000

- tons of oil annually for twenty years;*
- natural gas pipeline from Ukraine to Silesia--deliveries to Poland (1966);
 - natural gas pipeline "Bratstvo" from Ukraine to Czechoslovakia (1967);
 - natural gas pipeline from Ukraine to Bulgaria (1969);
 - natural gas pipeline from Ukraine to the GDR (extension in 1970 of the pipeline to Czechoslovakia);
 - natural gas pipeline "Soyuz" from Orenburg to Eastern Europe (1979-1978), delivering 15.5 billion cubic metres per year for twenty years (1980-2000);
 - the multilateral specialization agreement in the production of equipment for nuclear power plants;
 - joint investment in the 4000-megawatt Khmel'nitskii nuclear power plant in Ukraine (1979) with the participation of Czechoslovakia, Hungary and Poland;
 - joint investment in the construction of high tension transmission line "Mir" (1975-79) from Vinnitsa in Ukraine to Albertirsa in Hungary, connected with the USSR's "Edinyi" power system;
 - joint construction of a 750 kilovolt line from Khmel'nitskii to Rzeszow in Poland.**

5) Imports from Non-CMEA Sources:

In view of the rising costs of additional supplies of Soviet fuel minerals CMEA-6 countries have undertaken the initiative to develop imports of oil and gas from other sources.

Before the sharp oil world price increases OPEC countries were willing to trade with the CMEA countries on the basis of barter agreements, exchanging oil for machinery and equipment. As it comes out from Table IV-1, CMEA-6 (excluding Romania) imported in 1972-73 13% of the total import of oil from non-Soviet sources. In the period 1971-79, imports of oil from OPEC

*Petroleum Economist, March 1979.

*Savenko and Samkov (1980).

countries (including Romania) increased from US\$ 351 million to US\$ 2,040 million (Romania's share amounted to half of it).

In 1979, Romania imported 14 million tons of oil from OPEC countries. Poland concluded a long-term agreement with British Petroleum for the construction of an oil refinery and steady deliveries of 3 million tons of oil for this refinery. Poland's purchases of oil from non-Soviet sources were supposed to increase so as to cover the rising domestic demand in the early '80s (5 million tons of oil annually were envisaged).

Czechoslovakia concluded in the mid-seventies an agreement with Iran to buy 3.6 million cubic metres of natural gas annually. Czechoslovakia and Hungary attempted to increase imports from the Middle East of the order of 10 million tons annually by constructing the Adria pipeline in the late '70s.

However, the expansion of non-Soviet purchases was significantly constrained by:

- the consecutive sharp rises in oil world prices--in 1980 the cost of oil imported from OPEC countries as a percentage of CMEA-6 exports to the hard currency area amounted to 24%;
- unfavourable political developments--the revolution in Iran resulted in the cancellation of oil barter agreements with CMEA countries, and the Iraq-Iran war also cut back the hard currency deliveries from these markets.

Since 1980, Romania started importing oil from the USSR. Poland was unable to afford the continuation of hard currency oil purchases. Hungary and Czechoslovakia, in spite of the completion of the Adria pipeline were not able to use it, because they could not afford to pay current oil prices in hard currency.

Summing up, in spite of the increasing demand for additional oil, the use of outside CMEA sources supply is constrained by the low capacity to earn hard currency through industrial exports and by the rising indebtedness. In view of the insufficient hard currency earnings CMEA-6 countries were unable to

meet simultaneously the two burdens:

- to service the huge hard currency debt, and
- to afford hard currency expenditures for OPEC oil.

Therefore, the future development of oil imports from OPEC depends to a large extent on the capacity of the CMEA-6 to service the hard currency debt.

As it is shown by some economists^{*}, CMEA-6 countries were indebted very heavily in the West (hard currency area) and--to a smaller extent--in the USSR.

As comes out from the statistics, there are no indebtedness problems only with the Soviet Union and Czechoslovakia. However, the remaining CMEA countries surpassed all the "admissible" limits of credit worthiness. There occurred an evident incompatibility between the rising burden of debt servicing and the rising bill for hard currency imports of oil from OPEC markets.

