

COMMISSION OF THE EUROPEAN COMMUNITIES  
DIRECTORATE-GENERAL FOR ENERGY – DG XVII

**PROMOTION AND DEVELOPMENT  
OF ENERGY COOPERATION BETWEEN EEC  
AND CENTRAL AND EAST EUROPEAN COUNTRIES**

FINAL REPORT

JULY 1990

**VOLUME 2  
ECONOMIC AND ENERGY DATA  
ON CENTRAL AND EAST EUROPEAN COUNTRIES**

**ICE**

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## **FOREWORD**

This volume contains economic and energy data on the following Central and East European countries:

- Bulgaria
- Czechoslovakia
- German Democratic Republic
- Hungary
- Poland
- Romania
- Soviet Union

These reports are basically statistical evaluations of the individual countries. There are several basic primary sources of statistical information on these countries: Deutsches Institut für Wirtschaftsforschung (DIW), PlanEcon, ECE-UN series.

After analyzing each source of information, it was decided to base the statistical analysis on two sources. The primary energy side of the energy balance is best covered by the DIW data bank. Above all the DIW data are consistent. The end use side of the energy balance is not covered by DIW. For this part, ECE-UN data have been used.

The DIW figures are available only for the smaller countries (Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania). Complete data from 1970 to 1987 have been collected for all countries except the Soviet Union. For the Soviet Union other sources have been used.

## 1. INTRODUCTION: GENERAL PRESENTATION OF CENTRAL AND EAST EUROPEAN COUNTRIES' ENERGY DATA

### 1.1 The Reliability of Energy Data for Central and East European Countries

A certain number of features have to be borne in mind when analyzing Central and East European countries' energy situation on the basis of their energy balances. To begin with, it should be noted that these countries' energy balances are not constructed in the same way as those of OECD countries. At best, energy balance statistical series come from national statistical yearbooks (primary energy consumption, exports, imports, production, etc.). The only officially available Soviet energy balance, for example, is the highly aggregated 1985 balance which was given to the EEC-UNO. As a result, the balances which have been made up by Western organizations (EEC-UNO Geneva, UNO New York, IEA, DIW, PlanEcon, Enerdata, etc.) are only estimates. Their reliability is limited by the extent to which each country keeps its data confidential: highly confidential in the case of the GDR until 1989, and the Soviet Union; "open" in the case of Hungary and, for the moment, Poland. However, in the light of the changes which are currently taking place in these countries, it is likely that more information will become available in time. Summing up, several features should be noted.

1. The first problem encountered is the secrecy surrounding statistics and the poor quality of national figures. But though data (up to primary consumption) is relatively weak for coal, gas and electricity, this is not the case for oil. Particular attention should be paid to problems related to exportations/re-exportations. Between 1976 and 1986 the USSR gave its oil exports only in terms of their value (Roubles). Re-exportations (often of soviet oil) by smaller East European countries are rarely mentioned in national yearbooks (this is particularly true of the GDR but is to be seen in all countries). Finally, little is known about the refining sector, particularly that of the Soviet Union.
2. Methodological problems specific to East European countries concerning the breakdown of consumption by sector then have to be dealt with. Two features should be emphasized in this respect:
  - *The way in which the transport sector is dealt with* is particularly problematic. In general, only public transport is accounted for in East European countries. Private vehicles come under Households, industrial transport under Industry and it is very difficult to reallocate consumption from one sector to another. Significant differences appear in the transport sector between the EEC-UNO figures and those of the IEA.
  - *The distribution of consumption* between electricity generation and industry can also raise problems, since the electricity sector comes under industry in East European countries' accounting systems. For some countries differences appear between the EEC-UNO and IEA figures for the relative shares of these two sectors, even though electricity production is identical (Hungary and Czechoslovakia are typical in this respect).
3. Finally, the most delicate factor when looking at IEA figures concerns the *equivalence coefficients* used for coal which, given the differences in coal quality between countries, can bias the figures. Apart from Poland and possibly the Soviet Union, all the East European countries have coal of low calorific value.

## **1.2 Energy Data**

Energy data series were obtained as follows.

After analyzing each data source it was decided that statistical analysis should be based on two sources. The primary energy side of the balance is best covered using the DIW data bank since its figures are consistent. DIW data was not used for the end-use side of the energy balance.

DIW figures are only available for the smaller CMEA countries (Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania). Complete data from 1970 to 1987 has been collected for all countries except the Soviet Union, for which other sources have been used.

Having checked the consistency of the two sources (EEC-UNO and DIW) for primary consumption, the series were then completed in terms of final energy consumption using data from the EEC-UNO in Geneva. Only EEC-UNO data was used in the case of the Soviet Union.

The figures provided constitute a series of energy balances, their logical structure also being that of an energy balance, i.e.

- production
- exports
- imports
- primary consumption
- conversion sector (electricity mostly)
- final consumption by sector: industry, transport, housing-service-agriculture.

It should be pointed out that very little information is given concerning the refining sector since reliable data is scarce in this area. There is considerable secrecy in the Soviet Union, for example, concerning this sector since oil is traditionally considered as being highly strategic.

Finally, 1987 figures should be handled with caution, especially as regards final consumption. Certain data are not available for some sectors.

### **1.2.1. The DIW Data**

DIW data has been made up from national statistics corrected by specialists in the field of East Europe. Although they are inevitably affected by the exportation/re-exportation problems mentioned above, they are reliable on the whole. Two points should however be made.

- "Stock variations" and "international maritime bunkers" have been left out. Consumption data are thus only estimates, hence the differences when compared with EEC-UNO and IEA figures.
- Within the DIW data bank, nuclear power is dealt with under imports whereas it usually appears under production. This is a convention adopted by East European countries which can be explained by the fact that, under COMECON agreements, all uranium is enriched and processed by the Soviet Union.

Equivalence coefficients come from national sources and vary from year to year. Variations are particularly important for coal whose quality varies strongly from country to another and from year to year. The coefficients used are given in Annex I.

### 1.2.2. The EEC-UNO Data

The data collected by the EEC-UNO in Geneva comes *from questionnaires sent directly to member countries*. They can thus be relied upon to a reasonable extent. They avoid the problems concerning equivalence coefficients provided by the countries themselves, especially as regards coal. In this respect they are very close to the DIW primary data. IEA data was not used, notably because of problems involving equivalence coefficients. Differences between IEA and DIW data were too great for some countries (Bulgaria, Romania, Soviet Union) when it came to primary energy.

The electricity data provided is in equivalent terms to consumption data, i.e. 1 kWh = 0.086 toe.

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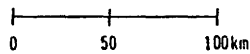
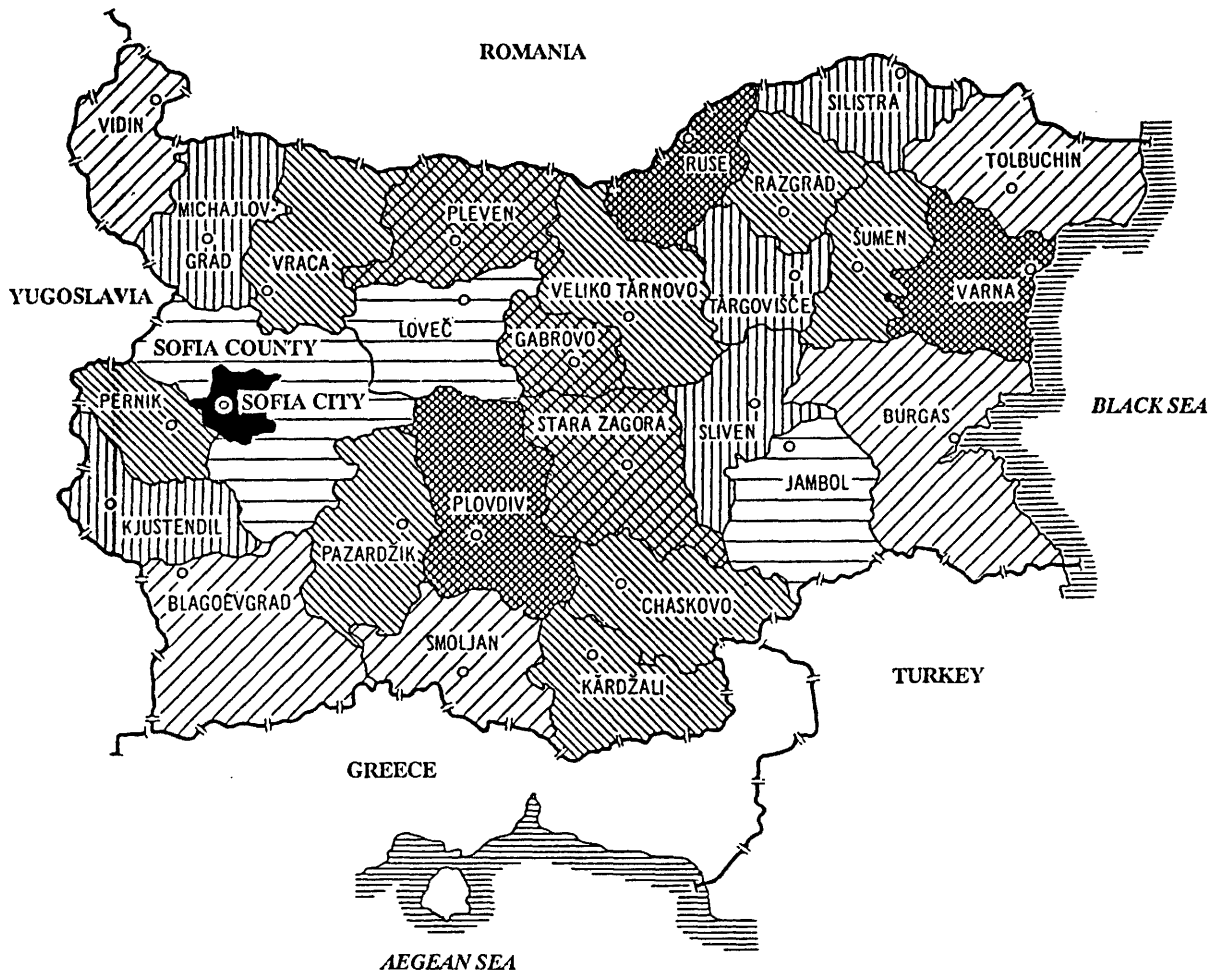
# **Bulgaria**

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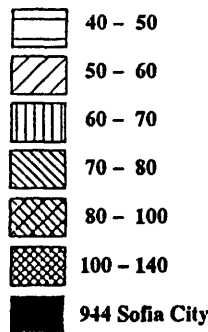
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# BULGARIA

## Administrative Districts, Population Density, 1984



Inhabitants per km<sup>2</sup>



**GOPA**

Statistisches Bundesamt 86 0271

## 2.1 Bulgaria

### 2.1.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	4220 US\$
- Population and Employment	
. Resident Population earning a livelihood (men 16-59 years, women 16-54 years)	8.986.6 mill 55.7 %
. Population Density (persons per km <sup>2</sup> )	81.0 %
. Growth of Population	0.12 %
. Workers and Employees thereof female persons	4.102 mill. 2.048 mill.
. Employment Ratio	45.6 %
. Sectoral Employment Shares	
Industry	38.0 %
Construction	8.3 %
Agriculture	18.7 %
Forestry	0.6 %
Transport	5.7 %
Communication	1.0 %
Trade	8.7 %
Other Sectors for Material Production	0.5 %
Residential and Community Affairs	2.3 %
Science	2.0 %
Education	6.2 %
Culture & Arts	1.0 %
Health & Sports	4.7 %
Finances, Credit and Assurances	0.6 %
Administration	1.3 %
Other non-productive Sectors	0.4 %
- Sectoral Output Shares (1987)	
. Agriculture	15.6 %
. Industry	41.6 %
. Productive Services	28.2 %
. Non-productive Services	14.6 %
- Selected Natural Resources and Raw Materials Production	
. Iron-ore	528 x 10 <sup>3</sup> t
. Manganese Ore	9.9 x 10 <sup>3</sup> t
. Raw Iron	1.484 x 10 <sup>3</sup> t
. Steel	2.875 x 10 <sup>3</sup> t
. Cement	5.535 x 10 <sup>3</sup> t
. Nitrogen Fertilizer	.433 x 10 <sup>3</sup> t

## 2.1.2 National Energy Resources<sup>1</sup>

Bulgaria has to meet its energy requirements almost completely through imports. Only some stocks of brown coal are of economic importance in this country. The known deposits of coal are estimated at 4.4 billion tons, 80 % of which have been explored after 1956. Additional reserves are expected to be about 2.6 billion tons. The reserves are distributed among 34 deposits, most of them being rather small with geological structures unfavorable to exploitation.

Two kinds of brown coal are distinguished: on the one hand brown coal with a net heating value in the range of 8.0 to 17.0 MJ/kg and on the other hand lignite which has a net heating value in the magnitude of 4.0 to 8.0 MJ/kg. The total stocks of the more valuable brown coal are estimated at 330 million tons only. Thus, the lion's share of Bulgaria's coal resources consists of the less favorable lignite, which in many other countries would even not be exploited at all.

The country's coal centre is located at Maritza-East with coalfields amounting to 240 km<sup>2</sup>. The seams with a thickness of 3 to 22 m are situated at depths of 20 to 90 m only, so that open-pit mining is possible.

In Maritza-West (nearby Dimitrovgrad), however, coal can be found in depths up to 200 m below surface in seams with a thickness of 1.7 to 3.0 m. Therefore, deep mining is partly necessary in this region.

The stocks of hard coal and anthracite are very small. They are located in the Eastern parts of the Balkan mountains, approximately between Gabrovo and Sliven. The net heating value of this coal is about 17.0 MJ/kg, so that it should be considered brown coal instead of hard coal for which – on the basis of an international convention – a net heating value of at least 23.0 MJ/kg is required.

In the seventies, hard coal deposits were identified 30 km north of Varna. The coal is supposed to be of good quality (net heating value averaging 34 MJ/kg), but the geological conditions are extremely unfavorable to exploitation: coal is available in depths of 1,200 to 2,000 m in seams which are 0.2 to 14.0 m thick. Exploitation will be started not earlier than the end of this decade.

The technically exploitable hydropower potential is of some importance in Bulgaria. It is estimated at 12 billion kWh, of which only about 20 % are presently used. The biggest hydropower plants have been built on Matonika River (775 MW), Stara Reka (228 MW), Arda (274 MW) and Isker (80 MW). The most important plant under construction is near of Cajra in the Rila Mountains. Once completed, its four turbines will provide 864 MW.

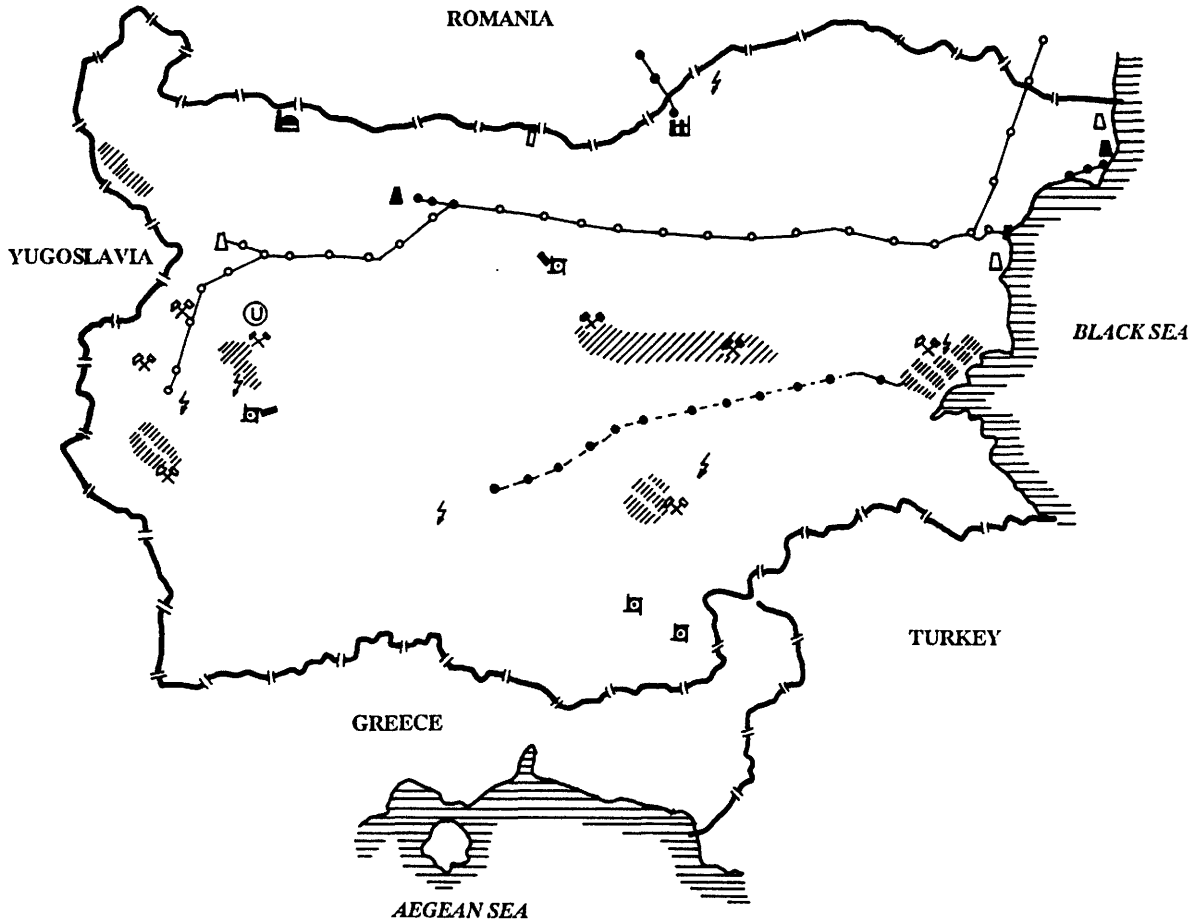
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**1** Source: Deutsches Institut für Wirtschaftsforschung (DIW), *Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren*, Berlin, November 1989


















# BULGARIA

## Energy Resources, Energy-related Infrastructure



0 50 100 km

- |   |                 |   |              |   |                      |
|---|-----------------|---|--------------|---|----------------------|
|  | Coal Deposit    |  | Oil          |  | Nuclear Power Plant  |
|  | Coal Mining     |  | Gas          |  | Dams, planned        |
|  | Lignite Deposit |  | Oil Pipeline |  | Hydropower Plants    |
|  | Lignite Mining  |  | planned      |  | Thermal Power Plants |
|   |                 |  | Gas Pipeline |   |                      |
|   |                 |  | Oil Refinery |   |                      |
|   |                 |  | Uranium      |   |                      |

### **2.1.3 Primary Energy Production<sup>2</sup>**

Bulgaria's 5-Year-Plan (1981–1985) aimed at a reduction of the country's dependence on energy imports by intensifying national energy production. For instance, coal production was to be increased from 30 million tons in 1980 to 45 million tons in 1985. According to the long-term plans, coal output was even to be raised to 60 million tons by the end of the eighties.

Compared to these goals, actual figures are rather disappointing. Although output of brown coal increased slightly in the early 1980s its 1985 level was almost the same as in 1980. Electricity generation from hydropower plants even dropped significantly. Considered on the whole, primary energy production in 1985 was 6 % less than in 1980.

Given these failures, the planners have fixed more moderate production goals, according to which coal output is to be increased to 39 million tons in 1990. Yet, as a matter of fact, this goal is well above the recent production figures, which documented 37 and 35.7 million tons for the years 1987 and 1988.

About 75 % of Bulgaria's output of brown coal comes from Maritza–East. This is mainly due to the favorable exploitation conditions prevailing there.

Lignite having significant net heating values is processed in a briquetting factory nearby Maritza–East. However, briquette production figures are very low (1.2 to 1.5 million tons yearly).

Production of other fuels is of minor importance in Bulgaria. For instance, output of hard coal amounted to 0.2 million tons in 1987 (which is only half the amount of 1970), and natural gas production experienced a reduction from 0.5 billion m<sup>3</sup> in 1970 to just 0.02 billion m<sup>3</sup> in 1987. Obviously the gas reserves in the Lovec region are exhausted. Production figures for crude oil have been more or less stable for many years, with an average output of 0.3 million tons per year.

To sum up, the declining trend of primary energy production which was observed until 1978 was able to be reversed. Overall yearly production figures are on a level of 300 PJ, which is about 17 % more than ten years ago. Yet, because of the scarcity of national energy resources, this seems to be the ceiling of the production possibilities.

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**2 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe–Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 1: Primary Energy Production**

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- power bill.kWh	Total PJ
1970	28.9	0.4	0.3	0.5	2.2	291
1971	26.6	0.4	0.3	0.3	2.2	267
1972	26.9	0.4	0.2	0.2	2.1	262
1973	26.5	0.4	0.2	0.2	2.6	261
1974	24.0	0.3	0.1	0.2	2.1	232
1975	27.5	0.3	0.1	0.1	2.5	261
1976	25.2	0.3	0.1	0.0	3.0	245
1977	24.9	0.3	0.1	0.0	3.5	249
1978	25.5	0.3	0.1	0.0	2.9	246
1979	28.0	0.3	0.3	0.1	3.3	280
1980	29.9	0.3	0.3	0.2	3.7	285
1981	29.0	0.2	0.3	0.1	3.6	276
1982	32.0	0.2	0.3	0.1	3.0	289
1983	32.1	0.2	0.3	0.1	3.5	295
1984	32.1	0.2	0.3	0.0	3.3	291
1985	30.7	0.2	0.3	0.0	2.2	267
1986	35.0	0.2	0.3	0.0	2.3	299
1987	36.6	0.2	0.3	0.0	2.5	313
in 1000 TOE						
1970	5454	167	335	407	598	6962
1971	5048	167	311	287	598	6387
1972	5096	167	239	191	598	6268
1973	5000	144	191	191	718	6244
1974	4545	120	144	144	574	5550
1975	5215	144	120	96	694	6244
1976	4761	120	120	24	837	5861
1977	4713	120	120	0	981	5957
1978	4832	120	96	24	813	5885
1979	5287	120	263	120	933	6698
1980	5239	120	263	167	1053	6818
1981	5072	96	287	120	1005	6603
1982	5598	96	287	72	861	6914
1983	5646	96	287	48	981	7057
1984	5622	96	263	48	909	6962
1985	5383	96	263	24	622	6387
1986	6148	96	263	24	646	7153
1987	6411	72	263	24	718	7488

Source: Data Bank CMEA-Energy of DIW

#### **2.1.4 Exports and Imports of Energy<sup>3</sup>**

Bulgaria's energy sector can only supply around 20 % of the primary energy needed. The remaining 80 % have to be imported, mainly from the USSR. This holds true not only for oil, gas and hard coal but also for primary electricity, the latter being a consequence resulting from the increase in nuclear energy based electricity generation, which is classified as imported energy due to the exclusive delivery of inputs from the USSR.

The Soviet Union supplies 96 % (1987) of Bulgaria's primary energy imports. Imports of gas, for instance, from the USSR amounted to 6 billion m<sup>3</sup> in 1987, thus exceeding the 1980 level by some 50 %. In the future, Iran most probably will deliver gas as well. (A contract to deliver 1 billion tons yearly during the next 20 years is said to have been agreed upon in mid-1989.)

Oil imports from the Soviet Union, however, are stagnating on a level of 12 million tons per year.

With regard to energy exports, one can say that – besides some small amounts of of hard coal – especially electricity is exported (mainly to Turkey, USSR and Poland).