VI) Alternative Domestic Sources of Energy

The discrepancy between rising needs on energy and limited supply possibilities forced CMEA-6 countries to restrict the previously planned increases in liquid fuel imports adapting their economies to structural changes in supplies, to reorient their policies towards the development of domestic resources of coal and nuclear energy, and to promote conservation policies.

Firstly, there occurred a shift in the relative use of oil and gas. Over the period 1976-80, CMEA oil import from the USSR increased by 23% while imports of gas increased by 167%. Hence, the share of Soviet gas in CMEA-6 total energy consumption rose from 2.9% in 1975 to 6.9% in 1980, whereas the corresponding share in oil rose from 18.7% to 20.1%. (See Table IV-1.)

* Polish Debt: A Game of Chicken, Business Week, February 16, 1981; G. Fink, An Assessment of European CMEA Countries Hard Currency Debt, September, 1981, Vienna, No. 72; some indications can be drawn from the yearbook "Vuesuyaya Torgoveye SSSR" and "Bulletin of Moscow Nazodny Bank".

Secondly, there were heavy involvements in coal mines during the whole period. (See Table III-1.) Poland relied heavily on coal and reached a coal production peak in 1979, then ran into difficulties and political unrests which resulted in a dramatic decline in the output and exports.

Domestic production reached in 1979 202 million tons, in 1980 195 million tons and in 1981, 163 million tons. Exports reached respectively 41 million tons, 31 million tons, and 15 million tons.

Romania expanded the coal production over the period 1970-79 by 62%. Czechoslovakia expanded the coal production over the same period by 13%. In the remaining countries coal production was stagnating or falling.*

Thirdly, the 32nd CMEA Council Session in 1978 placed heavy emphasis on the expansion of nuclear power. A joint investment has been undertaken: the construction of a 4000-megawatt Khmelnitskii nuclear power station, which will supply electricity to Czechoslovakia, Hungary and Poland. Actually, in 1980 the installed nuclear power capacity expanded to about 3,500 megawatts (Bulgaria 880 MW, Czechoslovakia 880 MW, and the GDR 1760 MW).**

Fourth, CMEA countries adopted a policy of "rationalization and conservation measures" aimed at constraining the consumption of fuels.*** All the CMEA countries agreed on a program of multilateral coordination of production location in chemicals

* Statisticheskii Ezhegodnik Stron-Chlenov Soveta Ekonomicheskoi Vzaimopomoshchi, Moskva, 1979, and Raport o sytuacji ekonomiiiznej, Warsaw 1981.

** Tiraspol'sky (1980) p. 50. Shabad (1981).

*** Dobozi (1980) p. 29.

within the general framework of the "Long-term Target Program Fuel, Energy and Raw Materials". Under this agreement there is a tendency to locate high energy-intensive chemicals in the USSR, and less energy-intensive projects in the remaining CMEA-6 countries.

VII. Projects for the Future

1. Projection of Overall Economic Development:

(a) The official CMEA projection of economic development (1980-85), published as materials of party congresses or publications of five-year plans*:

	B	Czec.	GDR	Hung	Pol	Rom	USSR
NMP	6.0	3.7	4.1	3.2	1.65	7.2	3.5

b) Western estimates of CMEA growth by country (1981-90):

Some of the official projections are reassessed by western authors for the period 1981-90. The most recent publication estimates the following NMP rates of growth (1981-90).

Bulgaria	4.6
Czechoslovakia	2.7
GDR	5.1
Hungary	2.7
Poland	0.5
Romania	6.7
USSR	3.4

Source: An Assessment of European CMEA Countries Hard Currency Debt, by G. Fink, Vienna Institute for Comparative Economic Studies, September 1981.