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**3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 2: Exports of Energy**

Year	Hard Coal mill.t	Oil mill.t	Electri- city bill.kWh	Total PJ
1970	0.0	0.3	0.3	14.7
1971	0.0	0.1	0.1	4.5
1972	0.0	0.1	0.2	4.4
1973	0.1	0.0	0.0	3.8
1974	0.1	0.0	0.0	1.6
1975	0.0	0.0	0.4	4.1
1976	0.0	0.0	0.5	5.6
1977	0.0	0.0	0.7	8.2
1978	0.2	0.0	0.7	12.8
1979	0.0	0.0	0.9	10.4
1980	0.2	0.0	1.0	16.9
1981	0.0	0.0	1.3	15.0
1982	0.2	0.0	2.7	37.4
1983	0.2	0.0	2.8	38.8
1984	0.3	0.0	3.3	45.6
1985	0.5	0.1	3.0	50.9
1986	0.3	0.0	1.5	24.2
1987	0.0	0.0	0.8	9.6
IN 1000 TOE				
1970	0	263	89	352
1971	0	72	36	108
1972	0	62	43	105
1973	81	0	10	91
1974	38	0	0	38
1975	0	0	98	98
1976	0	0	134	134
1977	0	0	196	196
1978	100	0	206	306
1979	7	0	242	249
1980	134	0	270	404
1981	7	0	352	359
1982	134	0	761	895
1983	122	19	787	928
1984	158	0	935	1091
1985	289	100	830	1218
1986	167	0	411	579
1987	0	0	230	230

Source: Data Bank CMEA-Energy of DIW

**Table 3: Imports of Energy**

Year	Brown Coal	Hard Coal	thereof: Pure Hard Coal	Coke	Oil	Gas	Electri- city	Nucl.* Energy	Total
	mill.t	mill.t	mill.t	mill.t	mill.t	billm3	bill.kWh	bill.kWh	PJ
1970	0.0	5.5	5.0	0.5	8.6	0.0	0.2	0.0	489
1971	0.0	6.4	6.0	0.4	10.1	0.0	0.4	0.0	575
1972	0.0	6.2	5.8	0.4	10.6	0.0	1.1	0.0	602
1973	0.0	6.3	5.9	0.4	12.1	0.0	3.3	0.0	689
1974	0.0	6.6	6.2	0.4	12.8	0.3	3.5	0.9	750
1975	0.0	6.7	6.4	0.4	12.3	1.2	4.1	2.6	791
1976	0.0	6.5	6.2	0.3	12.8	2.2	4.0	5.0	870
1977	0.0	6.6	6.3	0.4	13.6	2.8	4.1	5.9	936
1978	0.0	6.5	6.2	0.3	14.5	2.9	4.6	5.9	985
1979	0.0	6.7	6.4	0.3	14.9	3.0	4.6	6.2	1011
1980	0.0	7.2	6.7	0.4	14.9	4.0	4.9	6.2	1059
1981	0.0	7.5	7.1	0.4	14.0	4.5	4.7	9.1	1079
1982	0.0	7.7	7.2	0.5	12.6	4.8	5.5	11.0	1068
1983	0.0	7.6	7.1	0.5	12.6	4.9	5.3	12.0	1079
1984	0.0	7.7	7.2	0.5	12.6	5.5	5.9	13.3	1126
1985	0.0	8.7	8.1	0.7	12.8	5.5	7.5	13.1	1171
1986	0.0	7.8	7.3	0.5	12.8	5.8	5.4	12.1	1124
1987	0.0	8.1	7.9	0.2	13.1	6.1	5.2	12.4	1154
in 1000 TOE									
1970	0	3041	2732	309	8596	0	65	0	11698
1971	0	3521	3285	237	10124	0	100	0	13756
1972	0	3419	3155	263	10672	0	313	0	14402
1973	0	3495	3246	249	12084	0	916	0	16483
1974	0	3632	3392	237	12813	256	990	261	17942
1975	0	3727	3488	237	12342	988	1141	715	18923
1976	0	3603	3385	218	12823	1859	1124	1399	20813
1977	0	3658	3419	239	13598	2337	1153	1651	22382
1978	0	3598	3392	206	14581	2419	1299	1658	23564
1979	0	3706	3476	230	14940	2502	1297	1734	24186
1980	0	3966	3670	297	14940	3337	1366	1730	25334
1981	0	4127	3856	270	14036	3754	1328	2557	25813
1982	0	4275	3952	321	12634	4031	1531	3086	25550
1983	0	4210	3876	335	12634	4110	1490	3366	25813
1984	0	4299	3938	361	12634	4620	1646	3730	26937
1985	0	4847	4404	443	12832	4550	2088	3682	28014
1986	0	4330	3995	337	12832	4823	1522	3385	26889
1987	0	4454	4320	136	13141	5064	1459	3488	27607

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

**Table 4: Bulgaria: Exports and Imports of Energy**

Exports			Imports		
	Electricity (GWh)	Hard Coal + Anthracite (1000 tons)	Electricity (GWh)	Hard Coal + Anthracite (1000 tons)	Coke (1000 tons)
1980	866	200	4698	6711	466
1981	1300	0	4500	5800	300
1982	1794	200	4441	6200	300
1983	2220	200	4582	6300	200
1984	3334	300	5872	6300	200
1985	2956	529	7451	8054	664
1986	1470	306	5427	7304	471
1987	952	239	5326	7258	309

Source: H. Liely, Die Energiewirtschaft sozialistischer Länder '(forthcoming)

**Table 5: Regional Distribution of Electricity Exports and Imports (in 1985)**

Electricity Exports to .... (GWh)		Electricity Imports from ... (GWh)	
GDR	48	USSR	5855
Poland	304	Other countries	1596
Hungary	79		
USSR	1032		
Turkey	1477		
Other countries	16		

Source: H. Liely, Die Energiewirtschaft sozialistischer Länder (forthcoming)

## 2.1.5 Primary Energy Consumption

Table 6: Primary Energy Consumption

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	28.9	5.9	8.6	0.5	2.1	0.0	765.2
1971	26.6	6.8	10.3	0.3	2.4	0.0	837.0
1972	26.9	6.5	10.8	0.2	3.1	0.0	859.6
1973	26.5	6.5	12.2	0.2	5.8	0.0	946.8
1974	24.0	6.8	12.9	0.5	5.6	0.9	980.5
1975	27.5	7.1	12.4	1.3	6.2	2.6	1047.5
1976	25.2	6.8	12.9	2.3	6.5	5.0	1109.3
1977	24.9	6.9	13.7	2.8	6.9	5.9	1176.8
1978	25.5	6.6	14.6	2.9	6.8	5.9	1217.9
1979	28.0	7.0	15.2	3.1	7.1	6.2	1280.5
1980	29.9	7.2	15.2	4.2	7.6	6.2	1327.2
1981	29.0	7.7	14.3	4.6	7.1	9.1	1339.9
1982	32.0	7.7	12.9	4.9	5.8	11.0	1320.1
1983	32.1	7.6	12.9	5.0	6.0	12.0	1334.6
1984	32.1	7.7	12.9	5.6	5.8	13.3	1370.7
1985	30.7	8.4	13.0	5.5	6.7	13.1	1386.6
1986	35.0	7.7	13.1	5.8	6.3	12.1	1399.4
1987	36.6	8.3	13.4	6.1	6.9	12.4	1457.6
in 1000 TOE							
1970	5462	3206	8660	400	581	0	18306
1971	5038	3684	10351	275	675	0	20024
1972	5091	3576	10854	187	859	0	20564
1973	5009	3560	12270	187	1627	0	22650
1974	4543	3718	12954	407	1574	261	23457
1975	5208	3861	12461	1081	1730	715	25059
1976	4768	3725	12938	1890	1818	1399	26538
1977	4710	3777	13725	2344	1945	1651	28153
1978	4832	3610	14679	2447	1909	1658	29136
1979	5292	3813	15193	2617	1983	1734	30633
1980	5249	3943	15193	3498	2139	1730	31751
1981	5084	4222	14330	3871	1990	2557	32054
1982	5605	4239	12928	4100	1624	3086	31581
1983	5634	4189	12906	4158	1672	3366	31928
1984	5634	4234	12909	4658	1627	3730	32791
1985	5373	4651	13007	4569	1888	3682	33172
1986	6139	4249	13107	4837	1763	3385	33478
1987	6411	4538	13416	5079	1940	3488	34870



**Remark:** Differences between EEC-UNO and DWI figures can be as much as 8%, though only in several years (1974-1975). Otherwise they remain very slight. This is largely explained by differences in oil consumption. The question of re-exportations of oil affects Bulgaria just as it does other Eastern European countries.

## 2.1.6 Electricity Production

Table 7: Power Generation and Energy used for Power Generation (in Mtoe)

	Power Generation	Heat generation		
1971	1.6			0.7
1972	1.7			0.7
1973	1.7			0.8
1974	1.7			1.6
1975	1.7			1.7
1976	1.7			2.6
1977	1.7			3.7
1978	1.9			4.9
1979	2.0			4.3
1980	2.1			3.5
1981	2.1			3.5
1982	2.3			3.5
1983	2.3			3.8
1984	2.5			3.7
1985	2.3			3.7
1986	2.4			4.0
1987	2.4			3.8
Energy used for power generation (in Mtoe) – Bulgaria				
	Coal	Oil	Gas	Total
1971	4.2	0.7	0.0	2.6
1972	4.4	0.8	0.0	2.7
1973	4.2	1.0	0.0	2.7
1974	4.1	1.6	0.0	2.4
1975	4.5	1.8	0.0	2.8
1976	4.0	2.5	0.8	3.0
1977	4.2	3.3	1.0	3.1
1978	4.7	4.5	1.0	3.4
1979	5.1	4.3	1.2	4.3
1980	5.4	4.2	0.9	4.8
1981	5.3	3.8	1.1	4.6
1982	5.7	3.9	1.2	4.9
1983	5.6	3.9	0.9	4.4
1984	5.7	4.0	0.9	4.4
1985	6.5	4.0	0.6	5.0
1986	6.4	4.0	0.6	4.6
1987	6.5	3.9	0.4	4.5

Bulgaria's installed electricity production capacity was 11 290 MW in 1988. This included:

- 6 555 MW of installed fossil fueled power plants
- and 2 760 MW of nuclear capacity (the Kozlodui nuclear power plant).

Coal is used for a large proportion of electricity production. However, the coal used has a very low heat content with the result that it creates considerable environmental problems. For this reason, Bulgaria counts on nuclear power for half of its future total electricity production. In 1990, the share of thermal power plants in the generation of electricity should drop to 40 % only. It should be noted however that oil plays an important role in electricity production in Bulgaria as compared with other Eastern European countries.

#### **Electricity power generation in 1987 (GW)**

	<b>Production GWh</b>	<b>%</b>
Fossil fuel	28481	59.6
Nuclear	12436	26
Hydro	2533	5.3
Total	43455	100

The Bulgarians themselves reckon that their electricity losses are important.

**Table 8: Bulgaria's Main Fossil fueled power plants**

	<b>Fuel</b>	<b>Installed capacity</b>
Varna	Bituminous coal gas	1260
Maritsa East 2	Lignite	1020
Dimo Dichev	Lignite	840
Bobov Dol	Brown coal	630
Purva Komsomolska	Lignite	500
Rousse	Bituminous coal	400
Petrochemical works, Bourgas	Heavy fuel oil	257
Devnia	Bituminous coal heavy fuel oil gas	219
Metallurgical works, Brezhnev	Lignite heavy fuel oil coke gas	178

Source: "Profile Bulgaria. Part II", Energy economist report, 3, November 1989.

**Table 9: Capacity Mix in 1988 (MWe)**

Nuclear		2760	
Fossil fuel			6574
Utility		5508	
1. Coal		5004	
2. Residual fuel oil and natural gas		504	
Industrial			1066
Hydro		1975	
Total		11309	

### 2.1.7 Final Energy Consumption

Bulgaria's final energy consumption was 23.4 Mtoe in 1986. It was characterized by high energy intensity and per capita energy consumption:

- energy intensity 929 koe.1000 US\$
- per capita energy consumption 3862 koe/inhabitant

Bulgaria's final energy consumption is notable as compared with that of other Eastern European countries in that electricity plays a relatively important role.

**Table 10: Structure of Final Energy Consumption by Energy Form in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
11.5	41.0	17.5	13.7	16.3	100

The importance of electricity within final consumption is linked to its use in the housing-service-agricultural sector (25%).

**Table 11: Structure of Energy Consumption in the Housing-Service-Agricultural Sector in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
20	40	1.7	25	13.3	100

**Table 12: Final Energy Consumption (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	3.0	8.8	0.3	1.5	0.6	14.2
1972	3.0	9.2	0.2	1.6	0.7	14.6
1973	3.2	9.7	0.2	1.8	0.8	15.7
1974	3.1	10.0	0.2	1.9	1.5	16.6
1975	3.1	10.0	0.1	2.0	1.7	16.8
1976	3.1	9.7	0.9	2.2	2.4	18.2
1977	2.8	10.0	1.2	2.3	3.5	19.8
1978	2.8	9.8	1.6	2.5	4.7	21.3
1979	2.6	10.0	2.0	2.6	4.1	21.3
1980	2.9	10.3	2.2	2.7	3.3	21.4
1981	3.1	10.1	2.4	2.8	3.3	21.7
1982	3.2	10.0	2.7	3.0	3.3	22.2
1983	3.1	10.0	3.1	3.1	3.6	23.0
1984	3.2	10.0	3.3	3.3	3.5	23.2
1985	2.7	9.8	4.1	3.2	3.6	23.4
1986	2.7	9.6	4.1	3.2	3.8	23.4
1987	2.9	(1)	4.5	3.3	(1)	-

(1) Not available

**Table 13: Final Energy Consumption in the Industrial Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	1.8	4.2	0.3	1.0	0.5	7.8
1972	1.8	4.4	0.2	1.1	0.5	8.0
1973	1.9	4.5	0.2	1.1	0.6	8.3
1974	1.8	4.5	0.2	1.2	1.2	8.9
1975	1.8	4.5	0.1	1.2	1.3	8.9
1976	1.9	4.3	0.9	1.4	1.9	10.3
1977	1.7	4.4	1.2	1.4	2.8	11.4
1978	1.7	4.3	1.6	1.5	3.6	12.7
1979	1.6	4.4	1.9	1.5	3.2	12.6
1980	1.6	4.7	2.1	1.6	2.6	12.6
1981	1.7	4.7	2.3	1.7	2.6	13.0
1982	1.7	4.5	2.6	1.7	2.6	13.2
1983	1.7	4.4	3.0	1.8	2.8	13.7
1984	1.8	4.3	3.2	1.9	2.8	13.9
1985	1.5	4.1	3.5	1.6	2.8	13.6
1986	1.5	3.9	3.5	1.6	3.0	13.5
1987	1.7	(1)	4.5	1.7	(1)	-

(1) Not available

### Energy Consumption in the Domestic Sector

It should be noted that, within Bulgaria's domestic sector, the development of electricity as the basis of domestic heating raises a certain number of problems in terms of the management of the electricity network.

It should also be noted that district heating (mainly coal-based) plays an important role in this sector. Two approaches have been adopted in this field:

- the use of gas (marginal for the moment),
- and the use of nuclear power<sup>4</sup>.

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<sup>4</sup> TODORICO, N. "La politique de la République Populaire de Bulgarie dans le domaine de l'énergie", Journée coréenne de l'énergie, 16th September 1987.

**Table 14: Final Energy Consumption in the Housing-service-agricultural Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	1.1	2.6	0.0	0.4	0.1	4.2
1972	1.1	2.7	0.0	0.5	0.1	4.4
1973	1.1	3.0	0.0	0.6	0.2	4.9
1974	1.1	3.1	0.0	0.7	0.3	5.2
1975	1.1	3.0	0.0	0.7	0.3	5.2
1976	1.1	2.8	0.0	0.8	0.5	5.1
1977	1.1	2.8	0.0	0.8	0.7	5.5
1978	1.0	2.6	0.1	0.9	1.0	5.5
1979	1.0	2.6	0.1	1.0	0.9	5.5
1980	1.2	2.4	0.1	1.1	0.7	5.5
1981	1.4	2.3	0.1	1.1	0.7	5.5
1982	1.4	2.3	0.1	1.2	0.7	5.7
1983	1.4	2.4	0.1	1.2	0.8	5.8
1984	1.4	2.4	0.1	1.3	0.7	5.9
1985	1.2	2.4	0.1	1.5	0.8	6.0
1986	1.2	2.4	0.1	1.5	0.8	6.0
1987	1.2	(1)	(1)	1.5	(1)	-

(1) Not available

### Energy consumption in the transport sector

Although incomplete, some figures can be given for Bulgarian railways' energy consumption. Two features should be noted:

- the country' high level of electrification compared with the rest of Eastern Europe: as high as 60%,
- the sparseness of the network (38.2 km/1000 km<sup>2</sup>). This makes it one of the most spread-out in the COMECON apart from the Soviet Union<sup>5</sup>.

<sup>5</sup> BLAHA, J. and KAHN, M., "Les transports à l'Est: clé du commerce entre les deux Europes", *Le Courrier des pays de l'Est*, n°345, Dec 1989, p.6.

**Table 15: Final Energy Consumption in the Transport Sector**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	0.2	1.7	0.0	0.0	0.0	1.9
1972	0.1	1.8	0.0	0.1	0.0	2.0
1973	0.1	2.0	0.0	0.1	0.0	2.2
1974	0.1	2.0	0.0	0.1	0.0	2.2
1975	0.1	2.1	0.0	0.1	0.0	2.3
1976	0.1	2.2	0.0	0.1	0.0	2.3
1977	0.1	2.2	0.0	0.1	0.0	2.4
1978	0.1	2.3	0.0	0.1	0.0	2.5
1979	0.0	2.4	0.0	0.1	0.0	2.6
1980	0.0	2.5	0.0	0.1	0.0	2.6
1981	0.0	2.5	0.0	0.1	0.0	2.7
1982	0.0	2.6	0.0	0.1	0.0	2.7
1983	0.0	2.6	0.0	0.1	0.0	2.8
1984	0.0	2.6	0.0	0.1	0.0	2.8
1985	0.0	2.7	0.0	0.1	0.0	2.8
1986	0.0	2.7	0.0	0.1	0.0	2.9
1987	0.0	(1)	0.0	0.1	0.0	-

(1) Not available

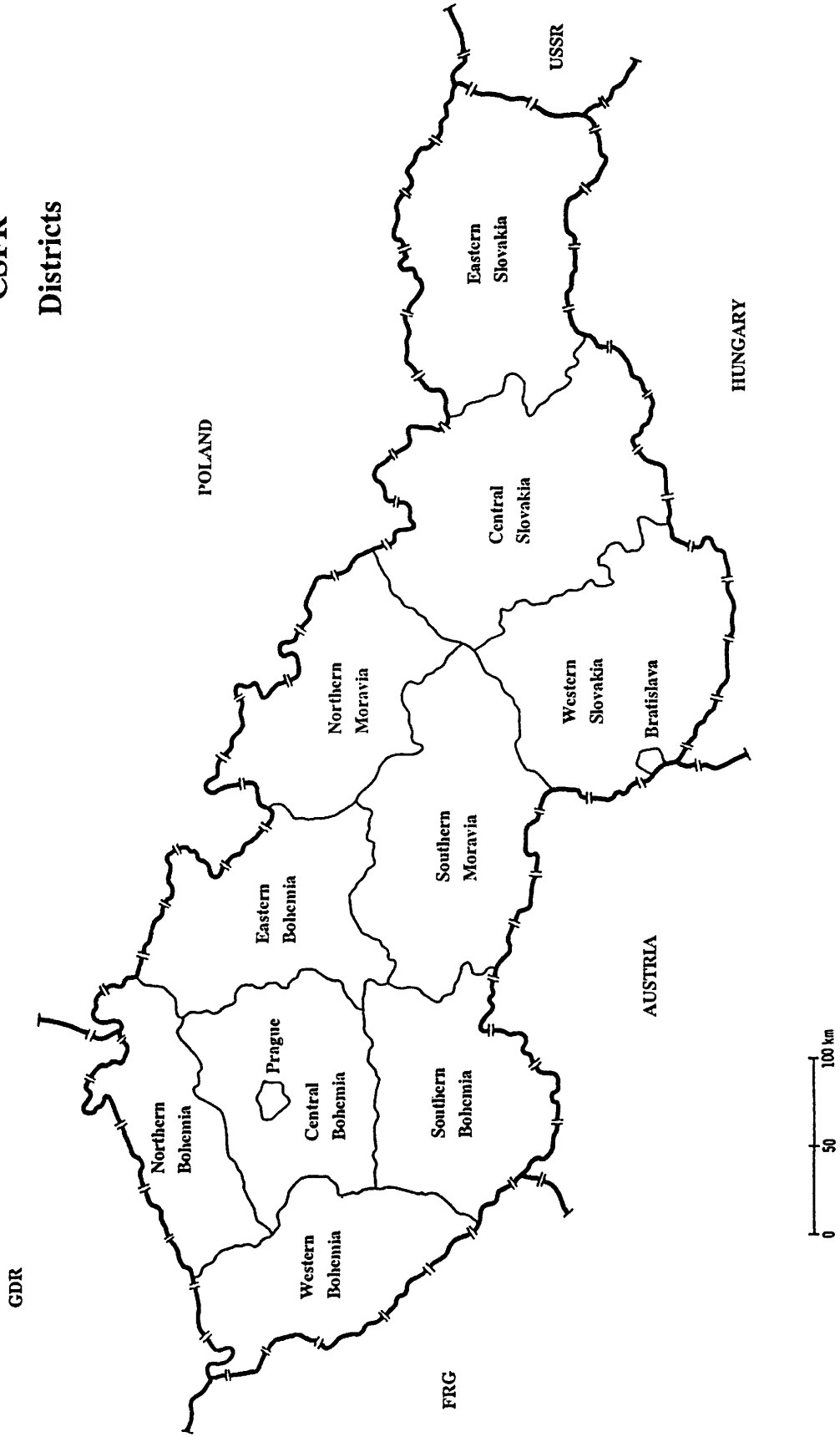


# **Czechoslovakia**

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# CSFR Districts



**2.2 Czechoslovakia****2.2.1 Selected Economic Indicators (1988)**

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	5080 US\$
- Population and Employment	
. Resident Population earning a livelihood (men 15-59 years, women 15-54 years)	15.608 mill. 56.4 %
. Workers and Employees (without pregnant females) thereof women average of pregnant females	7.804 mill. 46 % 0.358 mill.
. Employment Ratio (1986) (without pregnant females)	47.7 %
. Population Density (1986) (Persons per km <sup>2</sup> )	122
. Growth of Population	0.3 %
. Sectoral Employment Shares	
Industry	37.3 %
Construction	8.9 %
Agriculture and Forestry	12.0 %
Transportation and Communication	2.7 %
Science and Research	2.3 %
Domestic and Foreign Trade, Hotels	10.7 %
Education, Culture	7.7 %
Health and Social Affairs	5.8 %
Public Finances and Assurances	0.4 %
Administration and Jurisdiction	1.5 %
- Sectoral Output Shares (1987)	
. Agriculture	15.2 %
. Industry	40.3 %
. Productive Sectors	25.2 %
. Non-productive Sectors	19.3 %
- Natural Resources and Raw Materials Production	
. Raw Iron	9.706 mill. t
. Raw Steel	15.319 mill. t

## 2.2.2 National Energy Resources<sup>1</sup>

The energy resource situation in Czechoslovakia is mainly determined by brown coal. Resources are estimated at 8.4 billion tons, but less than a half of this is economically exploitable.

The most important deposits are located in the basin of Northern Bohemia. Resources are indicated with 6 billion tons, reserves with 2.4 billion tons. The quality of the brown coal differs considerably, ranging from 19.1 MJ/kg (deep mining) to 10.2 MJ/kg (opencast mining). The stripping ratio of 3/1 is relatively low. A serious problem is the content of sulphur: 1.7 % is a relatively high value.

The second largest brown coal field is located in the Sokolover Basin, in the western part of Northern Bohemia. The calorific value (11.9 MJ/kg) is worse than in the other fields of Northern Bohemia, but sulphur content is lower and the stripping ratio (2.5/1) is better.

Other deposits in Slovakia are extracted by deep mining. Extractable resources are indicated with 500 million tons, the average heating value is 11.3 MJ/kg.

Hard coal is extracted in the region around Ostrava. At the present coal production, reserves will have a life time of 40 years. The average net heating value of the coal is 24.6 MJ/kg.

Oil and gas resources are of minor importance in Czechoslovakia. Gas reserves are estimated to be between 15 and 20 billion m<sup>3</sup>, and recently a new field with about 4 billion m<sup>3</sup> was discovered in the East of Slovakia in 1987.

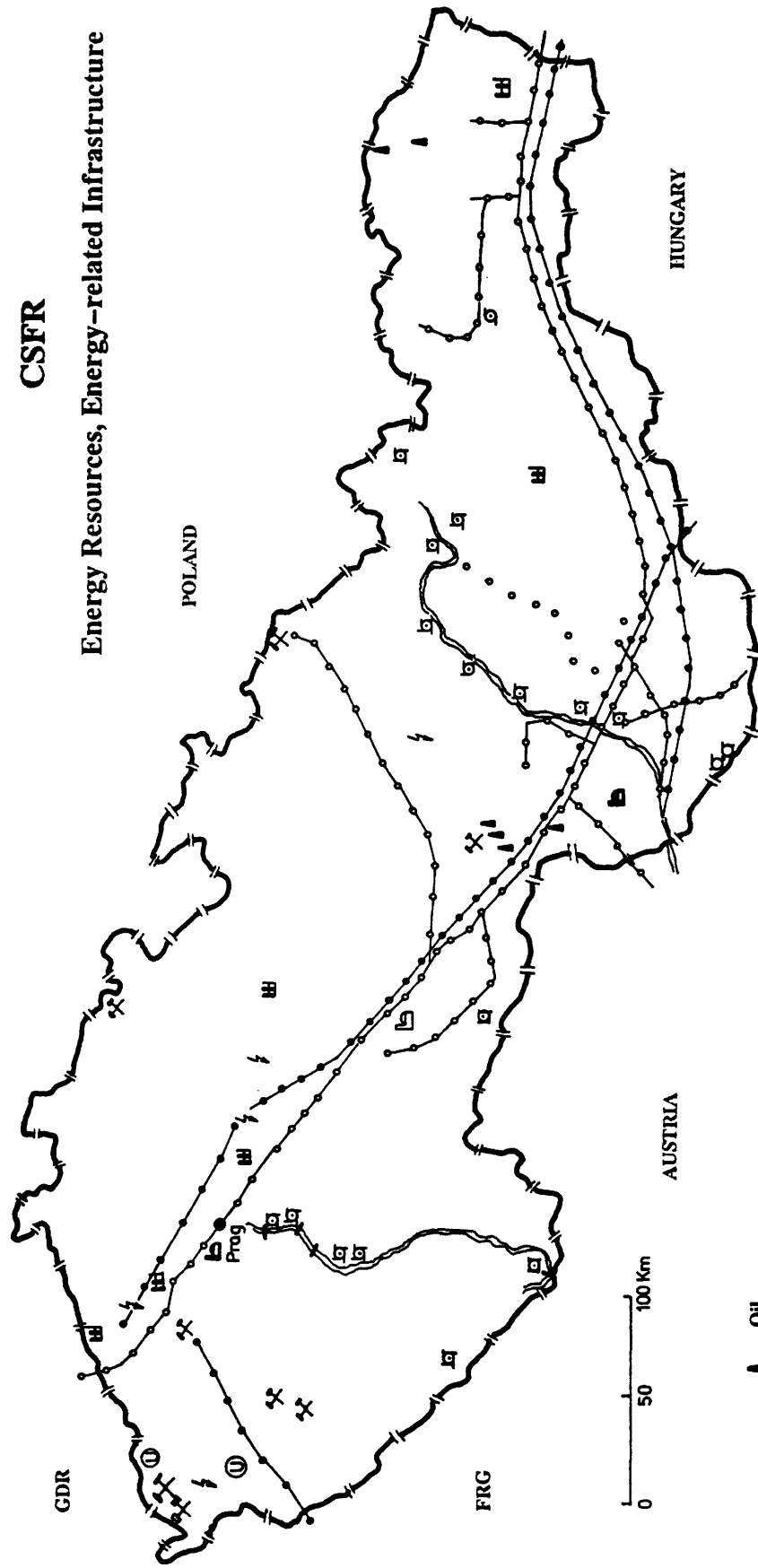
There are no official sources on the deposits of uranium, located in Pribram and Straz pod Ralskem.

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**1 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

# CSFR

## Energy Resources, Energy-related Infrastructure



- ▲ Oil
- Oil Pipeline
- Oil Refinery
- △ Gas
- Gas Pipeline
- ⚡ Coal
- ⚡ Lignite
- ⊕ Uranium
- ▣ Nuclear Power Plants, in construction
- ⚡ Major Thermal Power Plants
- ▣ Major Hydropower Plants
- |— Rivers, Dams

**GOPA**

### 2.2.3 Primary Energy Production<sup>2</sup>

Production of primary energy stagnated in the eighties. However, domestic production still covers around 60 % of energy consumption.

Two thirds of primary energy production is made up by brown coal. Brown coal production slightly decreased from more than 100 million tons p.a. in the mid-eighties to planned 94 million tons in 1990. Until 2000 a further reduction to 80 million tons is expected. About 90 % of brown coal is extracted from two fields in Northern Bohemia.

Hard coal production decreased slightly in the eighties. Planned production amounts to 25 million tons for 1990, and for the year 2000 a production of 23 million tons is expected. In spite of the diminishing production it is planned to meet the demand for metallurgical coke also in the future by domestic coke production. Nearly 90 % of the hard coal is extracted from the mines in the region around Ostrava, Upper Silesia. Due to increasing costs a production growth is not possible. The depths of the mines are expected to increase from 680 m (1980) to 900 m in 2000.

Gas production is relatively low (0.7 bill. m<sup>3</sup> in 1987) and is stagnating. Only about 6 % of domestic production can be covered from domestic sources.

Presently, hydropower plays a minor role in primary production, but the capacity shall be developed from about 1600 MW today to 2400 MW to the year 2000. By this, about 80 % of the hydro potential would come into use. The largest project in this plan is the plant of Gabčíkovo at the Danube, which was planned in cooperation with Hungary. As Hungary stopped all construction works due to discussions on environmental hazards of this project, it is questionable whether this project will come into operation.

In the long run nuclear power shall play an important role in electricity generation. At the end of the eighties, a capacity of 3,520 was installed and more than one quarter of electricity generation was nuclear. By the year 2000 the capacity is to be increased to 11,300 MW and for 2020 about 75 % of electricity shall be generated by nuclear power plants. (The current share is about 25 %)

It is noteworthy that the CSFR is the only country besides the USSR which produces reactors. These reactors, being built in the Skoda plants at Pilsen, are of the types VVER-440 and VVER-1000.

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**2** Source: Deutsches Institut für Wirtschaftsforschung (DIW), *Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren*, Berlin, November 1989

**Table 1: Primary Energy Production**

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- electricity bill.kWh	Total PJ
1970	81.3	28.2	0.2	1.2	3.7	1896.3
1971	84.2	28.8	0.2	1.2	2.7	1939.8
1972	84.9	27.9	0.2	1.2	2.8	1929.1
1973	81.2	27.8	0.2	1.0	2.4	1864.4
1974	82.2	28.0	0.1	1.0	4.0	1897.8
1975	86.3	28.1	0.1	0.9	3.8	1954.5
1976	89.5	28.3	0.1	1.0	3.3	1946.1
1977	93.2	28.0	0.1	1.0	4.4	2002.3
1978	94.9	28.3	0.1	1.1	4.1	2033.4
1979	96.2	28.5	0.1	0.9	4.2	2046.2
1980	94.9	28.2	0.1	0.6	4.8	2021.0
1981	95.3	27.5	0.1	0.7	4.2	1949.3
1982	97.1	27.5	0.1	0.7	3.7	1965.4
1983	100.5	26.9	0.1	0.6	3.9	1996.4
1984	102.9	26.4	0.1	0.8	3.3	2013.2
1985	100.8	26.2	0.1	0.7	4.3	1994.7
1986	100.4	25.7	0.1	0.7	4.0	1973.5
1987	100.4	25.7	0.2	0.7	4.7	1984.6
in 1000 TOE						
1970	27358	15815	199	962	1029	45365
1971	28322	16165	191	976	754	46406
1972	28581	15662	187	931	787	46150
1973	27342	15581	167	833	679	44602
1974	27650	15689	146	780	1134	45401
1975	29033	15772	139	742	1069	46758
1976	28854	15854	129	785	933	46557
1977	30069	15684	120	799	1227	47901
1978	30600	15871	115	914	1146	48645
1979	31028	15964	108	679	1172	48951
1980	30602	15818	91	500	1335	48348
1981	29394	15433	89	529	1191	46633
1982	29954	15404	89	524	1050	47018
1983	30995	15095	91	490	1088	47760
1984	31729	14820	89	605	916	48162
1985	31086	14715	120	579	1220	47719
1986	30968	14392	139	593	1120	47212
1987	30973	14435	148	593	1330	47478

Source: Data Bank CMEA-Energy of DIW



### 2.2.4 Exports and Imports of Energy<sup>3</sup>

Import dependency rose in the last twenty years from 20 % (1970) to nearly 40 % (1987). The demand for solid fuels can be matched by domestic production, but consumption in oil, natural gas and nuclear energy is nearly totally covered by imports. Most of the imports are delivered by the USSR.

Since the beginning of the eighties, Czechoslovakia has not reported on import quantities of crude oil. The reason could be the re-exports of mineral oil. Data on trade values show that oil export revenues corresponded to one fifth of import costs in 1980. This relation fell continuously during the eighties. The quantity of exported mineral oil products is estimated at 1 to 2 million tons, and imports from the USSR are estimated at 17.5 million tons.

Czechoslovakia imported about 11 bill. m<sup>3</sup> of Russian natural gas in 1987. One - unknown - share of these imports is a payment for the transfer of gas to the GDR and West-European countries. The annual capacity of the gas grid currently lies at 60 billion m<sup>3</sup> and shall be increased to 75 billion m<sup>3</sup> by 1992.

Electricity imports from the USSR will be increased in the next years. Through the Czechoslovakian contribution to the nuclear plant of Chmelnizki imports of 3.6 billion kWh p.a. are guaranteed. Further, minor exchanges of electricity take place between Austria and the Federal Republic of Germany.

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**3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 2: Exports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t	Coke mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Total PJ
1970	1.3	3.0	2.5	0.8	0.1	0.6	200.4
1971	1.2	3.5	2.3	0.9	0.1	0.6	214.5
1972	1.3	3.3	2.4	1.0	0.1	1.0	220.7
1973	1.3	3.5	2.6	0.9	0.1	1.0	225.9
1974	1.4	3.7	2.5	0.5	0.0	0.9	208.6
1975	1.7	3.7	2.3	0.7	0.0	0.6	212.7
1976	1.6	3.8	2.1	0.9	0.1	0.3	212.4
1977	1.7	3.3	2.0	1.3	0.1	0.8	221.7
1978	1.5	3.7	2.0	0.8	0.1	0.9	212.6
1979	1.6	4.0	1.9	0.7	0.1	1.1	212.7
1980	2.2	3.7	1.5	1.7	0.0	1.7	247.8
1981	2.5	3.1	1.3	1.2	0.0	1.1	205.4
1982	2.7	2.8	1.4	1.4	0.3	1.1	218.6
1983	2.7	2.8	1.2	1.6	0.3	1.3	225.8
1984	2.6	2.7	1.3	1.1	0.0	1.8	201.6
1985	2.8	2.7	1.2	1.5	0.0	2.5	223.6
1986	2.7	2.5	1.0	2.2	0.3	2.2	250.2
1987	2.7	2.5	1.0	2.5	0.0	2.2	250.2
in 1000 TOE							
1970	421	1665	1665	811	72	160	4794
1971	414	1940	1560	943	103	170	5131
1972	423	1856	1610	1022	98	270	5280
1973	426	1952	1713	952	81	280	5404
1974	469	2084	1677	490	31	239	4990
1975	567	2057	1531	739	31	163	5088
1976	519	2115	1402	914	50	81	5081
1977	533	1856	1352	1292	48	222	5304
1978	488	2100	1325	847	72	254	5086
1979	531	2220	1261	720	55	299	5088
1980	696	2091	974	1655	33	478	5928
1981	780	1722	842	1232	24	313	4914
1982	835	1584	914	1376	203	316	5230
1983	825	1584	830	1596	206	359	5402
1984	816	1498	873	1112	19	502	4823
1985	873	1500	770	1502	0	701	5349
1986	833	1423	667	2182	254	624	5986
1987	833	1402	665	2469	0	617	5986

Source: Data Bank CMEA–Energy of DIW

**Table 3: Imports of Energy**

Year	Brown Coal	Hard Coal	Thereof: Hard Coal	Coke	Oil	Gas	Electricity	Nucl. Energy*	Total
	mill.t	mill.t	mill.t	mill.t	mill.t	bill.m3	bill.kWh	bill.kWh	PJ
1970	1.0	4.5	4.5	0.0	10.9	1.4	4.0	0.0	663
1971	0.9	5.6	5.5	0.1	12.5	1.7	5.1	0.0	777
1972	0.7	5.6	5.5	0.1	13.6	2.0	4.6	0.0	828
1973	0.6	5.3	5.3	0.0	15.4	2.4	5.3	0.2	923
1974	0.5	5.3	5.2	0.1	16.0	3.3	5.4	0.5	980
1975	0.5	5.3	5.2	0.1	16.9	3.8	4.7	0.2	1023
1976	0.5	5.2	5.2	0.0	18.2	4.6	4.5	0.4	1105
1977	0.3	5.7	5.6	0.1	19.5	5.2	3.2	0.1	1172
1978	0.5	5.6	5.6	0.0	19.7	5.7	4.3	0.0	1209
1979	0.5	5.5	5.5	0.0	19.9	7.3	4.7	2.1	1298
1980	0.4	5.1	5.1	0.0	20.1	8.3	3.4	4.5	1311
1981	0.6	4.4	4.4	0.0	19.4	8.6	3.2	5.1	1278
1982	0.7	5.0	5.0	0.0	18.1	9.0	3.1	5.8	1259
1983	0.7	5.0	5.0	0.0	17.9	9.3	3.5	6.2	1265
1984	0.7	4.6	4.6	0.0	18.0	10.5	4.8	7.2	1326
1985	0.7	4.7	4.7	0.0	17.7	10.8	7.6	10.9	1402
1986	0.7	4.5	4.5	0.0	18.0	11.6	4.5	16.6	1464
1987	0.7	4.5	4.5	0.0	18.3	12.2	4.5	20.6	1544
in 1000 TOE									
1970	218	2486	2476	10	10914	1132	1115	0	15861
1971	182	3053	3002	50	12533	1385	1431	0	18588
1972	146	3072	3026	45	13667	1634	1280	10	19808
1973	122	2911	2897	14	15481	1990	1500	65	22081
1974	115	2907	2825	81	16045	2718	1529	136	23445
1975	110	2883	2837	45	16947	3189	1304	53	24473
1976	96	2866	2849	17	18244	3861	1249	124	26435
1977	67	3110	3074	36	19593	4316	907	31	28038
1978	98	3081	3057	24	19727	4794	1206	5	28923
1979	100	3005	3005	0	19909	6129	1309	603	31052
1980	93	2799	2799	0	20181	6076	947	1268	31363
1981	120	2428	2419	10	19425	6249	904	1440	30574
1982	136	2722	2722	0	18184	6586	856	1639	30119
1983	141	2758	2749	10	17899	6763	969	1725	30263
1984	148	2498	2498	0	18026	7672	1337	2031	31722
1985	155	2562	2562	0	17746	7887	2120	3062	33540
1986	148	2462	2462	0	18048	8450	1263	4658	35023
1987	148	2462	2462	0	18349	8923	1263	5785	36937

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

## 2.2.5 Primary Energy Consumption

Table 4: Primary Energy Consumption in Czechoslovakia

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	81.9	27.3	10.3	2.5	7.1	0	2359.1
1971	83.8	28.6	11.8	2.8	7.2	0	2502.2
1972	84.4	27.8	12.8	3	6.4	0	2536.1
1973	80.6	27.1	14.7	3.3	6.8	0.2	2561.1
1974	81.3	27	15.7	4.2	8.6	0.5	2669.3
1975	85.1	27.4	16.3	4.7	7.9	0.2	2765.2
1976	88.3	27.6	17.4	5.6	7.5	0.4	2838.9
1977	91.9	28.3	18.4	6.1	6.8	0.1	2952.1
1978	93.8	28.2	18.9	6.8	7.5	0	3029.6
1979	95	28.1	19.2	8.1	7.8	2.1	3131.5
1980	91.6	28.1	18.9	8.9	6.4	4.5	3078.1
1981	94.4	27.6	18.4	9.2	6.4	5.1	3040.4
1982	94.7	28.3	16.6	9.4	5.7	5.8	2990.8
1983	98.9	27.9	16.3	9.6	6.1	6.2	3038.2
1984	100.5	27	16.3	11.2	6.2	7.2	3104.5
1985	98.7	27.1	16.3	11.5	9.4	10.9	3172.8
1986	97.7	26.6	16	12	6.3	16.6	3178.3
1987	94.2	26.7	16	13	7	20.6	3223.9
in 1000 TOE							
1970	27157	14969	10304	2024	1986	0	56437
1971	28090	15717	11780	2258	2014	0	59860
1972	28306	15270	12832	2464	1799	0	60671
1973	27038	14827	14698	2742	1899	65	61269
1974	27296	14835	15701	3466	2423	136	63858
1975	28576	15067	16347	3899	2213	53	66152
1976	28430	15203	17457	4596	2103	124	67915
1977	29602	15586	18423	5069	1911	31	70623
1978	30208	15526	18995	5639	2105	5	72477
1979	30598	15488	19294	6753	2179	603	74915
1980	29495	15552	18971	6543	1806	1268	73637
1981	29069	15296	18397	6753	1782	1440	72735
1982	29157	15631	16626	6907	1588	1639	71549
1983	30454	15445	16315	7048	1699	1725	72683
1984	30944	14942	16342	8258	1751	2031	74269
1985	30368	15005	16366	8466	2636	3062	75903
1986	30066	14760	16004	8787	1756	4658	76034
1987	28995	14827	16026	9517	1976	5785	77125

Remark: There is only a slight difference between the two data sources as regards primary energy consumption (no greater than 5% depending on the year). As a result, the use of EEC-UNO data for final consumption does not raise any problems.

## 2.2.6 Electricity Production

**Table 5: Power Generation and Energy used for Power Generation (in Mtoe)**

	Power Generation	Heat generation		
1971	3.8			10.2
1972	4.2			10.4
1973	4.4			10.6
1974	4.4			10.8
1975	4.8			11.0
1976	5.1			11.2
1977	5.3			11.5
1978	5.6			11.7
1979	5.3			11.9
1980	5.5			12.2
1981	5.5			12.1
1982	5.6			12.1
1983	5.7			12.2
1984	5.8			12.5
1985	5.5			13.0
1986	5.4			12.3
1987	5.0			12.6
Energy used for power generation (in Mtoe) – Czechoslovakia				
	Coal	Oil	Gas	Total
1971	21.4	2.1	1.0	10.6
1972	22.6	2.4	1.1	11.6
1973	23.3	2.8	1.0	12.1
1974	22.7	3.5	1.1	12.0
1975	23.6	4.0	1.2	12.9
1976	24.4	4.4	1.3	13.9
1977	25.3	4.7	1.5	14.6
1978	25.9	4.9	1.7	15.1
1979	24.4	4.8	1.9	13.8
1980	24.9	4.4	2.4	14.1
1981	25.0	4.6	2.6	14.5
1982	25.2	4.2	2.9	14.5
1983	25.8	4.1	2.5	14.5
1984	26.7	3.9	2.6	14.9
1985	26.2	4.1	2.4	14.2
1986	25.7	3.6	2.8	14.5
1987	24.9	3.6	2.9	13.7

The evolution of Czechoslovakian electricity production is marked by two main features.

First of all, the growing importance of nuclear power. Several figures serve to illustrate this. Czechoslovakia's nuclear capacity currently stands at 3532 MW. The country possesses 8 VVER reactors each with a power rating of 440 MWe. Bearing in mind the 1979 agreement concerning nuclear specialisation within the COMECON, Czechoslovakia and the Soviet Union are effectively in charge of basic equipment, particularly reactors.

**Table 6: Electricity Generation in 1987**

	Generation GWh	%
Coal	51.5	63
Oil	2.8	3.5
Gas	5.2	6.4
Nuclear	22.2	27.2
Hydro	4.1	5.0

Czechoslovakia's own forecasts allow for strong growth in nuclear power. However, some options could change in the light of the reforms currently taking place. The 1988 figures targetted a nuclear capacity of 11,280 MW in the year 2000, thus generating 50 % of electricity in nuclear power plants. For the moment, only two out of a total of four units of the Temelin nuclear power station have been completed. Until 1992, each year the capacity should be enlarged by a 440 MW block. Each of these reactors will bring about savings of brown coal amounting to 2 mill. tons.

The crucial change in this field has without doubt been the important fall in the use of oil for electricity production since the Soviet Union reduced its oil exports to Czechoslovakia.

This is partly made up for by the use of nuclear power and by a renewed interest in coal. However, the scope of such a strategy is limited by production difficulties affecting coal.

### 2.2.7 Final Energy Consumption

With a final energy consumption of 52 Mtoe in 1986, Czechoslovakia is one of the biggest energy consumers within COMECON.

Its primary energy intensity is 1,008 koe/1000 \$80

Its per capita energy consumption is 4,973 koe/inhabitant.

Czechoslovakia's final energy consumption is dominated by the industrial sector and by the use of coal.

**Table 7: Structure of Final Energy Consumption by Sector in 1986 (%)**

Industry	Transport	Housing-services-agriculture	Total
56.3	6.2	37.5	100

**Table 8: Structure of Final Energy Consumption by Energy Form in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
26.9	20.4	18.7	10.6	23.3	100

The main change in this area is, of course, the fall in the absolute value of oil consumption, which has been particularly felt in the industrial and housing-service-agriculture sectors.

Oil consumption in the industrial sector fell from 4.3 Mtoe in 1977 to 2.8 Mtoe in 1986. Czechoslovakia's strategy has been to give priority to the use of oil for its chemical and petrochemical programmes. It should be borne in mind that Czechoslovakia is a significant exporter of chemical products, particularly to other Eastern European countries – an activity which it makes an effort to maintain. In contrast, according to V. MERKIN Czechoslovakia has made important energy substitutions in the steel sector.

Steel production, along with chemicals, remains among the biggest energy consumers within the industrial sector (the Open hearth process still accounts for 41 % of steel production). According to IEA data, it accounts for roughly 16 % of industrial consumption. A major effort is to be made to modernize this sector.

**Table 9: Final Energy Consumption (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	15.0	9.0	4.9	3.3	9.4	41.5
1972	14.2	10.2	5.2	3.5	9.6	42.7
1973	13.6	10.5	5.6	3.7	9.8	43.3
1974	13.4	10.7	6.0	3.9	10.0	44.1
1975	13.7	11.1	6.2	4.1	10.3	45.3
1976	13.9	11.4	6.5	4.3	10.5	46.6
1977	13.6	12.0	7.0	4.5	10.7	47.8
1978	13.2	12.5	7.3	4.7	10.9	48.7
1979	13.5	12.2	7.5	4.6	11.2	48.9
1980	13.4	12.2	7.7	4.9	11.4	49.6
1981	13.4	11.9	7.7	4.9	11.3	49.2
1982	13.4	10.6	8.0	5.0	11.4	48.4
1983	13.5	10.5	8.6	5.3	11.5	49.4
1984	13.3	10.4	8.5	5.5	11.9	49.5
1985	13.7	10.8	8.7	5.7	12.3	51.1
1986	14.0	10.6	9.7	5.5	12.1	52.0
1987	14.3	10.6	9.1	5.8	12.3	52.1

**Table 10: Final Energy Consumption in the Industrial Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	4.3	3.1	4.0	2.3	8.3	22.0
1972	4.3	3.8	4.1	2.4	8.4	23.0
1973	4.3	3.9	3.9	2.5	8.5	23.2
1974	4.3	3.9	4.0	2.6	8.7	23.5
1975	4.5	3.9	4.0	2.7	8.8	23.9
1976	4.4	4.1	3.9	2.8	8.9	24.2
1977	4.2	4.3	4.0	3.0	9.0	24.4
1978	4.3	4.3	4.0	3.1	9.1	24.8
1979	4.3	4.1	4.2	3.0	9.3	24.8
1980	4.3	4.0	4.0	3.1	9.4	24.8
1981	4.4	3.8	4.1	3.2	9.3	24.8
1982	4.4	3.2	4.3	3.2	9.3	24.4
1983	4.3	3.1	4.6	3.2	9.4	24.7
1984	4.3	3.0	4.3	3.3	9.6	24.6
1985	4.4	3.2	4.3	3.4	9.9	25.1
1986	4.3	2.8	5.1	3.4	9.7	25.3
1987	4.5	2.7	4.1	3.5	9.7	24.6



## Energy Consumption in the Transport Sector

In recent years, Czechoslovakia has given priority to the modernization of its public transport system, in particular the electrification of its rail network. Czechoslovakia is generally regarded as being relatively well provided for in terms of rail transport (especially when compared with Romania and Bulgaria) as well as in terms of road transport (if road density is taken as the criterion).

**Table 11: Selected Data concerning Czechoslovakian Transport in 1988.**

Rail	Road transport		
Lines (in km)	13,103	Metalled roads (1000 km)	73.6 (1)
Electric lines (%)	29	Road network density (km/1000 km <sup>2</sup> )	57.5
Network density (km/1000 km <sup>2</sup> )	102		

(1) 1987.

Source: Table 1, p.6 in J. BLAHA, M. KAHN, "Les transports à l'Est: clé du commerce entre les deux Europes", *Courier des pays de l'Est*, n°345, December 1989, pp.4-31.

It should be emphasized that Czechoslovakia's electrification policy has had a negative impact on the modernization of the rail system and so on the fall in specific energy consumption. Indeed, transport's share of investment has fallen in most Eastern European countries.

**Table 12: Final Energy Consumption in the Transport Sector**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	1.5	1.7	0.0	0.2	0.1	3.6
1972	1.3	1.9	0.0	0.2	0.1	3.5
1973	1.0	2.1	0.0	0.2	0.1	3.5
1974	0.9	2.2	0.0	0.2	0.1	3.4
1975	0.6	2.2	0.0	0.3	0.1	3.2
1976	0.5	2.4	0.0	0.3	0.1	3.3
1977	0.5	2.5	0.0	0.3	0.1	3.4
1978	0.4	2.7	0.1	0.3	0.1	3.4
1979	0.2	2.6	0.0	0.3	0.1	3.2
1980	0.1	2.5	0.0	0.3	0.1	3.1
1981	0.1	2.6	0.0	0.3	0.1	3.1
1982	0.1	2.5	0.0	0.3	0.1	2.9
1983	0.1	2.5	0.0	0.3	0.1	2.9
1984	0.1	2.5	0.0	0.3	0.1	3.0
1985	0.1	2.7	0.0	0.3	0.1	3.2
1986	0.1	2.6	0.0	0.3	0.1	3.2
1987	0.1	2.7	0.0	0.3	0.1	3.2

**Table 13: Final Energy Consumption in the Housing-Service-Agriculture Sector**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	8.6	2.2	0.9	0.8	1.1	13.5
1972	8.1	2.2	1.1	0.8	1.2	13.4
1973	7.8	2.5	1.2	0.9	1.2	13.6
1974	7.8	2.6	1.2	1.0	1.3	13.9
1975	8.0	2.9	1.5	1.1	1.4	14.9
1976	8.4	2.9	1.7	1.2	1.5	15.6
1977	8.4	3.2	2.0	1.3	1.6	16.4
1978	8.1	3.5	2.2	1.4	1.7	16.9
1979	8.5	3.4	2.3	1.4	1.8	17.4
1980	8.5	3.3	2.6	1.5	1.9	17.8
1981	8.4	3.0	2.6	1.5	1.9	17.5
1982	8.4	2.6	2.8	1.5	2.0	17.4
1983	8.6	2.5	2.9	1.8	2.1	17.9
1984	8.4	2.5	3.3	1.9	2.2	18.2
1985	8.6	2.6	3.4	2.0	2.3	19.1
1986	9.1	2.5	3.7	1.8	2.4	19.5
1987	9.1	2.6	4.0	1.9	2.5	20.2

Energy consumption in this sector is characterized by the importance of district heating (heat-steam accounts for 12.4 % of the housing sector's consumption). Solid fuels with a low heat content are widely used for district heating and constitute a major source of pollution. Given the priority given to nuclear power, Czechoslovakia has moved towards the use of nuclear power for district heating in recent years. There already exists a hot water pipeline between the Bohunice nuclear power station and Bratislava<sup>4</sup>.

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**4 Enerpress, n°4533, 11th March 1988.**

# **German Democratic Republic**

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# GERMAN DEMOCRATIC REPUBLIC

## Districts



**GOPA**

Statistisches Bundesamt 87 0082

## 2.3 German Democratic Republic

### 2.3.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	5100 US\$
- Population and Employment	
. Resident Population earning a livelihood (men 15-65 years, women 15-60 years, plus 40 % of the children aged 14 to 15 years)	16.675 mill. 65 %
. Population Density (Persons per km <sup>2</sup> )	154
. Growth of Population	0.07 %
. Workers and Employees (without apprentices)	8.594 mill.
. Employment Ratio	51.5 %
Men	55.1 %
Women	48.3 %
. Sectoral Employment Shares	
Industry (without energy sector)	37.4 %
Energy Sector	2.6 %
Handicraft	3.1 %
Construction	6.6 %
Transport, Post, Communication	7.4 %
Trade	10.3 %
Agriculture and Forestry	10.8 %
Other Productive Sectors	3.0 %
Non-productive Sectors	21.4 %
- Sectoral Output Shares (1987)	
. Agriculture	13.4 %
. Industry	44.6 %
. Productive Services	23.3 %
. Non-productive Services	18.7 %
- Natural Resources and Raw Materials Production	
. Potash Dung	3.510 x 10 <sup>3</sup> t
. Raw Steel	8.131.2 x 10 <sup>3</sup> t

### 2.3.2 National Energy Resources<sup>1</sup>

The energy resource basis is very limited in the GDR. The only energy source which is available to an important extent is brown coal. Reservoirs of natural gas are shrinking, and crude oil reserves, which are located along the coast of the Baltic Sea, provide only a small domestic supply basis. Due to the lack of valuable stocks, exploitation of hard coal was even stopped in 1978.

The geologically investigated stocks of brown coal are equal to 38 billion tons. Thereof, about 20 billion tons are considered economically viable. The supply stocks are heavily concentrated on the districts along the West-Elbe and East-Elbe, with the regions around Cottbus and Dresden having the share of about 50 %. Compared to coal from the areas Halle/Leipzig, coal from the East-Elbe district (which represents about 70 % of total supply) has a lower net heating value but it is also less sulphur-containing.

Brown coal mining is done as open-pit mining. The working conditions, however, are constantly worsening: The average mining depth is almost 70 m, and it is expected to increase to 100 m in the near future. Each year, the specific stripping and draining quantities grow at a rate of 2-3 %. For the time being, each year about 1.5 billion of m<sup>3</sup> of overburden have to be removed to reach the seams. Thus, during the period 1981-1985 the transport costs increased by 30 %. It is expected that the quality of the brown coal will decrease further: The contents of water, ash and - in many cases - sulphur will increase, whereas net heating values will be lower.

Large areas of the GDR are considered to be gas-carrying. In the sixties, the gas supply stocks were estimated at 2.5 billion m<sup>3</sup>, spread over an area of 4000 km<sup>2</sup>. However, some of these stocks can be found at depths of 5000 m and many efforts to explore the gas fields failed in the seventies.

The only significant places where natural gas is found are located in the Altmark Area near Salzwedel. Yet, the authorities do not publish any data on the amount of the reserves. Due to the high nitrogen content, the quality of gas is very bad. In order to preserve its usefulness, it has to be mixed with imported gas!