* Bulgaria, April 10, 1981; Czechoslovakia, April 16, 1981; GDR, April 15, 1981; Hungary, November 1980; Poland, October 1980; Romania, August 1, 1981; USSR, November 20, 1981.

c) IIASA long-term CMEA projections (1950-75-2000-2030):

The marked slow down in the rates of growth of GDP, GNP or NMP is consistent with the long-term trend resulting from the IIASA projections for the developed regions, and also for CMEA countries (Region II).

GNP per head GNP projection by IIASA

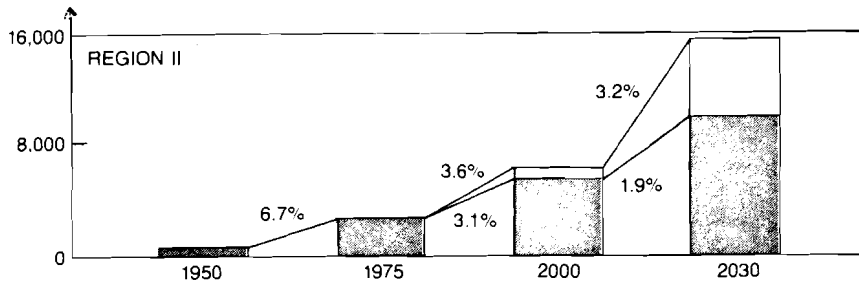


Figure 2. Source: W. Sassin, On Energy and Economic Development, IIASA, 1980.

Present figures on the connecting lines give historical and projected rates of economic growth in terms of the annual growth in the gross national product per head for three different time intervals between 1950 and 2030. All the figures are average annual growth rates over the interval in question. Light coloured parts of bars show the difference between high and low growth scenarios. Note that the medium and long range projections in "The Global 2000 Report to the President" assume the following overall rates shown in Table VI-3.

	1976-1985			1985-2000		
	High	Medium	Low	High	Medium	Low
OPEC	7.2	6.35	5.5	6.5	5.4	4.3
Low income LDCs	4.4	3.6	2.8	3.1	2.8	2.5
Medium income LDCs	6.6	5.55	4.5	4.9	4.4	3.9
OECD	4.9	4.0	3.1	3.7	3.1	2.5
CMEA	3.5	3.25	3.0	3.0	2.75	2.5
China	5.0	3.75	2.5	5.0	3.75	2.5

Table VI-1: Real GNP Growth Rate Assumptions (Compound annual %).
 Source: The Global 2000 Report to the President, Vol. II,
 Table X-1, US Government Printing Office, Washington, 1980.

2) Energy Balances (1985-1990-2000)

a) On the basis of these GNP projections it was possible to construct the following energy balances for the year 1985 and 1990.

Regional energy balances display a range of possible economic outcomes, but do not incorporate uncertainties, such as those concerning the energy exports from the centrally planned economies. Forecasts of their uncertain role in the international market between 1985 and 1990 range from net exports of 1 million barrels per day to net imports of 4-5 million barrels per day.

b) The structure of CMEA energy demand for 2000 is illustrated in the following:

Table VI-2: Regional Energy Balances. Source: The Global 2000 Report to the President, Vol. II, Table X-4, US Government Printing Office, Washington, p. 167, 168, 1980.

	Industrial- ized Countries *	Less Developed Countries	OPEC Countries	Centrally Planned Economies	World
MEDIUM GNP GROWTH					
Oil (thousands bbl/day)					
Production	16,276	7,429	39,257	15,295	78,256
Imports	34,066	2,816	-35,579	-1,304	
Consumption	50,342	10,245	3,678	13,992	78,256
Natural gas (billions cu ft/yr)					
Production	29,215	3,034	5,879	18,339	56,468
Imports	3,414	-600	-2,164	-654	
Consumption	32,629	2,433	3,720	17,684	56,468
Coal (millions short tons/yr)					
Production	1,726	426	5	2,616	4,772
Imports	97	-42	—	-55	
Consumption	1,823	384	5	2,561	4,772
Nuclear, hydro, solar, geothermal (terawatt-hr/yr)	2,515	585	19	760	3,879
Total energy consumption (quadrillion Btu)	203	39	12	98	352
MEDIUM GNP GROWTH					
Oil (thousands bbl/day)					
Production	16,281	8,006	48,823	16,995	90,105
Imports	40,635	4,546	-44,091	-1,090	
Consumption	56,915	12,554	4,731	15,905	90,105
Natural gas (billions cu ft/yr)					
Production	28,635	3,759	8,759	20,793	61,856
Imports	5,105	-700	-3,719	-687	
Consumption	33,739	2,995	5,051	20,106	61,886
Coal (millions short tons/yr)					
Production	1,796	502	7	2,986	5,291
Imports	115	-40	—	-75	
Consumption	1,911	462	7	2,911	5,291
Nuclear, hydro, solar, geothermal (terawatt-hr/yr)	3,513	924	64	1,350	5,851
Total energy consumption (quadrillion Btu)	231	50	16	117	414