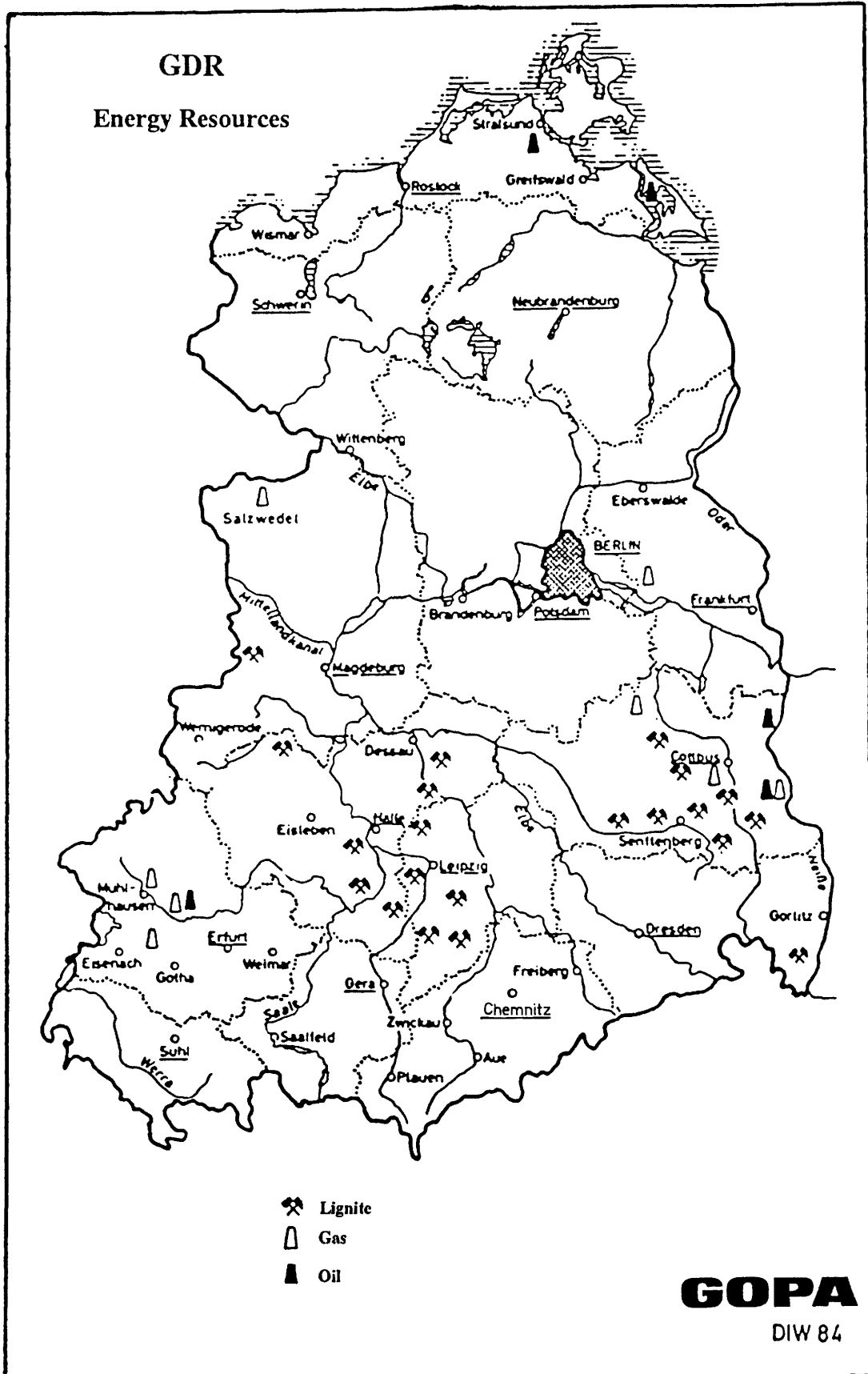
Any data on Uranium are treated as top secret in the GDR. The uranium is usually delivered to the USSR, where the fuel rods for the nuclear power plants come from. Thus, an intensification of nuclear power production will increase the country's dependence on energy imports.

Renewable energies are to be exploited more intensively in the future, especially geothermal energy, which is available in the Northern parts of the country. Pilot projects have already been set up in the Neubrandenburg District, where 22,000 dwellings are supplied with hot water by the end of this year. Besides this, a few wind and solar energy projects have been initiated.

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1 Source: Deutsches Institut für Wirtschaftsforschung (DIW), *Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren*, Berlin, November 1989





### 2.3.3 Primary Energy Production<sup>2</sup>

In the early eighties, the East German Government decided to increase the output of brown coal. This was mainly due to the expected increase in energy prices in general, and increasing oil prices in particular. During the plan period 1981–1985, this goal could be fully achieved. On the average, the yearly growth rate of primary energy production amounted to 4 %. The next 5–Year–Plan (1986–1990), therefore, postulated even more ambitious production goals, which up to now could not be completely fulfilled, as can be seen from the following table:

**Table 1: Brown Coal Output (in million tons)**

Year	1986	1987	1988	1989	1990
Plan	314	319	317	317	335
Reality	311	309	310	304	n.a.

Of course, the expansion of brown coal output created serious environmental problems, first of all with regard to SO<sub>2</sub>–emissions, which are about 5 million tons per year.

Given these problems, the plan to further extend brown coal output increasingly met with scepticism. In the context of the general reform of the political and economic system, a significant reduction of brown coal production is aimed at, with plan targets of about 200 million tons by the year 2000. Such a decrease could be compensated for in the following ways:

- Imports of gas (through a link with the West European gas network and from the USSR)
- Imports of hard coal (especially from Poland, USSR and Australia)
- Use of nuclear energy.

Nuclear energy currently seems to be strongly favored by East German decision–makers, and large parts of the population obviously agree with this strategy (cf. Frankfurter Allgemeine Zeitung, 17 March 1990, Die DDR–Bürger sind für mehr Atomstrom).

Besides the domestic brown coal, which in 1987 accounted for 68 % of total primary energy supply, the following primary energies contribute to the supply side (in brackets their respective shares in 1987):

- Oil (13 %)
- Gas (9 %)
- Hard Coal (5 %)
- Nuclear Energy (3 %)
- Others (2 %)

**2 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe–Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

According to national statistics, the GDR produced in 1976 an output of more than 200,000 tons of crude oil. However, international energy experts cast some doubts on such figures; about 50,000 tons yearly are assumed to be a more realistic figure\*. The remaining quantities (approximately 20 mill. tons) are imported.

Already in the 6th 5-Year-Plan 1976–1980 it was foreseen to convey 7.8 to 8.2 billion m<sup>3</sup> of gas yearly. Although this amount could be increased since then by 50 %, generation of town gas and imports of natural gas had to be increased as well\*\*.

Hard coal is completely imported, and nuclear energy, which still is at an immature stage, cannot be expanded without the help from the USSR or, in the future, from West European Countries.

The cooperation between GDR and USSR in the field of nuclear energy is managed by the joint company SDAG Wismut.

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\* Source: H. Liely, *Die Energiewirtschaft sozialistischer Länder* (forthcoming)

\*\* Source: H. Liely, *Die Energiewirtschaft sozialistischer Länder* (forthcoming)

Table 2: Primary Energy Production

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- power bill.kWh	Total PJ
1970	261.5	1.0	0.2	1.0	0.2	2372
1971	262.8	0.9	0.2	2.8	0.2	2401
1972	248.4	0.8	0.2	5.0	0.2	2299
1973	246.3	0.8	0.2	7.0	0.2	2303
1974	243.5	0.6	0.2	8.0	0.2	2287
1975	246.7	0.5	0.2	7.9	0.2	2313
1976	246.9	0.5	0.2	9.3	0.2	2318
1977	253.7	0.4	0.2	9.2	0.2	2374
1978	253.3	0.1	0.1	9.7	0.2	2367
1979	256.1	0.0	0.1	9.7	0.3	2389
1980	258.1	0.0	0.1	8.7	0.3	2395
1981	266.7	0.0	0.1	9.7	0.3	2483
1982	276.0	0.0	0.1	10.0	0.2	2555
1983	278.0	0.0	0.1	12.0	0.2	2596
1984	296.3	0.0	0.1	12.8	0.3	2768
1985	312.2	0.0	0.1	12.3	0.2	2901
1986	311.3	0.0	0.1	12.3	0.3	2862
1987	309.0	0.0	0.1	12.3	0.2	2841
in 1000 TOE						
1970	55669	526	191	287	48	56745
1971	55956	431	191	813	48	57439
1972	52894	407	191	1459	48	54999
1973	52439	383	191	2033	48	55095
1974	51841	287	191	2321	48	54712
1975	52535	263	191	2273	48	55334
1976	52272	239	191	2703	48	55454
1977	53707	167	191	2655	48	56793
1978	53611	48	96	2823	48	56626
1979	54210	0	48	2823	72	57152
1980	54640	0	48	2536	72	57296
1981	56482	0	48	2823	72	59401
1982	58109	0	48	2895	48	61123
1983	58516	0	48	3469	48	62104
1984	62391	0	48	3708	72	66219
1985	65716	0	48	3565	48	69401
1986	64783	0	48	3565	72	68468
1987	64305	0	48	3565	48	67965

Source: Data Bank CMEA-Energy of DIW

### 2.3.4 Exports and Imports of Energy<sup>3</sup>

In the eighties, the Government of the German Democratic Republic proclaimed the reduction of the energy imports as a major energy policy goal. During the period 1980–1985 the energy imports were reduced by 67 PJ, although domestic energy consumption increased by 150 PJ. To close the gap between supply and consumption, but also to export more energy, brown coal production was increased substantially (in the magnitude of 500 PJ). It is worthwhile to mention that this increase in brown coal output partially led to a re-exportation of oil, which had been imported but was going to be replaced by brown coal. Thus, energy export figures nearly doubled between 1980 and 1985 (351 PJ versus 605 PJ). In doing so, the GDR earned foreign currency, which was heavily needed to lower its debt burden.

Brown coal being the only important domestic resource, hard coal, oil and gas have to be imported, first of all from the USSR. For instance, the Soviet Union's share of gas imports is 100 %. With regard to oil and coal the shares are 75 % and 60 %, respectively. The strong dependence of the GDR on the oil imports from the USSR is the main reason why the country joined the transmission and distribution grid, which comes across Poland to the city of Schwedt, from where especially East Berlin is supplied with oil.

In 1986 and 1987 the country's dependence on energy imports grew once again, with gross energy imports from the USSR accounting for 30 % of total consumption. However, the GDR is still in a position to satisfy about 75 % of its primary energy requirements by means of own energy resources.

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**3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 3: Exports of Energy**

Year	Brown Coal mill. t	Hard Coal mill. t	Oil mill. t	Electricity bill. kWh	Total PJ
1970	3.8	0.0	1.3	0.8	136.2
1971	2.8	0.0	1.0	0.7	102.1
1972	2.5	0.0	2.3	0.4	150.3
1973	2.3	0.0	2.4	0.4	147.7
1974	2.6	0.0	2.9	0.6	177.4
1975	2.3	0.3	2.4	0.7	158.7
1976	2.3	0.3	2.2	1.1	154.4
1977	2.2	0.3	2.3	2.1	169.3
1978	2.2	0.3	2.3	3.2	180.3
1979	1.8	0.3	3.3	2.7	205.9
1980	2.2	0.3	6.6	2.7	351.3
1981	2.8	0.3	8.0	2.4	416.0
1982	3.0	0.3	8.9	3.1	466.7
1983	3.3	0.3	11.2	3.3	568.4
1984	4.0	0.3	13.3	3.9	673.9
1985	3.3	0.3	12.0	3.7	605.4
1986	3.5	0.3	10.8	3.9	561.5
1987	3.1	0.3	8.5	3.7	455.2
<b>in PJ</b>					
1970	73.1	0.0	55.0	8.1	136.2
1971	53.3	0.0	41.5	7.3	102.1
1972	48.1	0.0	97.7	4.6	150.3
1973	43.6	0.0	99.9	4.3	147.7
1974	49.2	0.0	121.8	6.4	177.4
1975	44.2	7.5	99.3	7.7	158.7
1976	44.2	7.8	90.8	11.6	154.4
1977	43.2	7.3	96.9	21.9	169.3
1978	42.7	8.1	97.0	32.6	180.3
1979	34.9	8.1	135.6	27.4	205.9
1980	42.7	7.8	274.0	26.9	351.3
1981	53.8	7.8	329.9	24.5	416.0
1982	57.9	7.8	369.5	31.4	466.7
1983	63.5	7.3	465.1	32.5	568.4
1984	76.6	7.8	550.2	39.3	673.9
1985	63.9	7.5	497.3	36.7	605.4
1986	67.4	8.1	447.4	38.7	561.5
1987	59.6	7.8	351.2	36.6	455.2

1 PJ = 23923 TOE

Source: Data Bank CMEA-Energy of DIW

Table 4: Imports of Energy

Year	Brown Coal	Hard Coal	thereof: Pure Hard Coal	Coke	Oil	Gas	Electricity	Nucl. Energy*	Total
	mill.t	mill.t	mill.t	mill.t	mill.t	bill.m3	bill.kWh	bill.kWh	PJ
1970	3.9	11.3	8.2	3.1	10.4	0.2	0.9	0.5	780
1971	3.6	11.0	8.0	3.1	11.1	0.1	0.8	0.4	793
1972	4.1	10.7	7.6	3.1	15.4	0.0	1.4	0.4	968
1973	5.0	12.7	9.5	3.2	16.1	0.8	1.7	0.4	1088
1974	5.2	10.2	7.2	3.0	16.5	2.8	1.7	2.2	1133
1975	3.4	9.4	6.4	3.0	17.1	3.2	1.4	2.7	1135
1976	3.1	9.0	6.1	2.9	18.2	3.4	1.5	5.3	1194
1977	3.4	9.1	6.1	3.1	19.2	3.6	2.7	5.2	1262
1978	3.3	8.5	5.9	2.6	20.1	3.6	4.0	7.9	1326
1979	3.0	11.6	8.7	3.0	20.8	4.3	4.0	9.8	1475
1980	1.6	10.0	6.8	3.1	22.2	6.4	4.2	11.9	1545
1981	1.2	7.8	5.4	2.4	23.1	6.3	4.2	11.9	1515
1982	0.9	6.8	4.7	2.0	21.9	6.4	4.3	10.8	1429
1983	0.2	6.0	4.2	1.8	22.8	6.4	4.6	12.2	1461
1984	0.0	5.5	3.6	1.8	23.5	6.2	4.2	11.7	1456
1985	0.2	6.8	5.1	1.7	23.0	6.2	3.8	12.7	1478
1986	0.0	8.8	7.0	1.8	22.3	7.0	4.9	10.9	1519
1987	0.0	9.0	7.2	1.8	21.0	7.0	7.5	11.2	1498
in 1000 TOE									
1970	837	7110	5093	2014	10246	132	220	115	18660
1971	758	6928	4957	1971	10892	91	196	100	18971
1972	876	6718	4488	1990	15110	5	352	96	23157
1973	1057	7995	5928	2067	15837	627	414	89	26028
1974	1108	6442	4478	1964	16227	2344	433	543	27105
1975	730	5923	4005	1919	16820	2663	344	682	27153
1976	655	5686	3794	1892	17813	2773	354	1287	28564
1977	722	5753	3770	1983	18868	2931	648	1270	30191
1978	708	5373	3694	1679	19734	2986	978	1935	31722
1979	632	7299	5387	1911	20437	3574	966	2385	35286
1980	333	6277	4249	2029	21811	4691	993	2844	36961
1981	244	4909	3335	1577	22665	4572	995	2847	36243
1982	201	4254	2947	1304	21437	4665	1026	2596	34186
1983	43	3787	2612	1175	22406	4682	1103	2926	34952
1984	0	3433	2251	1182	23079	4502	1007	2809	34832
1985	43	4289	3172	1117	22531	4524	919	3048	35358
1986	0	5543	4361	1182	21887	5131	1165	2610	36339
1987	0	5648	4459	1189	20614	5110	1782	2682	35837

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

**Table 5: Exports and Imports of Energy**

	Exports		Imports				
	Electricity (GWh)	Gas (mill. m3)	Electricity (GWh)	Hard Coal + Anthracite (1000 tons)	Coke (1000 tons)	Gas (mill. m3)	Oil (mill. tons)
1980	866	200	4698	6828	3136	6431	21.9
1981	1300	0	4500	5400	2400	6300	23.1
1982	1794	200	4441	4700	2000	6400	21.9
1983	2220	200	4582	4200	1800	6400	22.8
1984	3334	300	5872	3600	1800	6200	23.5
1985	2956	529	7451	5090	1730	6201	22.8
1986	1470	306	5427	7014	1832	7034	22.3
1987	952	239	5326	7166	1829	7002	20.9

**Table 6: GDR - Regional Distribution of Electricity Exports and Imports  
(in 1985)**

Electricity Exports to .... (GWh)	Electricity Imports from ... (GWh)
Bulgaria	CSR
Poland	Other countries
CSR	
Other countries	

Source: H. Liely, Die Energiewirtschaft sozialistischer Länder (forthcoming)



## 2.3.5 Primary Energy Consumption

Table 7: Primary Energy Consumption in the GDR (Mtoe)

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	262.7	12.4	9.3	1.2	0.3	0.5	3025.3
1971	263.6	11.9	10.3	2.9	0.3	0.4	3091.6
1972	250	11.5	13.3	5	1.2	0.4	3115.9
1973	249	13.5	14	7.8	1.5	0.4	3242.1
1974	246.1	10.8	13.8	10.8	1.3	2.2	3241.5
1975	246.4	9.4	15	11.1	0.9	2.7	3269.9
1976	250.2	9.9	16.2	12.7	0.5	5.3	3396.8
1977	256	9.1	17.1	12.7	0.7	5.2	3473.2
1978	256.4	9.3	17.9	13.3	1.1	7.9	3554.5
1979	254.3	10.2	17.6	14.1	1.5	9.8	3605.3
1980	256	9.2	15.7	15.2	1.7	11.9	3563.5
1981	265.2	7.1	15.2	16	2	11.9	3573.7
1982	274.4	6	13	16.4	1.4	10.8	3509.4
1983	277.2	5.7	11.7	18.4	1.6	12.2	3507.2
1984	297.3	5.7	10.3	19	0.5	11.7	3606.8
1985	300.4	7.2	11	18.5	0.3	12.7	3714.1
1986	306.4	7	11.6	19.4	1.3	10.9	3770.2
1987	313.8	5.4	12.6	19.3	4	11.2	3870.4
in 1000 TOE							
1970	55001	7634	9127	421	74	115	72374
1971	55442	7352	10096	902	69	100	73960
1972	52619	7122	12969	1447	289	96	74542
1973	52446	8371	13643	2653	361	89	77561
1974	51767	6739	13509	4660	328	543	77546
1975	51891	5861	14641	4938	215	682	78226
1976	52399	6148	15837	5469	124	1287	81262
1977	53638	5670	16746	5588	177	1270	83089
1978	53741	5789	17512	5801	256	1935	85034
1979	53391	6459	17248	6390	376	2385	86250
1980	53645	5813	15311	7220	419	2844	85250
1981	55454	4498	14832	7383	481	2847	85494
1982	57020	3804	12655	7557	325	2596	83955
1983	57523	3588	11340	8151	376	2926	83903
1984	61583	3588	9976	8206	127	2809	86285
1985	62410	4521	10694	8098	81	3048	88852
1986	62886	4450	11244	8706	299	2610	90194
1987	64520	3493	12272	8670	955	2682	92592

Remark: Differences between DIW and EEC-UNO data can be as high as 10%. They are essentially due to the problems created by East German oil exports. It should be emphasized that East German national statistical year-books are themselves contradictory when dealing with this question. The GDR does not publish figures for its primary oil consumption, though this can be estimated using primary consumption data for coal, gas and electricity and the GDR's own published figures for total consumption. The consumption levels obtained in this way are only plausible if it is assumed that oil exports are considerably larger than the GDR's own published figures would suggest. This is the approach adopted by DIW. The EEC-UNO for its part gives much higher figures for oil consumption, on the basis of less significant exports, and so in line with national statistics. However, this means that consistency with the GDR's published figures for primary energy consumption is no longer guaranteed.

**2.3.6 Electricity Production****Table 8: Power Generation and Energy used for Power Generation (in Mtoe)**

	Power Generation	Heat generation		
1971	5.8	15.8		
1972	6.1	16.0		
1973	6.5	15.5		
1974	6.6	16.3		
1975	6.9	16.6		
1976	7.1	17.3		
1977	7.4	17.6		
1978	7.5	18.0		
1979	7.4	18.2		
1980	7.3	17.7		
1981	7.5	17.3		
1982	7.8	17.0		
1983	7.8	17.0		
1984	8.3	17.9		
1985	8.5	19.1		
1986	8.8	18.2		
1987	8.7	18.7		
Energy used for power generation (in Mtoe) - GDR				
	Coal	Oil	Gas	Total
1971	37.0	2.3	1.4	19.1
1972	36.4	2.8	1.7	18.8
1973	36.9	2.8	2.4	20.2
1974	35.6	3.1	2.8	18.6
1975	37.2	3.4	2.2	19.3
1976	37.8	3.9	2.1	19.4
1977	39.0	4.1	2.0	20.2
1978	39.5	4.4	2.5	20.9
1979	38.9	4.1	2.6	20.0
1980	38.4	2.2	3.0	18.6
1981	39.0	1.6	3.6	19.5
1982	39.9	1.1	3.4	19.5
1983	40.4	0.4	3.9	19.8
1984	43.0	0.2	4.0	21.1
1985	44.7	0.2	3.6	20.8
1986	44.9	0.2	4.4	22.4
1987	44.5	0.2	4.0	21.3

Electricity production in the GDR is dominated by lignite-fueled power plants, an indication of the country's desire to use its own domestic resources. Lignite thus accounts for 85% (1988) of electricity production. Of an installed (fossil fuel powered) capacity of 24,000 MW in 1989, 17,260 was lignite powered. This is a major source of pollution since of the 15 large lignite-fueled power plants (excepting Berlin), none have sulphur removal units. The following emissions are reported for 1988: SO<sub>2</sub> – 4.85 mill. tons, NO<sub>x</sub> – 950 x 10<sup>3</sup> tons.

Nuclear power accounts for less than 10% of electricity production. Installed nuclear capacity was 1830 MW in 1989: 4 VVER units rated at 440 MW at GREIFSWALD, which are heavily disputed.

The national statistical year-books give the following energy balance for electricity:

**Table 9: Electricity Production by Energy Form (TWh)**

	1960	1970	1980	1985	1986	1987	1988
Lignite	29.3	56.3	77.2	93.8	96.0	94.3	100.4
Br. lignite *	2.7	1.2	0.6	0.3	0.5	0.6	0.2
Coal	1.8	1.0	0.4	0.2	0.2	0.4	0.2
Nuclear power	–	0.5	11.9	12.7	10.9	11.2	11.7
Hydro-electric	0.6	1.3	1.7	1.8	1.8	1.7	1.7
Oil	0.1	1.8	1.2	0.6	0.6	2.0	0.6
Other	5.8	5.7	5.8	4.4	5.3	4.0	3.5
<b>Total</b>	<b>40.3</b>	<b>67.8</b>	<b>98.8</b>	<b>113.8</b>	<b>115.3</b>	<b>114.2</b>	<b>118.3</b>

\* Lignite briquettes.

Source: Statistisches Jahrbuch der GDR, various years.

The rate of growth of electricity production remained relatively high (1.8% per year on average) during the eighties, though it was lower than it had been in the seventies (2.8% per year on average).

One other feature is worthy of note – the fall in oil consumption for electricity production since 1980. In 1988, crude oil accounted for only 0.5 % in electricity generation which was the lowest share since the 1980's. This change can be explained by the fall in Soviet oil deliveries as well as by East Germany's desire to increase its output of refined petroleum products intended for export. It should also be mentioned that there has been an increase in the production of refined products (in spite of restrictions on Soviet oil deliveries). In 1987 and 1988 oil imports from the Soviet Union were about 17 mill. tons, whereas in 1980 19 mill. tons were imported.

Finally, it can be seen that there was an increase in the use of natural gas for electricity production, mostly for peak production requirements. (Imports of natural gas from the USSR in 1988: 7.051 bill. m<sup>3</sup>)

### 2.3.7 Final Energy Consumption

Final energy consumption in the GDR was of the order of 60 Mtoe in 1986 (the GDR is of several countries in which the level of energy consumption fell (-3.5%) between 1980 and 1983). This fall is partly reflected in the evolution of its energy intensity, even though this remains, along with that of Czechoslovakia, among the highest in the COMECON.

**Table 10: Final Energy Consumption (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	19.9	7.8	3.3	4.3	9.3	44.4
1972	19.6	8.8	3.4	4.5	9.3	45.6
1973	18.8	9.5	3.5	4.8	9.1	45.8
1974	17.7	10.0	3.0	5.1	9.5	45.3
1975	17.6	10.3	3.7	5.3	9.9	46.9
1976	17.9	10.9	4.3	5.6	10.6	49.3
1977	17.7	11.5	4.3	5.8	10.8	50.1
1978	18.0	11.9	4.7	6.1	11.3	52.0
1979	18.6	14.0	4.9	6.1	11.5	55.1
1980	19.1	16.1	5.3	6.3	11.0	57.7
1981	17.9	16.0	5.5	6.4	11.0	56.7
1982	17.7	15.7	4.9	6.4	11.0	55.7
1983	17.4	15.1	5.6	6.5	11.1	55.7
1984	18.5	15.2	5.6	6.8	11.8	57.8
1985	20.3	15.0	5.7	7.0	12.5	60.5
1986	20.0	14.8	5.7	7.2	11.9	59.5
1987	21.0	(1)	5.9	7.4	13.3	-

(1) Not available

**Table 11: Final Energy Consumption in the Industrial Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	6.2	2.9	1.8	2.6	8.1	21.6
1972	6.4	3.6	2.0	2.7	8.0	22.7
1973	6.4	3.6	2.2	2.9	7.6	22.7
1974	5.8	3.4	1.9	3.0	7.9	21.9
1975	5.8	3.4	2.0	3.1	8.2	22.5
1976	5.9	3.7	2.0	3.2	8.6	23.4
1977	5.9	4.1	2.0	3.3	8.6	23.8
1978	6.0	4.2	2.1	3.3	8.8	24.3
1979	5.8	5.0	2.2	3.3	9.0	25.3
1980	6.0	5.8	2.6	3.4	8.7	26.5
1981	3.3	5.7	2.9	3.5	8.0	23.3
1982	3.2	5.6	2.3	3.5	7.9	22.4
1983	3.5	5.3	2.8	3.5	7.8	22.9
1984	3.7	5.3	2.7	3.6	8.2	23.3
1985	4.2	5.2	2.6	3.6	8.5	24.2
1986	3.6	5.0	2.7	3.7	7.6	22.6
1987	3.6	(1)	2.7	3.8	8.6	-

(1) Not available

The GDR shows several particular features as regards the structure of its energy consumption. The industrial sector's share (40% in 1986) is significantly smaller than in the COMECON as a whole (50%) and it has been falling since 1970, to the advantage not only of the housing-service-agriculture sector but, even more so, of the transport sector.

From a methodological point of view, it should be pointed out that it is difficult to distinguish between agriculture, housing and services using the EEC-UNO balance. Nor should it be forgotten that one of the GDR's policies has been to eliminate oil consumption from heating uses. Part of this sector's oil consumption doubtless accounts for petrol consumption and so includes part of the transport sector's consumption.

**Table 12: Structure of Final Consumption by Sector in 1986 (%)**

Industry	Transport	Housing-services-agriculture	Total
43.4	4.7	51.9	100

Three features should be emphasized when looking at the breakdown of consumption by energy form:

- the importance of solid fuels: 34% of final energy consumption,
- the importance of heat-steam: 20%,
- the weakness of both oil (25%) and electricity (12%).

### Energy Consumption in the Transport Sector

This sector's share (4.7% in 1986) of final energy consumption largely underestimates the real importance of transport. According to J. BETHKENHAGEN transport accounts for 15% of final energy consumption and 2/3 of diesel consumption<sup>6</sup>, the latter having reached a maximum of 2.1 million tons in 1980<sup>7</sup>.

The main energy conservation measures have been aimed at rail transport, particularly as regards savings of petroleum products. A major electrification programme has thus been initiated, accompanied by an increase in the share of goods transported by rail as compared with road transport. For the period 1980–1984, J. BETHKENHAGEN estimates that "the share of goods transported by rail rose from 67% in 1981 to 73% in 1984. At the same time, the length of electrified track was increased from 1,700 to 2,320 km, a share of almost 14%"<sup>8</sup>.