Table VI-3. Source: The Global 2000 ..., op. cit., Table X-10, p. 173.

CMEA Energy Demand Year 2000
in quadrillion Btu

Renewable Resources (hydro, geothermal, solar, biomass)	27
Nuclear	26
Oil	29
Natural gas	37
Coal	71
Total	190
Total world demand (including CMEA)	554

As comes out from these projections, the share of coal in the overall energy demand is very high in CMEA countries. This leads to grave consequences in gaseous emissions.

3) CMEA Trade Projections in Energy

a) Soviet oil supplies to CMEA-6 prospects 1985:

The differing assessments of the level of the production, consumption and export in the USSR in 1985 are illustrated by the following table, confronting the various projections.

Table VI-6. Projected USSR Production, Consumption of Crude Oil and Export. Sources: Pravda, December 2, 1980; Simulations of Soviet Growth Options to 1985, National Foreign Assessment 79; D. Bond, Forecasting Energy and Fuel Requirements Within a System of Macroeconometric models, mimeo 1980; Economic Commission of Europe, 1981; J. Vanous. Eastern European and Soviet Fuel Trade 1970-85, JEC July 1981.

in mill. tons	(base: 603 million tons in 1980)					
	Offic. plan	ECE/ UN	OECD	CIA	SOVMOD	J. Vanous
Production	630	720	625	500	575	505-650
Consumption	-	552	525	464	491	449-508
Export netto		168	100	36	83	56-142

In light of the lacking official data on the level of exports planned to CMEA-6 countries, one is left with the varying assessments of export totals as expected by various authors.

The only reliable source of information is the speech by Prime Minister Kosygin* delivered at the 34th CMEA Council Session, stating that "the Soviet Union will deliver to CMEA countries over the five-year plan period nearly 400 million tons of oil.

This means that the USSR oil exports to CMEA-6 would remain more or less at 1980 levels (72.3-80 million tons). Consequently, this means that unless new joint investments are undertaken by CMEA-6 in the USSR, the increases in demand for energy must be covered by other than oil fuel-minerals, or by additional imports from non-Soviet sources.

b) Gas prospects 1985:

The official plan fixes the production of gas in the USSR in 1985 at the level of 600-640 billion cubic metres**, which means that the high rates of growth achieved in the former five-year plan are to be maintained (this would mean an increase from 100 billion cubic meters during 1976-80 to 158 billion cubic metres during 1981-85 in Soviet supplies to CMEA-6).

The crucial question is what proportion of the Soviet domestic production will effectively be devoted to CMEA-6 imports. In 1980 these imports amounted to 31.5 billion cubic metres, which was 7% of the actual total production of gas.

The increase in domestic output should--first of all--cover the decline in Soviet imports of gas from Iran, amounting to 10 billion cubic metres. Next, it should envisage the substitution of gas for oil on the domestic market, as a consequence of constraints in oil production, and of the growth in domestic

*Pravda, June 18, 1980.

**Pravda, December 2, 1980.

demand for energy. Further, the increase in domestic output would probably be devoted to ensuring gas deliveries to Western Europe within the negotiated "deal of the century", envisaging the deliveries at the level of 40-45 billion cubic metres by 1986.