**Table 13: Final Energy Consumption in the Transport Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	1.1	1.0	0.0	0.1	0.3	2.5
1972	1.2	1.3	0.0	0.1	0.3	2.8
1973	1.2	1.4	0.0	0.1	0.2	3.0
1974	1.0	1.5	0.0	0.1	0.2	2.8
1975	0.7	1.6	0.0	0.1	0.2	2.7
1976	0.6	1.7	0.0	0.1	0.3	2.6
1977	0.5	1.7	0.0	0.1	0.3	2.5
1978	0.4	1.7	0.0	0.1	0.3	2.5
1979	0.3	2.0	0.0	0.2	0.3	2.8
1980	0.3	2.3	0.0	0.2	0.3	3.1
1981	0.2	2.3	0.0	0.1	0.2	2.9
1982	0.3	2.2	0.0	0.1	0.2	2.9
1983	0.3	2.1	0.0	0.2	0.2	2.8
1984	0.3	2.1	0.0	0.2	0.2	2.8
1985	0.3	2.1	0.0	0.2	0.3	2.8
1986	0.2	2.1	0.0	0.2	0.3	2.8
1987	0.2	(1)	0.0	0.2	0.3	-

(1) Not available

Private road vehicles have, nevertheless, maintained a certain degree of priority (3.5 million vehicles at the beginning of 1988) with high specific energy consumption (9 liters/100 km)

<sup>6</sup> BETHKENHAGEN, J. "The GDR's energy policy and its implications for the intensification drive", *Studies in comparative communism*, vol. XX, n°1, Spring 1987, p.60.

<sup>7</sup> MERKIN, V. *Petroleum conservation in East Europe*, Delphic Associates, 1988. p.129.

<sup>8</sup> BETHKENHAGEN, *op. cit.*, p.60.

### Energy Consumption in the Housing-service-agricultural Sector

As for the domestic sector, it should be noted that two energy forms are of particular importance: coal (52% of consumption) and heat-steam (12.9%). Thus over 1.5 million homes (21%) are heated in this way through district heating networks.

In contrast to this, oil consumption has been regularly falling since the beginning of the eighties, a reflection of the government's desire to eliminate petroleum products from heating uses.

**Table 14: Final Energy Consumption in the Housing-Service-Agriculture Sector (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	12.6	2.8	0.8	1.6	0.9	18.6
1972	12.0	2.9	0.8	1.7	1.0	18.4
1973	11.2	3.4	0.8	1.9	1.3	18.5
1974	11.0	3.8	0.8	2.0	1.4	18.9
1975	11.1	3.9	1.0	2.1	1.5	19.6
1976	11.4	4.2	1.2	2.2	1.7	20.7
1977	11.3	4.2	1.3	2.4	2.0	21.2
1978	11.6	4.5	1.2	2.7	2.2	22.3
1979	12.5	5.5	1.3	2.6	2.2	24.1
1980	12.7	6.3	1.4	2.7	2.1	25.2
1981	14.4	6.3	1.3	2.8	2.8	27.5
1982	14.1	6.1	1.4	2.8	2.9	27.4
1983	13.7	5.8	1.5	2.9	3.0	26.9
1984	14.5	5.8	1.6	3.1	3.4	28.4
1985	15.8	5.7	1.7	3.2	3.7	30.2
1986	16.1	5.7	1.8	3.3	4.0	30.9
1987	17.2	(1)	1.9	3.4	4.4	-

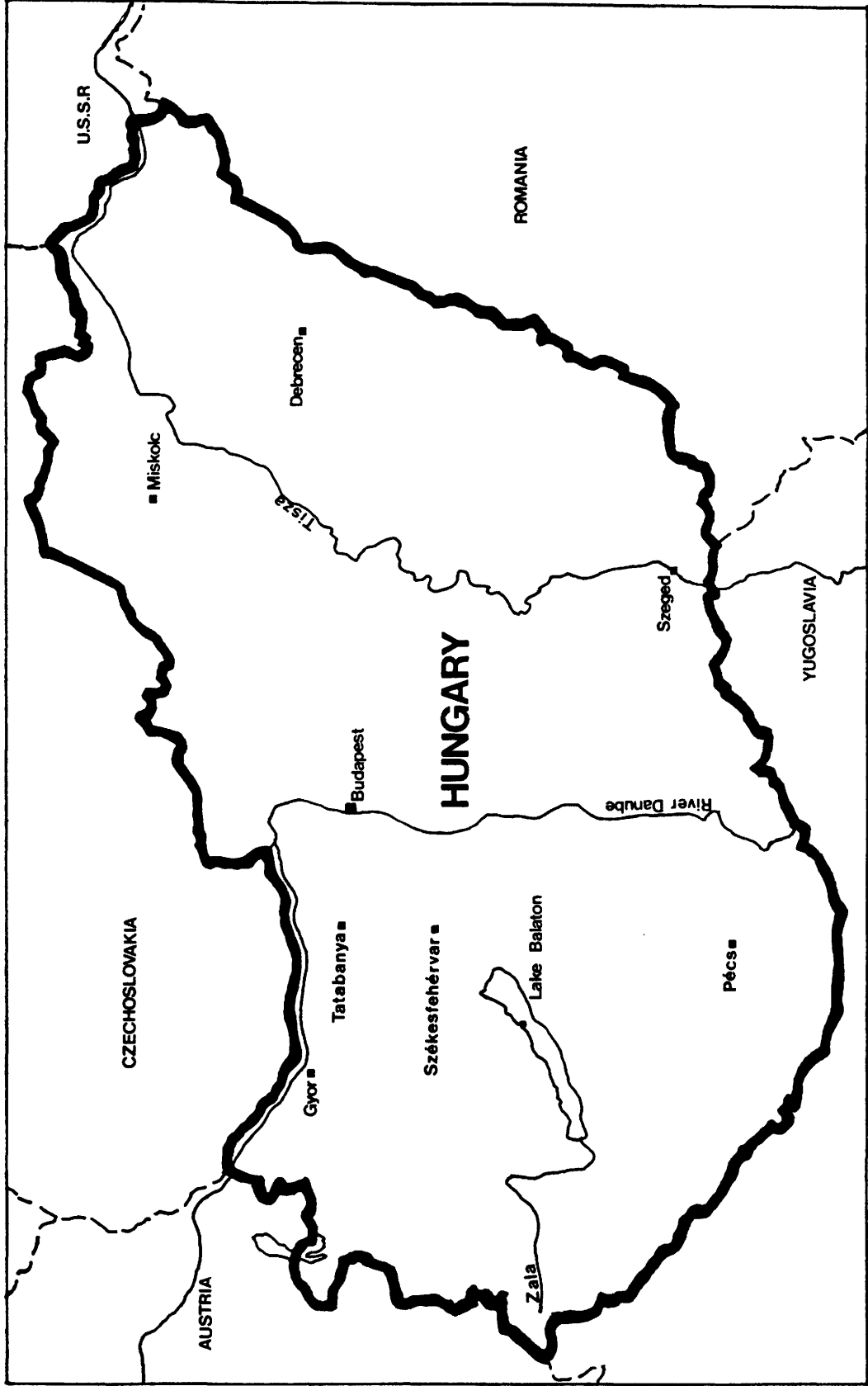
(1) Not available



# Hungary

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## 2.4 Hungary

### 2.4.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	4610 US\$
- Population and Employment	
. Resident Population (1989)	10.59 mill.
thereof children	20.8 %
thereof earning a livelihood (men 15-59 years, women 15-54 years)	57.3 %
thereof pensioners	21.9 %
. Active Employees	45.5 %
. Inactive Employees	24.2 %
. Share of Women in Active Employment Force	46.0 %
. Population Density (Persons per km <sup>2</sup> )	113.8
. Sectoral Employment Shares	
Industry	30.9 %
Building	7.1 %
Agriculture, Forestry and Water Supply	20.4 %
Transportation and Communication	8.3 %
Trade	10.7 %
Other Sectors	22.6 %
- Sectoral Output Shares (1987)	
. Agriculture	22.8 %
. Industry	33.0 %
. Productive Services	24.8 %
. Non-productive Services	19.4 %
- Selected National Resources and Raw Materials Production	
. Bauxite	2.59 mill. t
. Aluminium	74.7 thousand t
. Alumina	873 thousand t
. Raw Steel	3.58 mill. t

## **2.4.2 Natural Energy Resources<sup>1</sup>**

Hungary is one of those East European countries whose resources are worth mentioning. Coal resources are estimated at 7,4 billions tons: 56 % lignite, 25 % brown coal and 19 % hard coal. About 4.4 billions are economically exploitable.

The largest deposits of lignite are located in the Northeast of Hungary, in the vicinity of the Matra and Bükk mountains. Extraction is possible by open-cut mining. The calorific value is very low (between 7.0 and 8.0 MJ/kg) and, therefore, the lignite is not transported over longer distances. It is mainly fired in mine-mouth power plants.

Brown coal deposits in the West (Transdanubia) and in the North are qualitatively better than the lignite resources and have a heating value of 20 MJ/kg. The most important deposits are located in the fields of Tatabanya, west of Budapest. The thickness of the seams lies between 4 and 30 m. Northeast of these fields, the Doroger rim at the border to Czechoslovakia exhibits further high-grade brown coal deposits. With thicknesses up to 15 meters the seams are extracted in deep opencast mines.

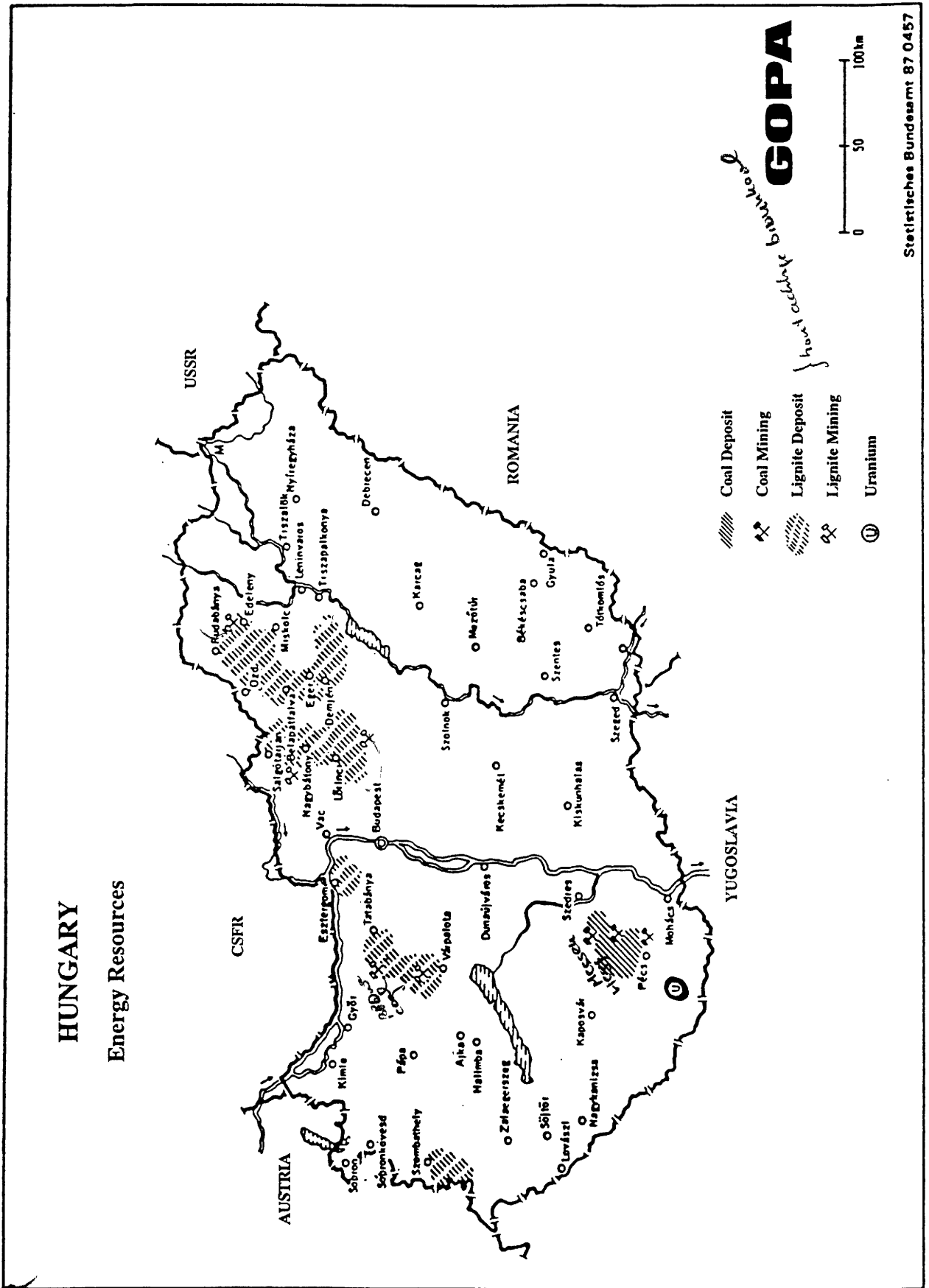
The only known deposit of hard coal is located in Southern Hungary in the Meczek Mountains. It consists of Lias coal with a calorific value of 20 MJ/kg. To some extent the hard coal can be coked. Total resources are estimated to be 800 mill. tons, of which 435 mill. tons are exploitable. At present production rates the extraction could continue for 150 years.

Deposits of oil and natural gas are located in Southwestern Transdanubia and in the Eastern parts of the Hungarian basin; in this region around 90 % of new deposits were explored recently. The most famous and largest crude oil field is situated at Algyő/Szeged, which accounts for 50 % of Hungarian crude oil production. The statistical lifetime is indicated with 12 years for oil reserves and with 17 years for gas reserves, equal to absolute amounts of 24 mill. tons of oil or, respectively 120 billion m<sup>3</sup> gas. Currently, the exploration of new oil and gas deposits is going on, partly financed with IBRD loans.

Finally, it has to be mentioned that Hungary possesses uranium deposits in the Western part of the Meczek Mountains, but the amount of resources is not published.

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**1 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**



### 2.4.3 Primary Energy Production<sup>2</sup>

Since the second oil price shock, Hungarian energy policy has aimed at reducing the dependency on energy imports. The main targets were the enlargement of coal production and the stabilization of oil and gas extraction. Considerable funds were invested to meet these targets and it was expected that one half of energy demand could be covered by domestic production.

With the Five-Year-Plan 1976 to 1980 four new hard coal mines were established with a planned production of 8 mill. tons. But expectations of increased coal production were not met. In 1985, production of 24 mill. tons coal fell below the level of 1980 (25.7 mill. tons). Due to this experience targets for the last Five-Year-Plan were adapted: Until 1990 production should be stabilized at a level of 24 mill. tons. With the new system of energy prices, production plans were revised in 1986. Extraction of expensive deep-mining coal should be substituted by a production increase of opencast-mining coal. 14 out of 36 mines should be closed. In spite of considerable investments, hard coal production was decreasing in the second half of the eighties (to 22.8 mill. tons in 1987).

The production of lignite was planned to reach 14 mill. tons in the opencast mines of Brukkabráng in the mid eighties. But this target was not achieved. Total lignite production was only 7.2 mill. tons in 1987. At the beginning of the nineties production is to start in the Visontra fields and is planned to increase to 8 mill. tons in 2000.

For 20 years the production of oil has remained constant at around 2 mill. tons p.a. To maintain this production level, increasing application of secondary and tertiary extraction methods is required. Presently, about 40 % of the oil is already extracted with these methods. However, some experts believe that production of oil will drop to 1.7 mill. tons in 1990, and in 2000 even to 1 mill. tons only.

The production of natural gas was slightly increased in the eighties to 7.1 billion m<sup>3</sup> in 1987. To achieve higher flexibility storage capacity of about 1 billion m<sup>3</sup> is to be enlarged. The expected output in 1995 is estimated at 5.2 billion m<sup>3</sup> only, so that future demand can only be met by additional imports.

Generally, targets for stabilizing fuel production are missed. Production is decreasing slightly and it can be expected that higher demands in the future have to be covered by imports.

Electricity generation in Hungary is based to a considerable part on nuclear energy. The share of nuclear energy grew from 24 % in 1985 to 36.9 % in 1987, corresponding to a production of 11 billion kWh. The nuclear plants of Paks are located 100 km South of Budapest and have a capacity of 1760 MW. For 1994 and 1996 the production start of two additional plants with 1000 MW each is planned. With these additions, the share of nuclear energy in electricity generation would rise to 50 % and further increases up to a share of 75 % are planned for 2015.

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**2 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

After political discussions and petitions the Hungarian Government decided to stop all construction works at the hydropower plant of Nagymaros on the Danube. The project would have contributed to about 5 % of the electricity production. Besides this, Hungary also gave up plans to construct four hydropower plants in cooperation with Yugoslavia, because the financial burden was considered to be too high. Other hydropower plants in Hungary are of minor importance. Only 50 MW of an estimated potential of 1000 MW are exploited.



**Table 1: Primary Energy Production**

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- power bill.kWh	Total PJ
1970	23.7	4.2	1.9	3.5	0.1	585.0
1971	23.5	3.9	2.0	3.7	0.1	587.1
1972	22.2	3.7	2.0	4.1	0.1	580.3
1973	23.4	3.4	2.0	4.8	0.1	614.7
1974	22.6	3.2	2.0	5.1	0.1	610.2
1975	21.9	3.0	2.0	5.2	0.2	573.6
1976	22.3	2.9	2.1	6.1	0.2	614.2
1977	22.5	2.9	2.2	6.6	0.1	636.7
1978	22.7	3.0	2.2	7.3	0.1	665.4
1979	22.7	3.0	2.0	6.5	0.1	629.9
1980	22.6	3.1	2.0	6.1	0.1	590.5
1981	22.9	3.1	2.0	6.0	0.2	572.9
1982	23.0	3.0	2.0	6.6	0.2	594.5
1983	22.4	2.8	2.0	6.5	0.2	578.0
1984	22.5	2.6	2.0	6.9	0.2	587.7
1985	21.4	2.6	2.0	7.5	0.2	595.8
1986	20.8	2.3	2.0	7.1	0.2	571.5
1987	20.5	2.4	1.9	7.1	0.2	565.9
in 1000 TOE						
1970	6969	2184	1899	2919	24	13995
1971	6909	2074	1919	3117	26	14045
1972	6524	1933	1940	3457	31	14122
1973	6878	1794	1950	4057	29	14705
1974	6636	1689	1959	4292	22	14598
1975	5832	1517	1966	4361	45	13722
1976	5954	1474	2100	5117	45	14694
1977	6009	1469	2148	5562	41	15232
1978	6060	1483	2155	6182	38	15918
1979	6043	1510	1988	5486	41	15069
1980	5469	1466	1993	5167	31	14127
1981	5526	1466	1986	4677	48	13705
1982	5567	1455	1988	5167	45	14222
1983	5409	1352	1966	5057	43	13827
1984	5431	1232	1969	5378	50	14060
1985	5172	1263	1974	5801	43	14253
1986	5026	1112	1966	5524	43	13672
1987	4950	1129	1878	5536	48	13538

Source: Data Bank CMEA-Energy of DIW

#### 2.4.4 Exports and Imports of Energy<sup>3</sup>

The energy economy of Hungary is highly dependent on imports. During the eighties dependency on imports increased and more than one half of primary energy consumption was covered by imports in 1987. Main supplier of energy imports is the USSR. → 1990!

Although Hungary is a net importer of oil, about 1.5 mill. tons to 2.5 mill. tons of annual imports of about 10 mil. tons are re-exported. A share of 0.5 to 1.0 mill. tons is directly re-exported crude oil, the other share consists of mineral oil products. Obviously Hungary uses the trade in mineral oil to earn hard currency. Russian imported oil as well as OPEC crude oil is traded. The gain of this trade is ambivalent: With refining and re-exporting Russian oil, Russian currency payments are converted to hard currency earnings; The gain of re-exporting OPEC oil is hard to estimate, as it is presumably based on compensation deals.

The electricity sector depends to a considerable amount on electricity imports. In 1987 about 37 % of domestic electricity consumption was imported from the USSR. If one adds the indirect electricity imports in form of nuclear fuel, the dependency on imported electricity amounts to 60 %.

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3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989

**Table 2: Exports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t.	Coke mill.t.	Oil mill.t.	Gas bill.m3	Electri- city bill. kWh	Total PJ
1970	0.0	0.0	0.0	1.2	0.0	0.1	52.1
1971	0.0	0.1	0.0	0.7	0.0	0.2	33.3
1972	0.0	0.0	0.1	1.4	0.0	0.4	64.4
1973	0.0	0.0	0.1	1.1	0.0	0.2	53.3
1974	0.0	0.0	0.0	0.7	0.0	0.3	33.7
1975	0.0	0.0	0.0	1.4	0.0	0.3	59.8
1976	0.0	0.0	0.0	1.6	0.0	0.4	72.4
1977	0.0	0.0	0.0	1.7	0.0	0.3	74.8
1978	0.0	0.0	0.0	1.9	0.0	0.3	85.6
1979	0.0	0.0	0.0	1.6	0.0	0.5	74.6
1980	0.0	0.3	0.0	1.7	0.0	0.3	81.1
1981	0.0	0.2	0.0	1.4	0.0	0.6	72.0
1982	0.0	0.6	0.0	2.5	0.0	0.3	121.2
1983	0.0	0.5	0.0	2.2	0.0	0.5	108.3
1984	0.0	0.6	0.0	2.3	0.0	0.3	110.2
1985	0.0	0.5	0.0	1.8	0.0	0.4	91.0
1986	0.0	0.6	0.0	1.2	0.0	0.4	66.0
1987	0.0	0.5	0.0	1.5	0.0	0.4	77.5
in 1000 TOE							
1970	0	0	0	1211	2	33	1246
1971	0	55	5	687	2	45	797
1972	0	0	60	1368	5	108	1541
1973	0	7	69	1124	12	62	1275
1974	0	14	29	689	5	69	806
1975	0	5	7	1344	2	72	1431
1976	0	7	19	1577	7	124	1732
1977	0	2	14	1675	7	91	1789
1978	0	0	19	1919	17	93	2048
1979	0	22	0	1624	7	132	1785
1980	0	134	0	1703	7	96	1940
1981	0	93	0	1438	10	179	1722
1982	0	301	0	2498	7	93	2899
1983	0	275	0	2177	7	132	2591
1984	0	278	0	2258	7	93	2636
1985	0	242	0	1823	14	98	2177
1986	0	278	0	1196	7	98	1579
1987	0	251	0	1493	12	98	1854

Source: Data Bank CMEA-Energy of DIW

Table 3: Imports of Energy

Year	Brown Coal mill.t.	Hard Coal mill.t.	thereof: Hard Coal mill.t.	Coke mill.t.	Oil mill.t.	Gas bill.m3	Elec- tri- city bill.kwh	Nucl. Energy* bill.kwh	Total PJ
1970	0.4	3.5	2.2	1.3	5.3	0.2	3.4	0.0	360
1971	0.5	3.4	2.1	1.3	5.7	0.2	4.4	0.0	389
1972	0.4	3.1	1.9	1.2	6.8	0.2	4.8	0.0	427
1973	0.4	2.9	1.7	1.2	7.6	0.2	4.8	0.0	454
1974	0.5	2.8	1.6	1.2	7.9	0.2	4.7	0.0	466
1975	0.6	3.1	1.7	1.4	9.4	0.8	4.4	0.0	552
1976	0.5	3.0	1.5	1.5	9.8	1.2	4.5	0.0	590
1977	0.6	3.2	1.8	1.4	10.1	1.2	4.6	0.0	601
1978	0.5	2.8	1.6	1.2	11.9	1.2	4.7	0.0	669
1979	0.5	3.1	1.8	1.3	11.7	2.7	6.1	0.0	730
1980	0.5	3.3	1.8	1.5	10.3	4.0	8.4	0.0	737
1981	0.5	3.1	1.9	1.2	9.3	4.0	8.4	0.0	692
1982	0.5	2.9	2.2	0.7	10.4	3.9	8.6	0.0	727
1983	0.5	2.9	2.1	0.9	10.4	4.1	9.6	0.0	747
1984	0.6	2.8	1.9	0.9	10.4	3.8	10.2	3.8	789
1985	0.6	4.0	2.8	1.2	9.1	4.0	11.4	6.5	818
1986	0.6	3.9	2.6	1.3	9.3	4.8	10.8	7.4	850
1987	0.6	3.3	2.0	1.3	9.2	4.9	10.6	11.0	874
in 1000 TOE									
1970	187	2074	1237	835	5242	165	957	0	8624
1971	225	2053	1182	871	5610	172	1230	0	9289
1972	187	1868	1050	818	6665	165	1337	0	10220
1973	175	1730	926	804	7430	165	1356	0	10856
1974	218	1720	919	801	7739	165	1306	0	11151
1975	232	1871	959	911	9210	665	1234	0	13215
1976	218	1821	849	971	9591	998	1256	0	13880
1977	242	1943	1031	911	9911	993	1294	0	14383
1978	211	1713	895	818	11746	1019	1313	0	16000
1979	194	1847	1000	847	11476	2246	1701	0	17464
1980	213	1990	998	993	10127	2952	2361	0	17641
1981	220	1840	1069	770	9203	2921	2368	0	16552
1982	206	1706	1230	478	10189	2871	2421	0	17392
1983	218	1742	1153	589	10239	2971	2691	0	17861
1984	249	1670	1041	629	10261	2787	2864	1055	18885
1985	254	2340	1550	789	9014	2926	3210	1818	19557
1986	254	2316	1438	878	9189	3471	3031	2081	20342
1987	254	1962	1096	866	9057	3576	2974	3081	20899

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

## 2.4.5 Primary Energy Consumption

Table 4: Primary Energy Consumption in Hungary

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	24.1	7.6	6	3.7	3.4	0	893.4
1971	24	7.2	7	3.9	4.3	0	942.2
1972	22.6	6.7	7.4	4.3	4.5	0	943.2
1973	23.8	6.2	8.4	5	4.7	0	1015.3
1974	23.1	6	9.2	5.3	4.5	0	1042.6
1975	22.4	6.1	10	6	4.3	0	1066.3
1976	22.8	5.9	10.3	7.3	4.2	0	1121.9
1977	23.1	6.1	10.6	7.8	4.4	0	1163.1
1978	23.2	5.7	12.2	8.6	4.5	0	1248.7
1979	23.1	6	12	9.2	5.7	0	1285.3
1980	23.1	6.1	10.6	10.2	8.2	0	1246.9
1981	23.4	5.9	9.9	10	8	0	1192.8
1982	23.5	5.3	9.9	10.6	8.5	0	1200.4
1983	22.9	5.2	10.2	10.6	9.3	0	1216.2
1984	23.1	4.8	10.2	10.7	10.1	3.8	1266.9
1985	22	6.1	9.3	11.4	11.3	6.5	1322.3
1986	21.4	5.7	10.1	11.8	10.6	7.4	1355.8
1987	21.1	5.1	9.6	12	10.4	11	1362.1
in 1000 TOE							
1970	7155	4256	5933	3081	947	0	21373
1971	7134	4067	6840	3287	1211	0	22540
1972	6710	3739	7237	3620	1258	0	22564
1973	7053	3450	8258	4208	1321	0	24289
1974	6854	3366	9009	4452	1258	0	24942
1975	6067	3380	9835	5021	1208	0	25509
1976	6172	3268	10117	6108	1177	0	26839
1977	6251	3395	10385	6548	1246	0	27825
1978	6270	3177	11983	7184	1258	0	29873
1979	6237	3332	11839	7727	1610	0	30748
1980	5682	3323	10416	8112	2297	0	29830
1981	5749	3213	9751	7588	2234	0	28535
1982	5773	2861	9682	8031	2371	0	28717
1983	5627	2821	10029	8019	2603	0	29095
1984	5677	2624	9971	8158	2823	1055	30308
1985	5423	3361	9163	8713	3153	1818	31633
1986	5280	3153	9959	8988	2976	2081	32435
1987	5201	2840	9440	9098	2921	3081	32586

Remark: The period from 1982–1984 was marked by significant differences between the DIW data and that of the EEC–UNO. These are mainly related to differences in coal and oil.