These factors determine the field of manoeuvre of CMEA-6 in their negotiations with the USSR for additional gas supplies. Western experts* see little chances for an essential increase in the Soviet exports of gas in comparison to the level of exports reached in 1980.

c) Nuclear energy and electricity prospects 1980:

The "CMEA Target Program for Cooperation in Fuels, Energy and Raw Materials"** set a target of 150,000 megawatts to be installed by 1990. Of this total 37,000 megawatts should be installed in CMEA-6 countries.***

Besides the plans foresee deliveries of electricity from the Khmel'nitskii nuclear power plant of the order of 20-24 billion Kwh annually to CMEA-6. The implementation of the above targets requires massive investments by those countries.

d) Coal prospects 1985:

The short-term prospects for increasing coal exports from CMEA producers to CMEA consumers are rather grim. The production of coal in the USSR is stagnating.***

The production of coal in Poland is deteriorating. Polish coal production fell from 202 million tons in 1979 to 163 million tons in 1981; Polish total exports fell respectively from 41 million tons to 15 million tons, and exports to CMEA fell from 20 million tons to 4 million tons in 1981.

* J.B. Hannigan and C.M. McMillan, The Energy Factor in Soviet-East European Relations, Research Report, No. 18, East-West Commercial Relations Series, 1981, p. 41.

** Adopted at the 33rd CMEA Council Session, June 1979.

*** J.B. Hannigan and C.M. McMillan, op.cit., p. 42-43.

In the long run, the coal reserves in the USSR and in Poland are very large (as already was stated in I). However, the increase in production is highly capital-intensive and highly air-polluting.

e) Trade with OPEC in the light of indebtedness prospects:

According to forecasts made by J. Vanous* the CMEA-6 import bill for oil from OPEC countries, amounting in 1980 US\$6.5 billion would increase in 1985 to US\$ 20.6 billion.

The crucial question arises, whether this mounting oil import burden is compatible with the burden of rising indebtedness.

Country		Total Debt in mil.\$	Debt in % of revenue	Debt in % of exports
Bulgaria	1980	4000	265	300
	1985	5932	210	238
Czecho- slovakia	1980	3800	122	117
	1985	8859	159	153
GDR	1980	10300	242	261
	1985	18397	212	230
Hungary	1980	8400	303	290
	1985	17348	322	308
Poland	1980	23000	347	388
	1985	33170	243	272
Romania	1980	7900	218	217
	1985	13976	168	167
USSR	1980	7500	29	31
	1985	4593	10	10

Table VI-4: Projection of CMEA Hard Currency Debt to 1985. Base Scenario. Source: G. Fink, op.cit., pp. 32-38.

In the light of the above figures the debt burden will reach in 1985 the level of US\$ 102.3 billion. Therefore, it seems reasonable to conclude that with the exception of the USSR, the increase of CMEA-6 imports from OPEC are doubtful. It seems highly improbable that CMEA-6 would be able to afford devoting 1/4 to 1/3 of their total hard currency earnings to oil purchases in a situation in which debt servicing payments surpass any tolerable limits of creditworthiness.

Increases in energy demand will lead to increases of the gaseous emissions generated in the course of energy use. The strategy based on a heavy use of coal--as is the case with CMEA countries--leads to heavy loadings of particulates, sulphur dioxide, oxides of nitrogen and carbon dioxide. The strongest impacts are likely to be those on urban air quality, increasing respiratory illnesses and damage to vegetation. In the longer run, accumulation of atmospheric carbon dioxide may have more impact on the environment than all the other effects of energy use taken together (see The Global 2000 ..., op.cit., Table X-16, p. 181).

VIII. General Characteristics of the CMEA Fuel Minerals Market Conclusions and Policy Issues

- General characteristics of the CMEA fuel minerals market:

The CMEA market in fuel minerals is state-controlled, internationally coordinated, strictly planned and structured. Nevertheless, it is a free market with economically sovereign agents (states), with unrestricted freedom of choice in the selection of suppliers, in the geographical allocation of exports and in the choice of investments. Yet, it is a market on which CMEA-6 importing countries are highly dependent upon the USSR's supplies of fuel minerals. This economic dependence results mainly from the geographical endowment in energy resources and constrained possibilities of relying on hard currency sources of supply. These latter constraints are due to a low capacity to earn hard currency through industrial exports and to a rising hard currency debt servicing burden in the 1980s.

- Energy consumption is the prime mover of CMEA's economic development. Energy production is the decisive factor constraining the rate of growth of CMEA countries. Parallel to other developed regions, CMEA rates of growth show a slowing down trend.*

- CMEA as an economic integration--dispose of limited resources of oil, large reserves of natural gas, and very large reserves of land.

2. Conclusions and Policy Issues

- CMEA countries dispose of large reserves in energy efficiency improvements (in terms of final energy use per unit of GNP). Concerted policy measures aimed at saving energy may bring substantial results at low costs.

- Switching from abundant coal reserves to more efficient, if less abundant, oil and natural gas resources has led to economic gains in excess of the costs involved in setting up regional distribution systems for oil and gas. Whereas in 1961 liquid fuels and natural gas accounted for 12.3% of total energy consumption, by 1978 the equivalent share rose to 35.5%. A crucial question for the future is whether this traditional cost-minimizing strategy can be sustained. Due to an expected depletion of oil reserves, the acceptable growth scenarios will require heavy investments in gas exploitation and transportation networks, and probably the introduction of coal liquefaction on a broader scale. This will require heavy capital outlays.

*An interesting econometric analysis how to link energy with economic growth prospects of CMEA-6 has been undertaken by R.A. Watson. The differences in GNP rates of growth (those under the assumption that energy requirements are fully met, and those under the assumption of possible energy constraints) are ranging (by country) from 0.2 to 2.8 points. R.A. Watson, "The Linkage Between Energy and Growth Prospects in Eastern Europe", Joint Economic Committee, Congress of the US, 1981.

- The diversion of this much coal from electric power generation to the conversion into synthetic fuels may in turn have to be partly compensated for by the further expansion of nuclear power. In the high long-term IIASA scenario for the CMEA-region for 2030 the share of nuclear power is 33% and that of coal is 38%. A lower share of nuclear power and a similar share of coal is forecasted for 2000 in Table VI-3. Hence, the use of primary energy sources shifts gradually in the long-term projections toward coal and nuclear power.

- CMEA countries are facing a difficult transition not only from cheap fuels to expensive ones, but also from comparatively clean and easy to handle fossil fuels to dirty and less versatile ones. These prospects raise questions of ecological stability, air pollution, water requirements and climatic effects.

- According to IIASA projections CMEA countries will not participate in the oil trade between regions. Oil exports from the USSR to CMEA-6 continue, and exports of coal and gas from the region as a whole expand. The level of this expansion remains an open question.

- Energy balances are putting severe limitations on economic growth of CMEA-6.

- These countries are heavily dependent upon energy supplies from the USSR. The share of crude oil imported from the USSR as a percentage of total oil imports amounted in 1979 to 90%. The respective share of gas was 97%. Oil and gas imported from the USSR as a % of total energy consumption amounted in 1980 to 27%.

- CMEA-6 prospects to increase imports of liquid fuels from OPEC countries are constrained by the growing burden of hard currency indebtedness.

- Imports of Soviet oil and gas have been for CMEA-6 cheaper than those from the hard currency area at world prices. However, there exists a ceiling on these imports, constraining the further growth in energy consumption.

- For CMEA-6 regional cooperation and joint investments in energy seem to be a feasible way in easing the fuel supply problems.

3. Further research: Many questions remain open:

What policies of fuel conservation should be followed?
Should individual countries invest in the expansion of domestic extracting industries, or participate in CMEA joint investments?

Which type of energy consumption should be promoted?

How to apply intra-CMEA specialization criteria to investment planning in individual countries?

What pricing rules should be applied so as to rationalize intra-CMEA trade?

How to assess the profitability of joint investments?

How to assess the profitability of East-West cooperation agreements?