Looking first at oil, the question of re–exportations arises as with all other Eastern European countries. In particular, some analysts (such as J. VANOUS) have indicated the existence in some years of **crude exports** which do not appear in any national statistical year–books. Under such conditions, it is hardly surprising that there are differences between the various sources related to the extent to which they are capable of handling the difficult task of taking account of re–exportations.

As for coal, the early eighties were marked by an increase in the differences between EEC–ONU and DIW data. These differences are due to problems concerning equivalence coefficients. Indeed it should be underlined that the EEC–UNO's solid fuel data is based on statistics provided by the Hungarian government. During the 1980s, these showed a certain number of discontinuities (according to the Hungarians themselves, they changed their methodology, though they do not provide any further explanation).

## 2.4.6 Electricity Production

Table 5: Power Generation and Energy used for Power Generation (in Mtoe)

	Power Generation	Heat generation		
1971	1.3			3.4
1972	1.4			3.5
1973	1.5			3.8
1974	1.6			3.9
1975	1.7			4.2
1976	1.9			4.5
1977	2.0			4.9
1978	2.2			5.1
1979	2.1			5.2
1980	2.0			5.2
1981	2.1			5.2
1982	2.1			5.1
1983	2.0			5.1
1984	1.9			4.6
1985	1.7			4.6
1986	1.8			4.7
1987	1.6			4.8
Energy used for power generation (in Mtoe) – Hungary				
	Coal	Oil	Gas	Total
1971	4.2	1.7	0.7	2.0
1972	4.6	1.9	0.9	2.4
1973	5.1	1.8	1.1	2.7
1974	4.9	2.1	1.2	2.8
1975	4.8	2.4	1.4	2.7
1976	5.0	2.3	1.9	2.9
1977	5.2	2.6	2.0	2.9
1978	5.4	3.0	2.1	3.2
1979	5.4	1.7	2.4	2.3
1980	5.4	1.9	2.8	2.9
1981	5.4	1.8	3.0	3.0
1982	5.6	1.7	3.0	3.2
1983	5.4	1.7	2.9	2.9
1984	4.6	2.5	4.4	5.0
1985	3.9	2.6	4.4	4.5
1986	4.0	2.2	4.7	4.4
1987	4.0	2.2	4.6	4.2

The rate of growth of fossil-fueled electricity production has been relatively high in Hungary: 6% on average per year between 1970 and 1980, which then fell between 1980 and 1987.

Since 1970, electricity production has undergone profound changes, characterized first of all by the penetration of oil, and later by the penetration of natural gas and nuclear power.

In 1970, coal accounted for 66.2% of electricity production. In 1988 it accounted for only 32.8%. Between 1970 and 1982, oil's share rose from 17.3% to 24.6%. After 1982, however, its share fell significantly to the advantage of nuclear power and natural gas as the result of Hungary's energy policy.

Hungary had an installed electricity production capacity of 6,872 MWe at the end of 1988, including 4 reactors at Paks rated at 440 MWe.



**Table 6: Electricity Capacity and Heating Plants (late 1988)**

	Fuels	MWe
"Gagarin"	Lignite	800
Dunamenti n°1	Heavy oil	580
	natural gas	
n°2	Heavy oil	1290
	natural gas	
Tiasza n°1	Heavy oil	860
	natural gas	
n°2	Coal, natural gas	235
Oreszlany	Coal	210
Borsod	Coal, natural gas	66 + 32
Ajka	Coal	126.6
Matravidé	Fuel oil	
Salgotarjan	Fuel oil	2.5
Kelenfold	Fuel oil	
	natural gas	171.4
"November 7"	Coal, light oil	100 + 170
Pecs	Coal	228.5
Komlo	Coal	9.9
Banhida	Coal	100
Tatabanya	Coal	32.2
Dorog	Coal	12.5
Kispest	Fuel oil	
	natural gas	24
Ujpest	Fuel oil	
	natural gas	9.6
Revesz steet + Angyalfold	Fuel oil	
	natural gas	9.7
Kolanya	Fuel oil	
	natural gas	8
Gyor n°1	Fuel oil	
	natural gas	21.9
n°2	Coal	3
Sopron	Fuel oil	
	natural gas	8.5
Szekesfehervar	Fuel oil	1.2
Szeged	Natural gas	1.4
Bekescsaba	Natural gas	-
Kecskemet	Natural gas	-
Debrecen	Fuel oil,	
	natural gas	-
Nyiregyhaza	Fuel oil,	
	natural gas	8.5
Paks	Nuclear	1760
<b>MVMT as total</b>	<b>6872.4</b>	

Source: Kozlemenyei 1989/2, Magyar Villamos Müvek Tröszt, Budapest 1989, vol 2.

### 2.4.7 Final Energy Consumption

Hungary's energy consumption is one of the lowest in Eastern Europe: 21.8 Mtoe in 1986.

Its (primary) energy intensity is 661 koe/1000 \$80.

Its per capita energy consumption is 3,014 koe/inhabitant.

**Table 7: Final Energy Consumption (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	6.0	5.0	2.6	1.3	3.2	18.1
1972	5.4	5.5	2.6	1.4	3.3	18.3
1973	5.1	6.3	3.0	1.5	3.5	19.5
1974	4.8	6.7	3.2	1.6	3.6	20.0
1975	4.6	7.5	3.5	1.7	3.9	21.2
1976	4.9	8.1	4.2	1.8	4.3	23.3
1977	4.4	8.4	4.7	1.9	4.5	23.9
1978	4.3	9.1	5.0	2.1	4.8	25.3
1979	4.4	9.8	5.2	2.1	4.8	26.2
1980	4.3	9.4	5.3	2.2	5.2	26.3
1981	4.3	8.8	5.3	2.2	5.2	25.8
1982	4.5	8.4	5.6	2.3	5.2	25.9
1983	4.4	7.9	5.7	2.4	5.4	25.8
1984	4.1	6.6	4.2	2.5	4.1	21.5
1985	4.6	6.6	4.4	2.6	4.2	22.3
1986	4.2	6.4	4.6	2.6	4.0	21.8
1987	4.2	6.6	4.7	2.7	4.1	22.4

When compared with the "coal countries" of Eastern Europe, two main features can be seen in the structure of Hungary's final energy consumption:

- the importance of hydrocarbons (gas in particular) and electricity,
- the importance of the housing-service-agricultural sector compared with industry.

**Table 8: Structure of Final Consumption by Energy Form in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
19.3	29.4	21.1	11.9	18.3	100

**Table 9: Structure of Final Consumption by Sector in 1986 (%)**

Industry	Transport	Housing-service-agriculture	Total
42.2	12.8	45.0	100

The eighties have been marked by a desire to substitute natural gas for oil in the wake of the reduction in deliveries of Soviet oil. As for the seventies, they were dominated by the massive penetration of oil within the Hungarian energy balance, with a view to increasing the energy efficiency of the industrial system and to developing new sectors such as petrochemicals.

It can also be seen that there was significant growth in electricity consumption (23% per year on average between 1980 and 1986). This can be partly explained by changes in the economic structure and the rapid development of services and the housing sector. In terms of the structure of final energy consumption, this change was related to the fall in the industrial sector's share of electricity consumption to the advantage of the housing-service-agricultural sector. Sectoral changes in Hungary's economic structure are doubtless one of the central reasons for the increasing difference between growth in total energy consumption and growth in the industrial sector's consumption.

#### Energy Consumption in the Industrial Sector

**Table 10: Final Energy Consumption in the Industrial Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	2.7	1.2	1.6	0.8	2.1	8.4
1972	2.5	1.3	1.6	0.9	2.3	8.6
1973	2.4	1.5	1.8	0.9	2.4	9.0
1974	2.3	1.5	1.9	0.9	2.4	9.1
1975	2.2	1.5	1.9	1.0	2.5	9.1
1976	2.3	1.5	2.3	1.0	2.9	10.1
1977	2.1	1.6	2.6	1.1	2.8	10.2
1978	1.8	1.6	2.8	1.1	2.9	10.2
1979	1.8	2.5	2.9	1.1	2.9	11.2
1980	1.7	1.9	2.8	1.2	3.4	11.0
1981	1.7	1.6	2.9	1.2	3.3	10.7
1982	1.7	1.4	3.0	1.2	3.2	10.6
1983	1.8	1.3	3.1	1.2	3.6	11.0
1984	1.1	0.6	2.0	1.2	2.6	7.6
1985	1.1	0.6	1.9	1.2	2.6	7.5
1986	1.0	0.6	2.0	1.3	2.5	7.4
1987	0.9	0.6	1.9	1.4	2.5	7.3

The main feature of the industrial sector is the lasting fall in its energy consumption during the eighties. This would appear to be particularly strong when calculated using the EEC-UNO figures and is partly a reflection of the problems mentioned in connection with primary oil consumption. It is also a reflection of difficulties involved in sharing gas consumption between the industrial and electricity sectors. It should be noted that Hungarian national statistical year-books place the electricity sector within the industrial sector, thus creating methodological problems when it comes to reconstructing energy balances. The IEA data confirms the fall in industrial consumption, while at the same time showing an industrial gas consumption greater than that given by the EEC-UNO figures. Conversely, gas consumption within the electricity sector is less than that given by the EEC-UNO.

Going beyond statistical problems, it should be emphasized that "economic factors" could justify falls in this sector. The work carried out by the EEC-UNO on Hungary is useful in this respect<sup>4</sup>.

In the eighties, the Hungarian economy underwent major structural changes:

- a reduction in the importance of the so-called "productive" sector (excluding services),
- an increase in the shares of the service and housing sectors.

This could explain the relatively differentiated changes in total energy consumption and industrial energy consumption.

Nor should it be forgotten that, in the face of a very strong external constraint, economic growth has been weak in Hungary and has been characterized by a definite slow-down in the growth of highly energy-consuming industries. Nevertheless, the EEC-UNO study emphasizes the fact that Hungary's industrial structure has hardly altered. This would seem to imply that the reductions in this sector's consumption are also due to a certain degree of improvement in energy efficiency. Several specific energy consumption figures confirm this, though the observation periods are rather short. In the case of steel, specific energy consumption was as follows:

1980: 4.92 GJ/ton  
1983: 3.64 GJ/ton.

The other indicator which confirms this point of view is the penetration of electricity within the industrial sector which has accompanied the use of certain industrial processes. Energy consumption in the housing-service-agricultural sector

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4 Hungary energy conservation policy case study, The ECE energy series. United Nations, Economic Commission for Europe, Geneva, 1988.

**Table 11: Final Energy Consumption in the Housing-Service-Agriculture Sector**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	2.6	1.6	0.4	0.4	1.1	6.1
1972	2.4	2.0	0.5	0.4	1.0	6.3
1973	2.2	2.5	0.6	0.5	1.1	6.9
1974	2.1	2.7	0.7	0.6	1.2	7.2
1975	2.0	2.7	0.8	0.6	1.3	7.5
1976	2.3	2.9	1.0	0.7	1.3	8.1
1977	2.1	3.0	1.1	0.7	1.7	8.6
1978	2.2	3.4	1.3	0.8	1.8	9.5
1979	2.4	3.3	1.3	0.9	1.8	9.6
1980	2.4	3.5	1.4	0.9	1.8	10.0
1981	2.5	3.3	1.4	0.9	1.9	9.9
1982	2.6	3.2	1.6	1.0	1.9	10.3
1983	2.6	2.8	1.6	1.1	1.8	9.8
1984	3.0	2.4	1.4	1.2	1.4	9.3
1985	3.5	2.3	1.6	1.2	1.5	10.2
1986	3.2	2.1	1.8	1.2	1.5	9.7
1987	3.2	2.2	2.0	1.2	1.6	10.2

This sector is characterized by significant changes in the shares of the various energy forms as a result of Hungarian energy policies. These have been particularly marked by the desire to substitute natural gas and solid fuels for diesel oil in district heating systems.

**Table 12: Structure of Consumption in the Housing-service-agriculture Sector by Energy Form (%)**

	Coal	Oil	Gas	Electricity	Heat-steam	Total
1978	23.2	35.8	13.7	8.4	18.9	100
1986	32.7	21.4	18.4	12.2	15.3	100

According to V. MERKIN,<sup>5</sup> between 1980 and 1985, the use of liquid fuels for domestic heating fell by a third.

The desire to economize on the use of oil was also felt in the transport sector.

<sup>5</sup> MERKIN, V. Petroleum conservation in Eastern Europe, Part II, Delphic Associates, 1988, p.199.

## Energy Consumption in the Transport Sector

**Table 13: Energy Consumption in the Transport Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	0.7	1.3	0.0	0.1	0.0	2.1
1972	0.5	1.4	0.0	0.1	0.0	2.0
1973	0.5	1.5	0.0	0.1	0.0	2.1
1974	0.4	1.6	0.0	0.1	0.0	2.2
1975	0.4	1.9	0.0	0.1	0.0	2.4
1976	0.3	1.9	0.0	0.1	0.0	2.4
1977	0.3	2.0	0.1	0.1	0.1	2.5
1978	0.3	2.3	0.1	0.1	0.0	2.8
1979	0.2	2.2	0.1	0.1	0.0	2.7
1980	0.2	2.1	0.1	0.1	0.0	2.5
1981	0.1	2.1	0.1	0.1	0.0	2.5
1982	0.1	2.1	0.1	0.1	0.0	2.4
1983	0.1	2.0	0.1	0.1	0.0	2.4
1984	0.0	2.5	0.0	0.1	0.0	2.7
1985	0.0	2.6	0.0	0.1	0.0	2.7
1986	0.0	2.7	0.0	0.1	0.0	2.8
1987	0.0	2.8	0.0	0.1	0.0	3.0

Hungary's rail electrification policy has allowed it to limit increases in oil consumption, at least during the 1979–1983 period. On the other hand, the end of the eighties has seen strong increases in oil consumption. However, to judge by the World Bank's figures, diesel's share of rail transport remained important in 1982.

**Table 14: Rail Traction by Type (%)**

Steam:	4.0
Electric:	51.0
Diesel:	45.0

Source: Hungary, reform, adjustment and growth, A World Bank country study, vol.II, 1987, p.324.

# Poland

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# POLAND

## Districts



**GOPA**

Statistisches Bundesamt 87 0085

## 2.5 Poland

### 2.5.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	4590 US\$
- Population and Employment	
. Resident Population	37.9 mill
earning a livelihood	
(men 18-64 years, women 18-59 years)	21.9 mill
. Population Density (persons per km <sup>2</sup> )	121
. Growth of Population	0.3 %
. Workers and Employees	17.1 mill
Socialist sector	71.3 %
Private sector	28.7 %
. Employment Ratio	45.2 %
. Sectoral Employment Shares	
Industry	28.6 %
Construction	7.8 %
Agriculture	27.6 %
Forestry	0.9 %
Transport and Communication	7.0 %
Trade	8.6 %
Residential and Community Affairs	3.9 %
Health & Social	4.6 %
Education	5.4 %
Science	0.7 %
Culture & Arts	0.5 %
Administr., Finance, Credit and Assurances	2.5 %
Sport and Tourism	0.6 %
Other non-productive Sectors	1.8 %
- Sectoral Output Shares (1987)	
. Agriculture	25.5 %
. Industry	32.5 %
. Productive Services	23.5 %
. Non-productive Services	18.5 %
- Natural Resources and Raw Materials Production	
. Steel	16.9 x 10 <sup>6</sup> t
. Copper	401.0 x 10 <sup>3</sup> t
. Aluminum	47.7 x 10 <sup>3</sup> t
. Cement	17.0 x 10 <sup>6</sup> t
. Zinc	174.0 x 10 <sup>3</sup> t
. Sulfur	4.9 x 10 <sup>6</sup> t
. Pig iron	6.3 x 10 <sup>3</sup> t

### 2.5.2 National Energy Resources<sup>1</sup>

The energy economy of Poland is mainly based on its coal resources. The deposits are located in Upper and Lower Silesia, and around Lublin in the eastern part of Poland. According to estimates published by the Polish Government in the late seventies, coal resources amount to 80 billion tce, 40 % of which is economically exploitable. The regional distribution is as follows:

Upper Silesia: 55 billion tons (in tce)

Lublin: 24 billion tons (in tce)

Lower Silesia: 2 billion tons (in tce)

Recent investigations on the coal fields of Upper Silesia show differing figures as far as the economically recoverable reserves are concerned. Although total resources are estimated at 140 billion tons (tce) and proven resources at 56 billion tons, exploitable reserves only amount to 13 billion tons. From this, the extraction of about 6,5 billion tons would be only feasibly with very high technical and financial efforts.

The estimates for brown coal and lignite differ by data sources. One source indicates resources of 20 billion tons and economically exploitable reserves of 10 billion tons. Another estimate states proven resources with 16,4 billion tons and reserves with 12,4 billion tons. Deposits are estimated to be distributed over one half of the area of Poland. The calorific value of the coal ranges from 8,0 MJ/kg to 9,0 MJ/kg. Stripping ratios are expected to increase in future. Generally, ratios range from 4:1 to 5,7:1, but in some mines the ratio already amounts to 8:1.

Proven oil reserves are estimated at 2 mill. tons. They are located in the Southeast. Petrobaltic – a joint venture of Poland, GDR and the USSR – is exploring resources in the Baltic Sea. A deposit discovered near Bornholm is expected to amount to 20 mill. tons. An economic extraction of these oil fields cannot be expected in the near future.

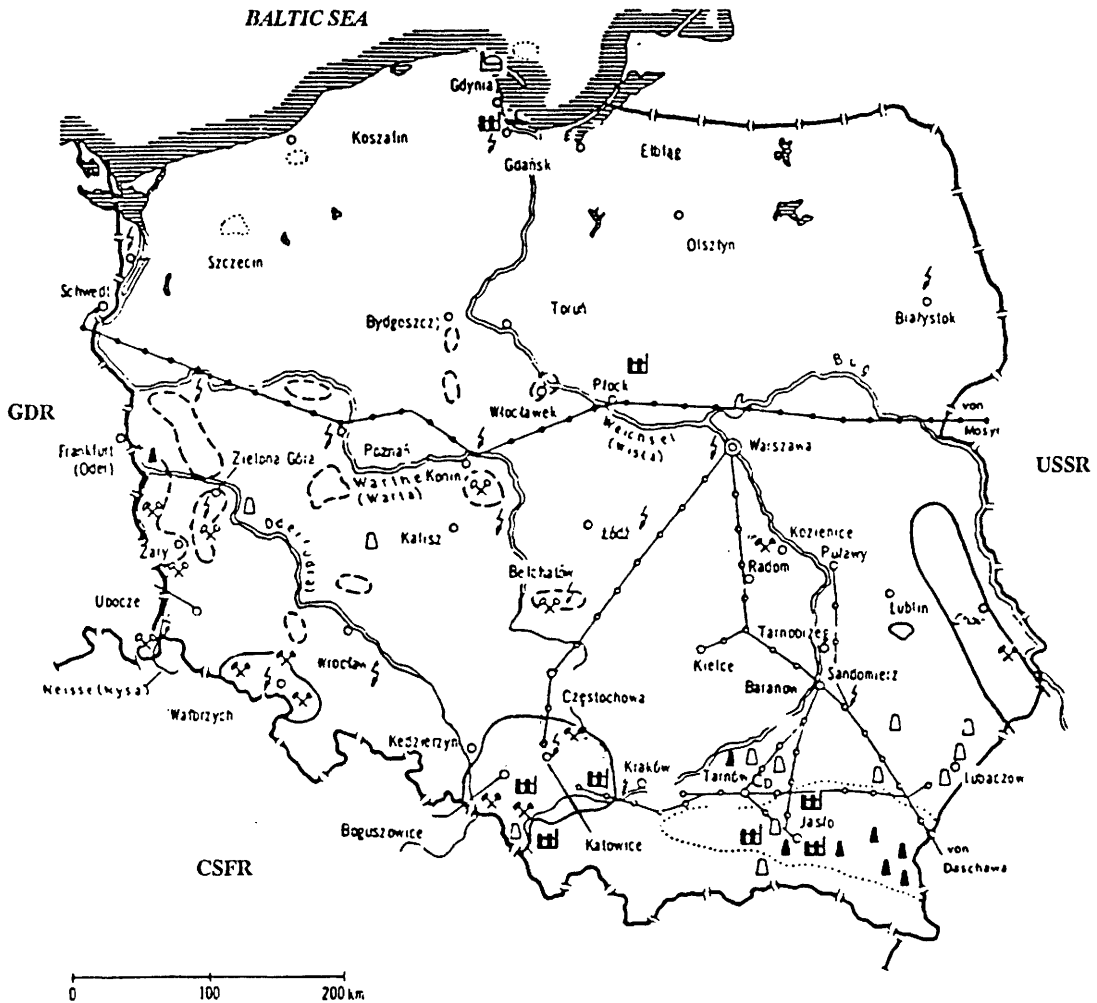
Reserves of natural gas are indicated with 165 billion m<sup>3</sup>. On this basis the current extraction could be maintained for 27 years. Larger gas fields are located in the Southeast and in the region of the upper parts of the river Oder.

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**1 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

# POLAND

## Energy Resources, Energy-related Infrastructure



- |  |                  |  |                                     |
|--|------------------|--|-------------------------------------|
|  | Coal Deposit     |  | Thermal Power Plants                |
|  | Coal Mining      |  | Nuclear Power Plant in Construction |
|  | Lignite Deposit  |  | Oil Pipeline                        |
|  | Lignite Mining   |  | Gas Pipeline                        |
|  | Oil Field        |  | Oil Refinery                        |
|  | Oil Exploitation |  |                                     |
|  | Gas Exploitation |  |                                     |

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### 2.5.3 Primary Energy Production<sup>2</sup>

In 1987, about 85 % of primary production was attributed to the share of hard coal. With an extraction of 193 mill. tons Poland was the fourth-largest producer worldwide. This production volume could be stabilized after a serious reduction in output in the early eighties.

The extraction of hard coal suffers from falling investments and increasing mining depths. Investments in mining decreased (in real terms) from 1980 to 1987 by about one third. In the same period the share of the coal industry in the industrial total declined from 19 % to 14 %. In 1980 average mining depths were around 560 m. An average depth of 750 m is expected for the year 2000. The corresponding efforts for extraction, transport and safety raise exploitation costs. Also, costs increase by exploitation of increasingly smaller seams. Due to low investments and worsening geological conditions of coal deposits it can be expected that the coal production will not rise in the medium term.

The extraction of brown coal and lignite was expanded in the eighties. In 1987 and 1988 the extraction of 73 mill. tons was twice as high as in 1980. The share of lignite in the domestic production of primary energy is about 12 %; the calorific value is about 8.5 MJ/kg. The strong production growth heavily depended on the development of the fields around Belchatow. Extraction started in 1981 and nearly achieved the planned production target of 28 mill. tons p.a. in 1987. Production is expected to increase only slightly in the future. The target of 80 mill. tons for the year 2000 is based to 50 % on the production of the Belchatow strippings.

About 95 % of brown coal is fired in power plants; the production of briquettes is of very limited importance. The largest brown coal power plants are Belchatow (4320 MW planned), Turow (2000 MW), Katnow (15,000 MW) and Adamow (600 MW).

About 4 % of the polish production of primary energy rely on natural gas. In the last ten years production decreased from 7.5 to 5.5 billion m<sup>3</sup>. In the long term a production of 5 billion m<sup>3</sup> is expected.

Whether the oil fields in the shelf of the Baltic Sea will be exploited in this century is uncertain but improbable. Oil production will play a minor role in primary energy production and will stagnate at a level of 0.2 mill. tons p.a.

In summary, it can be stated that in the eighties the growth in primary energy production was determined by the production increase of brown coal and lignite, whereas in the seventies the growth relied on hard coal production. In the medium term, domestic production is expected to stagnate, and increasing consumption can only be covered by growing imports and the use of nuclear power. However, Poland seems to have a nuclear power development programme which is too ambitious; In the year 2000, for instance, the installed capacity should reach the level of 20000 MW!

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2 Source: Deutsches Institut für Wirtschaftsforschung (DIW), *Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren*, Berlin, November 1989

Table 1: Primary Energy Production

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- power bill.kWh	Total PJ
1970	32.8	140.1	0.4	5.0	1.5	4013.4
1971	34.5	145.5	0.4	5.2	1.6	4171.0
1972	38.2	150.7	0.3	5.6	1.5	4345.3
1973	39.2	156.6	0.4	5.8	1.5	4511.8
1974	39.8	162.0	0.6	5.5	2.1	4656.3
1975	39.9	171.6	0.6	5.8	2.0	4777.3
1976	39.3	179.3	0.5	6.5	1.6	4977.4
1977	40.8	186.1	0.4	7.0	2.0	5171.9
1978	41.0	192.6	0.4	7.6	2.0	5356.4
1979	38.1	201.0	0.3	7.0	1.8	5509.5
1980	36.9	193.1	0.3	6.0	2.0	5119.6
1981	35.6	163.0	0.3	5.8	1.9	4391.3
1982	37.6	189.3	0.2	5.2	1.9	5003.1
1983	42.5	191.1	0.2	5.1	1.9	5082.7
1984	50.4	191.6	0.2	5.7	1.9	5181.4
1985	57.7	191.6	0.2	6.0	1.9	5189.3
1986	67.3	192.1	0.2	5.4	1.8	5258.4
1987	73.2	193.0	0.2	5.4	1.8	5328.4
in 1000 TOE						
1970	6663	84293	416	4220	421	96013
1971	7019	87537	388	4380	459	99783
1972	7770	90668	340	4751	421	103953
1973	7974	94237	385	4931	409	107936
1974	8098	97472	541	4689	596	111393
1975	8105	100182	543	4899	557	114287
1976	7993	104663	447	5512	462	119074
1977	8287	108637	356	5897	548	123727
1978	8337	112438	356	6462	548	128141
1979	7744	117330	325	5899	507	131804
1980	7495	109034	323	5055	569	122476
1981	7241	92039	309	4931	533	105053
1982	7655	106883	237	4380	533	119689
1983	8648	107888	206	4320	533	121593
1984	10244	108170	187	4823	533	123955
1985	11741	106594	191	5098	519	124144
1986	13674	106838	167	4612	505	125797
1987	14882	107352	187	4545	505	127471

Source: Data Bank CMEA-Energy of DIW

#### **2.5.4 Exports and Imports of Energy<sup>3</sup>**

Until 1979 Poland was a net-exporter of energy. The reduction in hard coal production at the beginning of the eighties led to diminishing energy exports. Since 1980 imports surpassed exports.

Hard coal exports still contribute significantly to the Polish trade balance, although the share is decreasing. In 1987 returns on exports of coal and coke formed about 13 % of total foreign currency earnings. More than one sixth of the domestic hard coal production was exported in the eighties, about 31 mill. t in 1987. Heavy fluctuations of exports in this period were caused by the oscillating pattern of production. In 1984 Poland was the third largest exporter of hard coal, but since 1985 exports have been decreasing as a result of stagnating production. This trend is expected to continue as domestic demand will rise and extraction cannot be increased. It is estimated that Polish hard coal exports will diminish after the year 2000.

Concerning oil and gas, Poland depends on imports. Main supplier is the USSR. Imports increased continuously during the seventies, but in the eighties increasing prices and the economic crisis reduced imports. In 1987 the import level of 1980 was again reached. The import dependence on oil is nearly total, oil imports have been about 17 mill. tons p.a. since 1981.

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**3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 2: Hard Coal Exports (1979 – 1987)**

Year	Exports			Share (Value) of Hard Coal Exports in Total Exports		
	Total	Socialist	Non-socialist	Total	Socialist	Nonsocialist
	mill. t			%		
1979	41.4	15.0	26.4	11.4	-	-
1980	31.0	10.8	20.1	9.2	5.9	13.3
1981	15.2	7.3	7.9	7.9	6.4	9.5
1982	28.5	14.3	14.2	12.0	8.2	16.4
1983	35.1	17.6	17.5	12.7	10.3	15.7
1984	42.9	18.1	24.8	14.3	10.0	19.1
1985	36.2	15.1	21.0	13.0	7.6	19.7
1986	34.3	17.1	17.2	11.2	7.5	15.4
1987	31.0	13.9	17.1	8.8	5.9	11.3

Source: Foreign Trade Statistics, Republic of Poland

Oil imports from the USSR show small variations: they range from 15 to 16 mill. tons p.a. It is intended to increase oil imports by 7 mill. tons until the year 2000. But this target can only be financed if hard currency earnings are increased by an improvement of competitiveness of Polish products.

Consumption of natural gas is covered to more than one half by imports from the USSR. Since 1980 imports grew by 40 % to 7.5 billion m<sup>3</sup> in 1987. Further increases are expected as Poland contributes to the construction of gas pipelines in the USSR also in the future. Gas imports up to 15 billion m<sup>3</sup> are expected until 2000.

The import-export balance for electricity showed small surpluses until 1985. But at present and in the future the imports will be higher than exports, because the USSR is going to supply Poland with electricity from the nuclear plant Chmelnizki, which was constructed with Polish support.

It can be expected that the growing energy consumption will be covered by imports. The lack of hard currency will limit oil imports from OPEC countries and Poland has to rely on the exchange system with the USSR. How the exchange system in the CMEA will be affected by the new economic policies in the East European countries will be shown by the future.



**Table 3: Exports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t	Coke mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Total PJ
1970	4.0	28.8	2.3	1.3	0.0	1.5	895.1
1971	3.6	30.3	2.4	1.1	0.0	2.3	932.0
1972	4.1	32.7	2.3	1.7	0.0	2.6	1023.2
1973	5.0	35.9	2.8	1.3	0.0	3.8	1122.1
1974	5.2	40.1	3.0	1.2	0.0	4.5	1237.8
1975	3.4	38.5	3.1	1.6	0.0	2.9	1156.4
1976	3.1	38.9	3.1	2.6	0.0	2.8	1207.0
1977	3.4	39.3	2.7	2.1	0.0	3.1	1188.4
1978	3.3	40.1	2.1	1.8	0.0	5.1	1201.1
1979	3.0	41.4	2.1	1.5	0.0	5.1	1214.2
1980	1.6	31.1	1.8	1.6	0.0	4.4	913.4
1981	1.4	15.0	1.4	0.8	0.0	4.2	488.1
1982	0.9	28.3	1.6	0.6	0.0	6.0	816.1
1983	0.2	35.1	1.6	1.4	0.0	7.2	1017.9
1984	0.0	42.9	1.8	0.4	0.0	9.2	1189.6
1985	0.2	36.2	1.6	0.5	0.0	7.6	996.0
1986	0.0	34.4	1.5	0.4	0.0	7.8	951.6
1987	0.0	31.0	2.3	0.5	0.0	8.7	907.3
in 1000 TOE							
1970	809	17337	1522	1318	7	421	21413
1971	725	18239	1598	1072	7	655	22296
1972	835	19667	1512	1727	2	734	24478
1973	1010	21588	1852	1337	0	1055	26844
1974	1057	24122	1993	1182	0	1258	29612
1975	699	22461	2088	1596	0	821	27665
1976	627	22732	2072	2653	0	789	28875
1977	689	22949	1811	2117	0	864	28430
1978	677	23411	1390	1823	0	1433	28734
1979	605	24189	1383	1457	0	1416	29047
1980	318	17559	1179	1562	0	1232	21851
1981	282	8469	928	811	0	1187	11677
1982	191	15978	1067	620	0	1670	19524
1983	41	19844	1086	1366	0	2014	24351
1984	0	24232	1194	445	0	2588	28459
1985	41	20110	1091	462	0	2122	23827
1986	0	19107	1029	443	0	2187	22765
1987	0	17220	1514	529	0	2440	21705

Source: Data Bank CMEA-Energy of DIW

**Table 4: Imports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t	thereof: Hard Coal mill.t	Coke mill.t	Oil mill.t	Gas bill.m3	Electricity bill.kWh	Nucl. Energy* bill.kWh	Total PJ
1970	0.3	1.1	1.1	0.0	9.4	1.0	1.6	0.0	477
1971	0.0	1.3	1.3	0.0	10.2	1.5	2.2	0.0	574
1972	0.0	1.2	1.2	0.0	12.0	1.5	2.4	0.0	612
1973	0.0	1.2	1.2	0.0	14.2	1.7	2.0	0.0	706
1974	0.0	1.2	1.2	0.0	13.6	2.1	1.7	0.0	692
1975	0.0	1.1	1.1	0.0	16.4	2.5	2.4	0.0	831
1976	0.0	1.1	1.1	0.0	18.3	2.6	2.7	0.0	914
1977	0.0	1.1	1.1	0.0	19.7	2.8	3.1	0.0	985
1978	0.0	1.1	1.1	0.0	20.0	2.8	4.7	0.0	1016
1979	0.0	1.0	1.0	0.0	20.5	4.0	4.6	0.0	1075
1980	0.0	1.0	1.0	0.0	20.7	5.3	4.2	0.0	1126
1981	0.0	1.1	1.1	0.0	17.4	5.3	4.2	0.0	989
1982	0.0	1.0	1.0	0.0	16.4	5.6	4.3	0.0	955
1983	0.0	1.3	1.3	0.0	17.5	6.0	4.1	0.0	1020
1984	0.0	1.1	1.1	0.0	16.9	6.0	4.6	0.0	997
1985	0.0	1.4	1.4	0.0	17.2	5.9	5.5	0.0	1023
1986	0.0	1.5	1.5	0.0	17.8	7.1	7.8	0.0	1120
1987	0.0	1.1	1.1	0.0	17.5	7.5	10.4	0.0	1144
in 1000 TOE									
1970	65	617	617	0	9452	840	438	0	11411
1971	2	713	713	0	10182	1246	624	0	12765
1972	0	653	653	0	12064	1256	677	0	14648
1973	0	653	653	0	14249	1431	565	0	16897
1974	0	675	675	0	13629	1770	486	0	16562
1975	0	620	620	0	16481	2098	677	0	19875
1976	0	617	617	0	18354	2132	758	0	21863
1977	0	612	612	0	19780	2309	873	0	23574
1978	0	589	589	0	20088	2304	1323	0	24301
1979	0	531	531	0	20555	3332	1289	0	25708
1980	0	569	569	0	20763	4440	1167	0	26940
1981	0	603	603	0	17488	4392	1172	0	23660
1982	0	548	548	0	16399	4698	1196	0	22842
1983	0	718	718	0	17531	5009	1144	0	24404
1984	0	581	581	0	16952	5029	1299	0	23861
1985	0	782	782	0	17229	4921	1531	0	24464
1986	0	811	811	0	17827	5966	2196	0	26799
1987	0	598	598	0	17564	6285	2923	0	27368

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

## 2.5.5 Primary Energy Consumption

Table 5: Primary Energy Consumption in Poland

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	29.1	109.4	8.5	6	1.6	0	3577.5
1971	31	114.1	9.5	6.6	1.5	0	3772.6
1972	34.1	116.9	10.7	7.1	1.3	0	3934.5
1973	34.2	119.2	13.3	7.5	-0.3	0	4096
1974	34.6	120.2	13	7.7	-0.6	0	4110.8
1975	36.4	131.2	15.4	8.3	1.5	0	4453.2
1976	36.2	138.5	16.1	9.1	1.5	0	4687.3
1977	37.4	145.7	18	9.7	2	0	4980
1978	37.7	151.8	18.6	10.4	1.6	0	5177
1979	35.1	160	19.4	10.9	1.4	0	5405.7
1980	35.3	156.8	19.5	11.3	1.8	0	5226.7
1981	34.2	147.3	16.9	11.1	1.9	0	4881.2
1982	36.7	163.4	16	10.8	0.2	0	5211
1983	42.3	158.3	16.3	11.1	-1.2	0	5146.6
1984	50.4	146.4	16.7	11.7	2.7	0	4954.3
1985	57.5	153	16.9	11.9	-0.3	0	5161.8
1986	67.3	156.4	17.5	12.6	1.8	0	5397
1987	73.2	160.3	17.2	12.9	3.5	0	5552.3
in 1000 TOE							
1970	5919	65623	8552	5053	435	0	85585
1971	6294	68413	9497	5620	428	0	90252
1972	6938	70145	10677	6005	364	0	94125
1973	6964	71451	13296	6361	-84	0	97989
1974	7041	72030	12988	6462	-177	0	98343
1975	7407	76286	15428	7000	414	0	106534
1976	7363	80549	16146	7646	431	0	112134
1977	7598	84757	18019	8206	557	0	119137
1978	7660	88367	18622	8765	438	0	123849
1979	7139	93149	19423	9229	380	0	129321
1980	7177	88338	19526	9495	505	0	125038
1981	6959	82979	16983	9328	522	0	116773
1982	7464	92044	16016	9079	60	0	124663
1983	8607	89151	16371	9332	-337	0	123122
1984	10244	82460	16725	9851	-756	0	118522
1985	11701	84881	16959	10019	-72	0	123486
1986	13674	86788	17559	10574	514	0	129112
1987	14882	88907	17222	10828	988	0	132828

Source: Data Bank CMEA-Energy of DIW

Remark: Differences between the two sources (DIW and EEC-UNO) do not exceed 8% - acceptable given the consumption levels which involved. They are largely explained by differences in coal figures related to problems involving equivalence coefficients.

## 2.5.6 Electricity Production

**Table 6: Power Generation and Energy used for Power Generation (in Mtoe)**

	Power Generation	Heat generation		
1971	5.8	12.2		
1972	6.4	13.3		
1973	7.1	14.5		
1974	7.7	14.9		
1975	8.2	16.9		
1976	8.8	17.9		
1977	9.2	19.2		
1978	9.7	20.3		
1979	9.9	21.6		
1980	10.2	19.0		
1981	9.6	17.8		
1982	9.9	17.7		
1983	10.5	18.1		
1984	11.3	18.0		
1985	11.5	18.9		
1986	11.7	19.7		
1987	12.2	19.7		
Energy used for power generation (in Mtoe) – Poland				
	Coal	Oil	Gas	Total
1971	37.6	1.2	1.1	21.9
1972	41.3	1.3	1.5	24.3
1973	41.6	1.4	1.1	22.5
1974	43.4	1.5	0.8	23.1
1975	47.3	1.6	0.8	24.6
1976	50.5	1.5	0.8	26.0
1977	53.0	1.9	0.6	27.1
1978	56.3	2.3	2.1	30.7
1979	57.0	2.6	1.6	29.7
1980	57.3	2.3	1.8	32.1
1981	51.0	2.2	1.5	27.3
1982	54.1	2.0	1.6	30.2
1983	57.3	2.0	1.7	32.3
1984	62.5	2.0	1.6	36.9
1985	63.5	1.8	1.5	36.4
1986	55.9	2.0	1.6	28.1
1987	57.1	2.1	1.2	28.5

As the following figures show, electricity production in Poland is dominated by coal-fired power plants. In 1988, coal accounted for roughly 90% of fossil-fueled electricity production, one third being based upon lignite. Out of a total electricity production capacity of 27,786 MW, coal accounted for 25,781 MW, or 93%.

The following balance for electricity supply (TWh) is provided by the Polish government:

	70	73	79	80	84	85	86	87
Solid fuels	58	78	110	114	129	131	133	138
Oil	2	2	4	4	2	2	2	2
Gas	3	2	1	1	1	1	1	1
Export-Import	0	-2	0	0	-5	-2	0	2
Hydro	2	2	2	3	3	4	4	4
<b>Total</b>	<b>65</b>	<b>82</b>	<b>117</b>	<b>122</b>	<b>130</b>	<b>136</b>	<b>140</b>	<b>148</b>

Source: National energy data profile, Poland, 14th Congress of the World Energy Conference, 1989, Polish National Committee.

Three points should be underlined:

1. Firstly, the falls in production in 1981-1982 in the wake of the Polish crisis should be noted. Since 1982, growth in production has never reached 1970's levels.
2. Secondly, a certain penetration of oil can be seen during the 70's as regards fossil-fueled electricity production, followed by a return to coal in the 80's. This is explained by the limitation of Soviet oil exports, the very strong constraint imposed on Poland by foreign exchange limiting its ability to import OPEC oil.
3. Finally, important losses were seen in the electricity sector (roughly 10% of production).

**Table 7: Electricity Production Capacity**

	1980	1988
Total gross capacity (GW)		
- public utilities	25.3	32.1
- auto-production	3.0	3.2

### 2.5.7 Final Energy Consumption

Poland's final energy consumption was 89 Mtoe in 1989, making the country a major energy consumer:

- per capita energy consumption: 3,483 koe/inhabitant,
- (primary) energy intensity: 827 koe/1000 \$80

Final energy consumption fell regularly between 1980 and 1984, a reflection of the country's economic difficulties and of the fall in its GDP.

**Table 8: Final Energy Consumption (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	27.5	7.4	7.1	4.4	12.2	58.5
1972	28.0	8.1	6.7	4.7	13.3	60.9
1973	28.1	9.1	7.4	5.2	14.5	64.2
1974	28.0	10.3	7.8	5.6	14.9	66.6
1975	30.1	11.6	8.6	6.1	16.9	73.2
1976	31.0	12.2	9.8	6.5	17.9	77.4
1977	31.6	13.2	9.5	6.9	19.2	80.4
1978	32.2	14.1	8.7	7.2	20.3	82.4
1979	33.0	14.7	9.9	7.3	21.6	86.5
1980	31.2	14.1	9.5	7.5	17.6	79.8
1981	33.3	12.9	9.2	7.3	16.6	79.2
1982	34.2	11.6	9.2	7.3	17.2	79.5
1983	31.5	12.2	9.9	7.5	17.8	78.8
1984	30.6	11.9	10.3	8.0	17.5	78.4
1985	32.7	12.7	9.7	8.4	17.0	80.4
1986	37.7	13.7	10.5	8.7	17.8	88.4
1987	37.5	13.2	11.5	9.1	17.8	89.1

The structure of this final energy consumption is characterized by:

- the importance of solid fuels (42% in 1987) and heat-steam destined for heating purposes in the housing and industrial sectors. This makes Poland one of the world's main consumers, ahead of the Soviet Union,
- the weakness of electricity (9.8% in 1986) and of oil (15.5%). The policy which has been followed for the latter has been to give priority to chemicals and petrochemicals. Oil is the only energy form to have fallen in quantitative terms.

**Table 9: Structure of Final Consumption by Energy Form in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
42.6	15.5	11.8	9.8	20	100

The second major feature of this final energy consumption is, of course, the importance of the industrial sector which accounts for nearly 42.7% while, at the same time, transport and housing are weak.

**Table 10: Structure of Final Consumption by Sector in 1986 (%)**

Industry	Transport	Housing-service-agricultural	Total
42.7	7.6	49.7	100

It should however be noted that the transport sector only covers public transport. According to the East European countries' methodology, private transport (private cars) is accounted for either along with household consumption or else at an industrial level (in the case of transport for professional purposes).

#### Energy Consumption in the Industrial Sector

**Table 11: Final Energy Consumption in the Industrial Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	6.5	2.1	5.4	2.9	10.5	27.4
1972	7.6	2.3	5.0	3.2	11.5	29.6
1973	7.9	2.6	5.2	3.4	12.8	31.9
1974	7.7	2.9	5.1	3.7	12.9	32.3
1975	7.9	3.3	5.9	4.1	14.5	35.7
1976	8.1	3.5	6.6	4.4	15.4	38.0
1977	8.5	3.8	6.0	4.6	16.5	39.4
1978	9.4	4.0	5.6	4.8	17.2	41.0
1979	9.7	4.3	6.6	4.8	18.4	43.8
1980	8.8	4.1	6.2	4.7	14.6	38.4
1981	10.6	3.3	5.9	4.3	13.4	37.5
1982	8.8	2.9	5.5	4.2	13.7	35.1
1983	7.9	2.8	6.3	4.5	13.7	35.2
1984	8.0	2.7	6.4	4.7	14.1	35.9
1985	8.6	2.8	5.4	4.8	12.1	33.7
1986	7.1	2.9	5.7	4.8	12.4	32.9
1987	7.1	2.5	6.1	5.2	12.4	33.3

The industrial sector is the biggest energy consumer (34 Mtoe in 1987). This level has fallen strongly since the beginning of the eighties, from 39 mtoe in 1979. The industrial sector accounted for 55% of consumption in 1979 and accounted for only 42% in 1986. This change can be explained by significantly stronger growth on the part of the so-called light industries as compared with heavy industry. This can be seen in the World Bank figures:

**Table 12: Structure of Industrial Value Added (% shares)**

	1960	1970	1975	1985	1987	1988
Fuel and power	18.1	15.5	12.1	13.6	14.3	13.6
Metallurgy	8.1	7.4	7.6	4.3	8.6	8.8
Engineering	15.7	26.0	31.5	33.4	26.8	27.6
Chemicals	4.8	8.6	10.3	8.1	8.4	8.5
Minerals	5.0	4.4	4.1	4.7	3.6	3.7
Wood and paper	5.0	4.6	4.4	4.4	4.1	4.2
Light industry	17.2	16.2	16.1	12.3	10.5	10.9
Food industry	26.1	16.4	13.0	16.7	20.9	20.3

Source: Poland, reform, adjustment and growth, Vol. II, The World Bank, Washington DC, 1987, p.75 and internal sources

This change is also related to the polish economic crisis and the under-utilization of production capacities which has resulted.

The major energy-consuming activities within the industrial sector are:

- steelmaking: 26.4% of consumption in 1986
- chemicals: 21.7%.

Source: IEA balances.

High specific energy consumption, linked not only to the technologies in use but also to particularly wasteful energy management methods, can be seen in all sectors. The World Bank provides the following figures:

**Table 13: Specific Energy Consumption in Selected Industries (MJ per ton of product)**

Product	Poland	International Indicator
Raw steel	15.632	13.400
Open hearth steel	6.231	4.600
Aluminium smelting	16.327 (kWh)	13.500 (kWh)
Cement	5.010	3.700
Ammonia	40.120	40.000

Source: World Bank (1987) op. cit., p.189.

A major share of final electricity consumption (54%) and final gas consumption (75%) goes to the industrial sector. Oil does not play a major role in final energy consumption (8.2%). This is the result of a deliberate choice to restructure oil to its specific uses.



### Energy Consumption in the Transport Sector

This sector is difficult to analyze given the methodological problems outlined above. We can however make several remarks.

The policies which have been adopted in this field have been aimed at railway electrification and the introduction of diesel road transport. Looking first at rail electrification, the situation is as follows:

**Table 14: Rail Traction by Type (%)**

Steam	6
Electric	67,0
Diesel	27,0

Source: World Bank (1987) Op. cit., p.324.

Railways are the dominant transport method. Over 70% of households do not have a car. Private transport is, however, currently gaining ground. The World Bank provides the following figures:

**Table 15: Number of Motor Vehicles at 31 December (1000s)**

Year	Total	Private
1970	479	458
1980	2383	2333
1982	2882	2813
1984	3426	3369

Source: World Bank (1987), Op. cit., p.315.

It should be noted however that in the face of production problems affecting refined petroleum products at the beginning of the eighties, severe petrol rationing was introduced in 1981. According to V. MERKIN<sup>4</sup>, consumption by private cars only accounts for 7% of the consumption of refined products in 1986. A probable major constraint will be the priority given to the petrochemical program which will require a growing share of available oil.

<sup>4</sup> MERKIN, V. Petroleum conservation in East Europe, part II, Delphic Associates, 1988, p.254.

**Table 16: Energy Consumption in the Transport Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	4.3	3.3	0.0	0.3	0.0	7.8
1972	4.1	3.5	0.0	0.3	0.0	7.9
1973	3.8	3.5	0.0	0.3	0.0	7.6
1974	3.6	3.2	0.0	0.3	0.0	7.1
1975	3.8	3.6	0.0	0.3	0.0	7.8
1976	3.6	3.7	0.0	0.4	0.0	7.7
1977	2.9	4.2	0.0	0.4	0.0	7.5
1978	2.7	4.7	0.0	0.4	0.0	7.8
1979	2.3	4.7	0.0	0.4	0.0	7.4
1980	1.9	5.3	0.0	0.4	0.0	7.6
1981	1.6	4.6	0.0	0.4	0.0	6.5
1982	1.4	4.3	0.0	0.4	0.0	6.1
1983	1.5	4.4	0.0	0.4	0.2	6.5
1984	1.4	4.3	0.0	0.5	0.2	6.4
1985	1.5	4.5	0.0	0.5	0.2	6.7
1986	0.9	5.0	0.0	0.5	0.2	6.7
1987	0.9	3.3	0.0	0.5	0.3	4.9

**Table 17: Final Energy Consumption in the Housing-Service-Agricultural Sector (Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	16.6	0.8	0.9	1.2	1.7	21.2
1972	16.3	1.0	0.9	1.3	1.9	21.3
1973	16.4	1.4	0.9	1.4	1.7	21.8
1974	16.7	2.4	1.4	1.5	2.1	24.1
1975	18.4	2.8	1.4	1.6	2.4	26.5
1976	19.3	3.0	1.8	1.8	2.5	28.3
1977	20.1	3.2	1.7	1.8	2.7	29.5
1978	20.1	3.0	1.7	2.0	3.1	30.0
1979	21.0	3.5	1.9	2.1	3.2	31.6
1980	20.4	2.1	1.9	2.3	3.0	29.8
1981	21.1	2.9	2.0	2.6	3.2	31.7
1982	24.0	2.2	2.3	2.6	3.6	34.7
1983	22.0	2.8	2.1	2.5	3.9	33.3
1984	21.2	2.7	2.4	2.9	3.3	32.5
1985	22.5	2.8	2.7	3.1	4.7	35.9
1986	29.5	3.1	2.8	3.3	5.2	43.9
1987	29.2	4.7	3.2	3.4	5.2	45.7

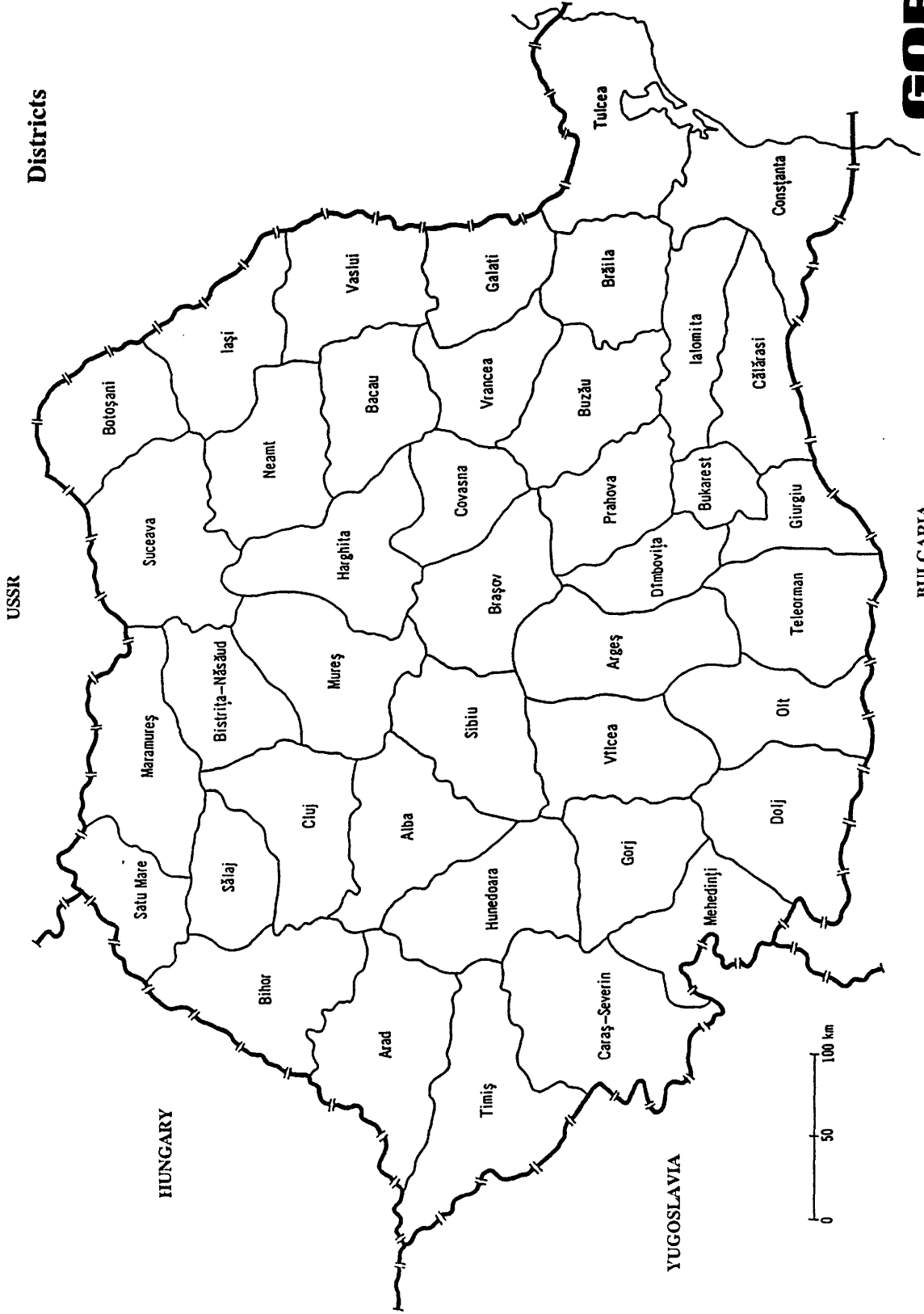
# Romania

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# ROMANIA

## Districts



**GOPA**

Statistisches Bundesamt 87 0086

## 2.6 Romania

### 2.6.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	3590 US\$
- Population and Employment	
. Total Population	23.112 mill.
. Resident Population earning a livelihood (1985) (15 - 65 years)	66.7 %
. Workers and Employees	11.07 mill.
. Employment Ratio	47.9 %
. Population Density (Persons per km <sup>2</sup> )	97.3
. Sectoral Employment Shares	
Industry	37.3 %
Agriculture and Forestry	28.7 %
Building	7.4 %
Telecommunication	0.8 %
Trade and Transport	11.9 %
Community Affairs	4.2 %
Education, Culture and Arts	3.8 %
Science and Research	1.3 %
Health and Social Affairs	2.7 %
Administration	0.5 %
Other Sectors	1.4 %
- Sectoral Output Shares (1987)	
. Agriculture	28.7 %
. Industry	40.4 %
. Productive Services	19.3 %
. Non-productive Services	11.6 %
- Selected National Resources and Raw Materials Production Figures	
. Raw Steel	14.3 mill. t
. Aluminium	269 thousand t

## **2.6.2 National Energy Resources<sup>1</sup>**

The economically viable crude oil reserves are currently estimated at 122 million tons, which corresponds to a statistical coverage of about 12 years. According to this estimate, one can conclude that during this decade no new oil fields were found because the amount of reserves dropped from 190 million tons in 1980 to the said 122 million tons in 1988; This decrease is equal to the output generated in this period.