What are the strategic potentialities in developing East-West trade and cooperation in the field of fuel minerals?

How to compare the efficiency of trade with hard currency partners and trade with clearing markets?

These exemplary problems need research. Some of these questions can be solved exclusively by research institutes of the respective countries. Some other questions could be analyzed jointly with an international institute.

BIBLIOGRAPHY

- Balkay, B., Energy Situation and Cooperation Within CMEA. Workshop on East-West European Economic Interaction: Prospects of European East-West cooperation in the field of energy. Vienna, April 8-12, 1979.
- Dienes, L. and Shahad, T., The Soviet Energy System: Resource Use and Policies. Washington, V.N. Winston, 1979.
- Dobozi, I., Policy Responses to the Energy Crisis: East and West. Paper presented at the Fifth US-Hungarian Economic Round Talk, May 7-9, 1980, Cambridge, Mass.
- Filanovskii, V., Zapadno-Sibirskii Neftegazovyi Kompleks: Rezultaty: Perspektivy, Planovoe Khoziaistvo, No.3, March 1980.
- Fink, G., An Assessment of European CMEA Countries' Hard Currency Debt, Forschungsbericht No. 72, Vienna Institute for Comparative Economic Studies, Vienna 1981.
- The Global Report 2000 to the President, US Government Printing Office, Washington, 1980.
- Hannigan, J.B. and McMillan, C.M., Joint Investment in Resource Development: Sectoral Approaches to Socialist Integration, in Joint Economic Committee, Congress of the US, East European Economic Assessment-Part2. Washington, DC, Government Printing Office 1981.
- Hannigan, J.B. and McMillan, C.M., The Energy Factor in Soviet-East European Relations, Research Report No. 18, Institute of Soviet and East European Studies, Ottawa, 1981.
- Haefele, W., Energy in a Finite World, Report written by McDonald, A., IIASA, Laxenburg, 1981.
- Hewett, E.A., The Impact of the World Economic Crisis on Intra-CMEA Trade, in E. Neuberger and L. Tyson, The Impact of International Economic Disturbances on the Soviet Union and Eastern Europe, Pergamon Press, New York, 1980.
- Hoffman, G.W., Energy Projections - Oil, Natural Gas and Coal in the USSR and Eastern Europe, Energy Policy, Vol. 7, No.3, 1979.
- Iakushin, A., Sotrudnichestro Stron SEV v Toplivno-Energetichoskom Kompleke, Voprosy Ekonomik, No. 6, 1979.
- Kozlov, I.D., Energoticheskoe Khozieistvo Stron SEV: Problemy i Perspektivy Sotrudnichestra, Moskva, Nanka 1980.
- National Foreign Assessment Center: The World Oil Market in the Years Ahead, ER-79-10327U, 1979.

- National Foreign Assessment Centre: Energy Supplies in Eastern Europe, ER 79-10624, 1979.
- OECD, Committee for Energy Policy, Energy Resources and Trade of the USSR and Eastern Europe, Paris, 1980.
- Oechisper, R.G., and Martens, J.A., Eastern European Trade with OPEC, in Joint Economic Committee, Congress of the US, East European Economic Assessment, Washington, DC, Government Printing Office, 1981.
- Pekshev, In.A., Dolgosrochnye Tselevye Programmy Sotrudnichestva Stran Chlenov SEV, Moskva, Nanka 1980.
- Scanlan, T., CMEA Oil Demand Balance to 1980, in NATO-Economic Directorate, CMEA: Energy 1980-1990, 1981.
- Stern, J.P., Western Forecasts of Soviet and East European Energy and the Next Two Decades (1980-2000) in Joint Economic Committee, Congress of the US, Energy in Soviet Policy, Washington, 1981.
- Sassin, W., On Energy and Economic Development, IIASA, Laxenburg, 1981.
- Vanous, J., Eastern European and Soviet Fuel Trade 1970-1985, in Joint Economic Committee, Congress of the US, East European Economic Assessment, Part 2, Washington 1981.