In the past, the center of oil exploitation was around the city of Ploiesti, north of Bukarest. In recent years, the districts in Pitesti (north-west of Bukarest) and in Tirgu-Jiu gained importance. Besides this, oil reserves are exploited nearby Bacau, which is situated in the Eastern parts of the Carpathians.

In the Black Sea, drilling operations started in 1976 when the first Romanian drilling platform was set-up. In those days, only exploratory drilling was done. In May 1987, oil and gas fields were exploited for the first time in an area located 80 km from the coast. In 1988, the seventh drilling platform was set in operation allowing drilling to a depth of up to 6000 m.

In 1988, natural gas reserves were estimated at 235 billion m<sup>3</sup>. As the estimates stood at 210 billion m<sup>3</sup> in 1985, important new fields must have been investigated during the last years. This was absolutely necessary in order to keep methane gas output at its current level of almost 30 billion m<sup>3</sup>. Natural gas stocks are primarily located in the area of Transsylvania, the center being Tirgu Mures.

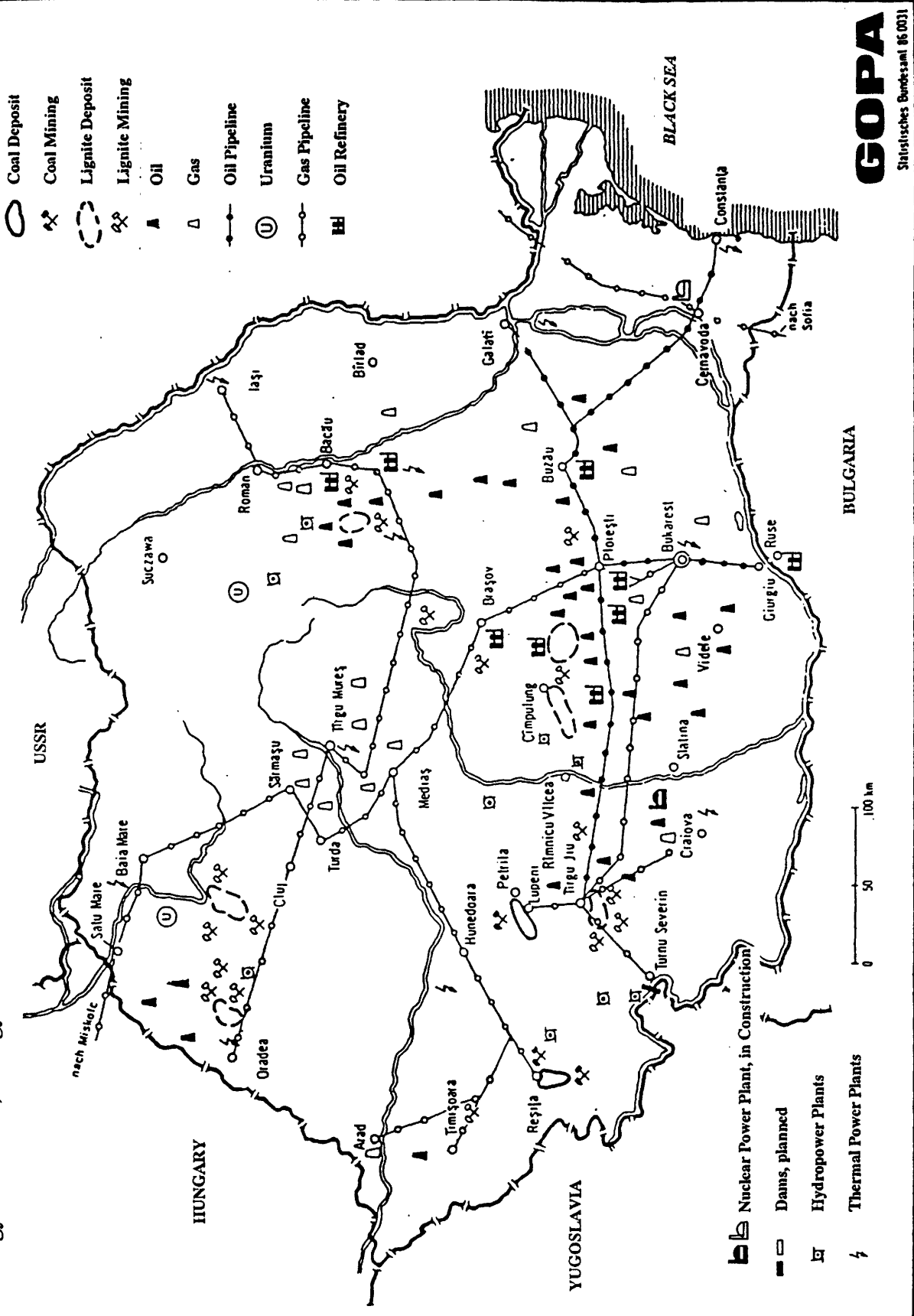
Coal resources are available in the magnitude of 4 billion tons, thereof about 1 billion tons being hard coal. Mining takes place first of all in the Banater Mountains (Resita District) and south of Tirgu-Jiu and Chimpulung. In half of the cases, open-pit mining is done. The geological conditions for brown coal mining are very unfavourable: The thickness of the seams is 2 to 8 m, the overburden to-coal ratio is 7:1 and will be 14:1 in the future. Net heating values of coal are in the range of 6.6 to 8.0 MJ/kg.

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**1 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

# ROMANIA

## Energy Resources, Energy-related Infrastructure



**GOPA**  
Statistisches Bundesamt 86 0031



### 2.6.3 Primary Energy Production<sup>2</sup>

The growth rate of primary energy production has been retarded in recent years. While in the seventies the average annual growth rate was about 5 %, it dropped to only 1 % in the eighties.

Natural gas is ranked first in the national primary energy production statistics. It is exploited both as methane gas and petroleum gas, the latter being an associated gas of crude oil exploitation with a net heating value equal to that of crude oil. Altogether, natural gas production has stagnated since 1977. The annual output is about 38 billion m<sup>3</sup>. However, there is a difference in trend between methane gas and petroleum gas. While petroleum gas output increased from 7 billion m<sup>3</sup> in 1980 to 12 billion m<sup>3</sup> in 1987, methane gas figures dropped from 28 to 25 billion m<sup>3</sup>. This structural shift brought about a 10 % increase in the net heating value of gas production. Yet, due to decreasing oil production figures and rather limited gas reserves, further expansion cannot be expected. On the contrary, the Five-Year-Plan 1986–1990 is based on the assumption of a slow-down in gas production.

Oil production has been a problem area since the mid-seventies, as can be seen from the following figures:

**Table 1: Crude Oil Production (in million tons)**

1970	1975	1980	1985	1987	1988
13.4	14.6	11.5	10.7	9.5	9.4

The Romanian economy was strongly hit by this development in so far as it began in times of increasing oil prices in the world market, so that the import oil bill went up drastically.

Oil production is clearly limited by insufficient reserves. Consequently, deep drilling activities shall be intensified, and the ultimate recovery of stocks is to be increased from 33 % to 40 %.

Production of lignite, however, is increasing. Most of it is produced at Rovinari (west of Bukarest). Total output amounted to 42 million tons in 1987, thus tripling the 1970 figure. Hard Coal output expanded from 6.5 million tons in 1970 to only 9 million tons in 1987. For 1990, the plan target concerning coal production has been set at 117 million tons, which is most certainly a unattainable target given the recent production figures (for instance, 60 million tons in 1988). Nevertheless, coal already is and will be the most important domestic energy form for Romania. In the past, nuclear power has never been promoted strongly. The official up-to-date capacity figures are stated as 4000 MW, and extension plans are proclaimed for the 1990s.

<sup>2</sup> Source: Deutsches Institut für Wirtschaftsforschung (DIW), *Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren*, Berlin, November 1989

**Table 2: Primary Energy Production**

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Hydro- power bill.kWh	Total PJ
1970	14.1	6.4	13.4	25.3	2.8	1683.8
1971	13.8	6.8	13.8	26.7	4.5	1771.5
1972	16.5	6.6	14.1	27.7	7.3	1869.0
1973	17.7	7.2	14.3	29.2	7.5	1948.7
1974	19.8	7.1	14.5	30.1	8.5	2014.2
1975	19.8	7.3	14.6	33.3	8.7	2130.7
1976	18.7	7.1	14.7	36.3	8.1	2213.3
1977	19.6	7.1	14.7	38.3	9.3	2200.7
1978	21.8	7.4	13.7	35.5	10.6	2209.7
1979	24.7	8.1	12.3	34.1	11.3	2153.5
1980	27.1	8.1	11.5	35.2	12.6	2171.8
1981	28.6	8.3	11.6	37.0	12.7	2260.5
1982	30.7	7.2	11.7	37.4	11.9	2269.2
1983	36.7	7.8	11.6	38.1	10.0	2336.5
1984	35.8	8.5	11.5	39.1	11.3	2389.0
1985	37.9	8.7	10.7	38.9	11.9	2387.7
1986	38.8	8.7	10.1	39.4	10.8	2381.9
1987	42.4	9.1	9.5	37.4	11.2	2328.9
in 1000 TOE						
1970	2703	3187	13131	20483	777	40282
1971	2643	3380	13538	21557	1261	42380
1972	3167	3292	13868	22327	2060	44712
1973	3383	3569	14024	23526	2117	46619
1974	3787	3538	14220	24263	2378	48186
1975	3785	3643	14320	26782	2443	50973
1976	3584	3541	14430	29121	2273	52949
1977	3756	3557	14380	28332	2620	52647
1978	4182	3694	13471	28543	2976	52863
1979	4718	4036	12095	27488	3179	51518
1980	4734	4012	11299	28368	3543	51956
1981	5002	4124	11430	29952	3572	54078
1982	5356	3579	11526	30502	3325	54286
1983	6414	3880	11380	31409	2816	55896
1984	6256	4210	11241	32267	3177	57152
1985	6622	4309	10521	32332	3337	57121
1986	6780	4328	9938	32904	3031	56982
1987	7409	4529	9330	31303	3143	55714

Source: Data Bank CMEA-Energy of DIW

#### **2.6.4 Exports and Imports of Energy<sup>3</sup>**

Until 1972, Romania was a net exporter of energy. However, especially in the second half of the seventies, the share of imported energy grew steadily, so that by the end of 1980 about 20 % of energy supply were imported. Due to foreign currency problems, restrictions were imposed on the energy imports in the eighties, so that the former import levels were not attained before 1987.

Energy imports first of all covered mineral oil products. They rose from 3 million tons in 1972 to 16 million tons in 1980. This was necessary in order to maintain the capacities of the domestic refineries, given the decreasing production of crude oil in the country. The exports of mineral oil products amounted to 10 million tons yearly in those days. In contrast to the other CMEA countries, Romania was unable to make use of the difference between internal CMEA accounting prices and world market prices through re-exporting Soviet oil, because the Soviet Union did not deliver oil to Romania at these internal prices until 1985. After 1985, however, world market prices for oil were lower than CMEA accounting prices.

Romania has intensified its trade relations with the USSR; besides oil, natural gas and electricity are increasingly imported. In 1987, imports from the Soviet Union accounted for a share of 16 % in Romania's primary energy consumption. In 1988, energy imports from the USSR were as follows: electricity 4 bill. kWh; natural gas 3.7 bill. m<sup>3</sup>.

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**3 Source: Deutsches Institut für Wirtschaftsforschung (DIW), Die Energiewirtschaft in den kleineren Mitgliedstaaten des Rates für Gegenseitige Wirtschaftshilfe-Entwicklungstendenzen in den achtziger Jahren, Berlin, November 1989**

**Table 3: Exports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t	Coke mill.t	Oil Products mill.t	Gas bill.m3	Electri- city bill.kWh	Total PJ
1970	0.0	0.0	0.0	5.4	0.2	2.4	261.3
1971	0.0	0.0	0.0	5.4	0.2	3.2	270.7
1972	0.0	0.0	0.0	5.1	0.2	3.7	265.3
1973	0.0	0.0	0.0	4.9	0.2	3.8	259.3
1974	0.0	0.0	0.0	6.6	0.2	3.1	320.0
1975	0.0	0.0	0.0	6.2	0.2	3.0	301.8
1976	0.0	0.0	0.0	7.8	0.2	2.1	361.7
1977	0.0	0.0	0.0	6.7	0.2	1.7	310.5
1978	0.0	0.0	0.0	7.6	0.2	1.8	345.6
1979	0.0	0.0	0.0	7.4	0.2	2.0	340.9
1980	0.0	0.0	0.0	8.8	0.2	0.0	375.5
1981	0.0	0.0	0.0	8.1	0.2	0.7	356.7
1982	0.0	0.0	0.0	6.4	0.2	0.9	286.2
1983	0.0	0.0	0.0	9.1	0.2	0.0	390.0
1984	0.0	0.0	0.0	10.4	0.0	0.0	438.1
1985	0.0	0.0	0.0	9.7	0.0	0.0	406.1
1986	0.0	0.0	0.0	10.0	0.0	0.0	419.1
1987	0.0	0.0	0.0	10.0	0.0	0.0	419.1
in 1000 TOE							
1970	0	0	0	5385	191	677	6251
1971	0	0	0	5383	191	902	6476
1972	0	0	0	5110	191	1048	6347
1973	0	0	0	4952	187	1065	6203
1974	0	0	0	6581	196	880	7655
1975	0	0	0	6191	184	844	7220
1976	0	0	0	7863	191	600	8653
1977	0	0	0	6761	194	474	7428
1978	0	0	0	7579	191	498	8268
1979	0	0	0	7416	191	550	8155
1980	0	0	0	8777	191	14	8983
1981	0	0	0	8146	191	196	8533
1982	0	0	0	6402	191	254	6847
1983	0	0	0	9141	191	0	9330
1984	0	0	0	10462	19	0	10481
1985	0	0	0	9715	0	0	9715
1986	0	0	0	10026	0	0	10026
1987	0	0	0	10026	0	0	10026

Source: Data Bank CMEA-Energy of DIW

**Table 4: Imports of Energy**

Year	Brown Coal mill.t	Hard Coal mill.t	thereof: Hard Coal mill.t	Coke mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy* bill.kWh	Total PJ
1970	0.0	3.3	0.7	2.6	2.3	0.0	0.0	0.0	186.0
1971	0.0	3.3	0.7	2.5	2.9	0.0	0.1	0.0	210.0
1972	0.0	3.4	1.8	2.6	2.9	0.0	0.4	0.0	219.0
1973	0.0	4.6	1.4	3.2	4.2	0.0	0.3	0.0	301.0
1974 <sup>†</sup>	0.0	4.5	1.9	2.6	4.5	0.0	0.8	0.0	317.0
1975	0.0	5.0	2.4	2.5	5.1	0.0	0.5	0.0	347.0
1976	0.0	5.4	2.6	2.8	8.5	0.0	0.7	0.0	503.0
1977	0.0	5.1	3.4	1.7	8.8	0.0	1.6	0.0	516.0
1978	0.0	6.0	4.7	1.4	12.9	0.0	0.3	0.0	694.0
1979	0.0	5.0	3.8	1.2	14.3	0.7	1.2	0.0	762.0
1980	0.0	6.7	3.9	2.8	16.0	1.6	0.5	0.0	901.0
1981	0.0	8.3	4.9	3.4	12.9	1.5	0.6	0.0	811.0
1982	0.0	6.9	4.2	2.7	10.9	1.5	0.6	0.0	688.0
1983	0.0	7.0	5.3	1.7	12.4	1.7	2.1	0.0	776.0
1984	0.0	8.8	7.0	1.8	13.5	1.8	3.1	0.0	879.0
1985	0.0	7.9	6.0	1.9	14.6	1.8	3.3	0.0	908.0
1986	0.0	8.8	7.0	1.8	13.5	2.5	3.0	0.0	903.0
1987	0.0	8.8	7.0	1.8	14.0	3.3	3.0	0.0	950.0
in 1000 TOE									
1970	0	2112	409	1703	2330	0	7	0	4450
1971	0	2110	416	1691	2899	0	19	0	5026
1972	0	2167	423	1744	2952	0	115	0	5234
1973	0	2916	761	2155	4208	0	69	0	7194
1974	0	2801	1050	1754	4550	0	220	0	7572
1975	0	3053	1356	1696	5098	0	141	0	8292
1976	0	3354	1471	1883	8497	0	191	0	12040
1977	0	3033	1931	1103	8868	0	440	0	12339
1978	0	3526	2620	907	12971	0	96	0	16593
1979	0	2957	2155	799	14335	584	347	0	18225
1980	0	4079	2215	1866	16002	1335	132	0	21550
1981	0	5038	2742	2297	12950	1251	155	0	19392
1982	0	4134	2356	1780	10928	1251	153	0	16469
1983	0	4122	2981	1141	12428	1419	600	0	18567
1984	0	5139	3950	1189	13536	1502	861	0	21038
1985	0	4658	3392	1263	14638	1502	914	0	21710
1986	0	5124	3926	1199	13536	2093	842	0	21595
1987	0	5124	3926	1199	14036	2722	842	0	22727

\* By definition, nuclear energy is treated as imported energy

Source: Data Bank CMEA-Energy of DIW

## 2.6.5 Primary Energy Consumption

Table 5: Primary Energy Consumption in Romania

Year	Brown Coal mill.t	Hard Coal mill.t	Oil mill.t	Gas bill.m3	Electri- city bill.kWh	Nucl. Energy bill.kWh	Total PJ
1970	14.1	9.7	10.3	25.1	0.4	0	1608.6
1971	13.8	10.1	11.3	26.5	1.3	0	1711
1972	16.5	10	12	27.5	4	0	1822.5
1973	17.7	11.8	13.5	29	4	0	1990.2
1974	19.8	11.6	12.5	29.9	6.1	0	2010.7
1975	19.8	12.3	13.5	33.1	6.2	0	2175.5
1976	18.7	12.6	15.3	36.1	6.7	0	2354.9
1977	19.6	12.2	16.8	35.1	9.2	0	2406
1978	21.8	13.4	19.1	35.3	9.2	0	2557.7
1979	24.7	13.2	19.2	34.6	10.6	0	2574.3
1980	27.1	14.8	18.7	36.6	13.1	0	2697.1
1981	28.6	16.6	16.4	38.3	12.6	0	2714.5
1982	30.7	14.1	16.3	38.7	11.5	0	2671.4
1983	36.7	14.8	14.9	39.6	12.2	0	2722.6
1984	35.8	17.3	14.5	40.8	14.4	0	2830.3
1985	37.9	16.6	15.6	40.7	15.2	0	2889.1
1986	38.8	17.5	13.6	41.9	13.8	0	2865.8
1987	42.4	17.9	13.5	40.7	14.2	0	2860
in 1000 TOE							
1970	2703	5299	10076	20291	108	0	38483
1971	2643	5490	11057	21366	376	0	40932
1972	3167	5459	11710	22136	1127	0	43600
1973	3383	6486	13280	23339	1122	0	47612
1974	3787	6342	12189	24067	1718	0	48102
1975	3785	6696	13227	26595	1742	0	52044
1976	3584	6892	15064	28930	1866	0	56336
1977	3756	6591	16488	28138	2586	0	57559
1978	4182	7218	18863	28351	2574	0	61188
1979	4718	6993	19016	27880	2978	0	61585
1980	4734	8093	18526	29511	3663	0	64523
1981	5002	9163	16234	31011	3531	0	64939
1982	5356	7713	16052	31562	3227	0	63908
1983	6414	8002	14667	32636	3414	0	65133
1984	6256	9349	14316	33751	4038	0	67709
1985	6622	8966	15442	33834	4251	0	69116
1986	6780	9454	13452	34997	3873	0	68559
1987	7409	9655	13344	34028	3986	0	68420

**Remark:** At 5 %, differences between EEC-UNO and DIW data for primary energy consumption are acceptable. EEC-UNO data can thus be used for final consumption. Most of the differences observed can be attributed to discrepancies in the figures for solid fuels, doubtless due to problems concerning equivalence coefficients. It should however be mentioned that Romania's own figures (including those covering its relations with other Eastern European countries) are generally considered to be highly unreliable. Data should thus be taken as estimates which can only give a general idea of the scale of the figures involved.

## 2.2.6 Electricity Production

Table 6: Power Generation and Energy used for Power Generation (Mtoe)

	Power Generation	Heat generation		
1971	3.0	9.2		
1972	3.1	10.4		
1973	3.4	11.1		
1974	3.5	11.7		
1975	3.9	12.9		
1976	4.3	14.1		
1977	4.4	14.8		
1978	4.6	15.7		
1979	4.6	15.9		
1980	4.7	16.3		
1981	4.9	17.3		
1982	4.9	15.9		
1983	5.2	13.4		
1984	5.2	16.2		
1985	5.2	16.2		
1986	5.6	16.9		
1987	5.4	17.3		
Energy used for power generation (in Mtoe) – Romania				
	Coal	Oil	Gas	Total
1971	3.9	1.2	10.0	2.9
1972	4.3	1.6	10.2	2.6
1973	4.7	2.0	10.8	3.0
1974	5.1	2.4	11.3	3.6
1975	5.1	2.9	11.6	2.9
1976	5.1	3.7	12.4	2.6
1977	5.4	4.3	12.3	2.9
1978	5.7	5.1	12.1	2.6
1979	6.3	4.6	11.5	1.8
1980	6.6	3.8	12.2	1.7
1981	6.7	4.1	12.7	1.2
1982	7.0	3.5	12.6	2.3
1983	7.9	3.8	13.0	6.2
1984	8.5	3.8	13.4	4.4
1985	8.5	3.9	13.4	4.5
1986	8.5	4.0	13.5	3.5
1987	(1)	(1)	(1)	-

(1) Not available



The basic feature of electricity production from fossil fuels during the eighties has been a certain stagnation (zero growth between 1983 and 1985). Production plans have never been fully attained. This had the notable result of a state of emergency and martial law being declared in 1985 covering the coal-fired power generation sector. A few figures give some idea of the extent of the gaps between production targets and reality. According to European energy report, production should have reached 82.5 TWh in 1985. In reality it was 71.8 TWh<sup>4</sup>. Electricity shortages mainly affect the housing sector, industry being given the highest priority (though this has not prevented power cuts from affecting industrial production). This situation is the result of several factors.

1. The non realization of targets in the field of nuclear power. The commissioning of the first nuclear reactor (of Canadian design) at Carnavoda, planned for the mid-eighties, has been constantly put back. Targets in this field for the year 2000 have been ambitious – the construction of 16 nuclear power stations. Apart from the fact that the targets would appear to be unrealistic, it is also possible that new priorities could be defined in the light of current changes in the political situation.
2. Problems affecting coal production have delayed the coal-based electricity generation programme (particularly as regards lignite). The use of coal has been envisaged in Romania particularly because of problems affecting gas production, gas being one of the main sources of energy for electricity production. In recent years, however, the Romanian authorities have had recourse to significant gas imports, from the Soviet Union in particular.
3. Finally, major financial constraints and Romania's strategy of debt repayment have affected the commissioning of new production capacity as well as the modernization of existing installations.

### Power Generation (TWh)

	1975	1980	1985	1986	1987	1988
Thermal	45	54.5	59.9	64.7	62.9	64.3
Hydro	8.7	12.6	11.9	10.8	11.2	11.0
Total	53.7	67.5	71.8	75.5	74.1	75.3

### Power Generation Capacity (GWh)

	1975	1980	1985	1986	1987
Thermal	8.9	12.7	15.2	15.3	16.3
Hydro	2.6	3.4	4.4	4.4	5.1
Total	11.6	16.1	19.6	19.7	21.4

4 "Profile Romania. Part II. Natural gas reserves exhaustion while electricity generation fails to meet demand", European energy report, n°292, p.9.

**Power Generation Capacity as of 1986/1987**

Type and location		2640
Coal-fired:	Turceni	1720
	Rovinari	1035
	Isalnita	1260
	Mintia	520
	Diocesti	300
	Others	95
All coal-fired		7570
All oil and gas fired		7760
Hydro		4500
All stations		19830

**2.6.7 Final Energy Consumption****Table 7: Final Energy Consumption**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	5.3	8.4	10.2	2.3	8.2	34.4
1972	5.3	8.8	9.8	2.6	9.4	35.9
1973	5.7	9.8	10.3	2.9	9.6	38.2
1974	5.8	8.3	10.0	3.2	10.6	37.9
1975	6.0	8.8	10.8	3.3	11.7	40.6
1976	6.2	10.0	12.0	3.7	13.0	44.9
1977	6.3	10.2	12.3	4.0	13.7	46.5
1978	6.3	10.7	12.3	4.2	14.6	48.1
1979	6.6	12.8	12.7	4.3	14.8	51.2
1980	6.8	12.2	13.9	4.5	15.1	52.5
1981	6.7	11.4	14.9	4.7	16.2	53.8
1982	7.0	10.9	14.7	4.6	14.9	52.2
1983	7.1	9.6	15.2	4.8	12.5	49.2
1984	8.1	8.9	16.0	5.0	15.3	53.3
1985	8.1	10.0	16.0	5.0	15.2	54.3
1986	8.1	10.6	16.3	5.3	15.9	56.2
1987	(1)	(1)	(1)	5.3	(1)	-

(1) Not available

With a level of final energy consumption of the order of 56 Mtoe in 1986, and an energy intensity of roughly 862 koe/1000 \$80, Romania is a major Eastern European energy consumer. Its level of consumption has, however, slowed down significantly during the eighties: 1.3 % growth on average from 1980 to 1986 as opposed to 5.8 % between 1971 and 1980. A clear slow down can also be seen in energy consumption in the housing-service-agriculture sector. It should be emphasized that the housing sector has suffered the most from energy restrictions under CEAUSESCU: the limiting of heating to 12°C in winter being but one example.

More than in any other country, final energy consumption is dominated by industry.

**Table 8: Structure of Final Energy Consumption by Sector in 1986 (%)**

Industry	Transport	Housing–Service–Agriculture	Total
69.7	4.1	26.2	100

This structure is the result of Romania's industrialization strategy. In particular, the country has developed major refinery and petrochemical programmes as essential sources of foreign currency. It has tried to develop its refinery sector in order to increase oil exports. This strategy has, however, turned out to have its own constraints. The fall in oil production forced Romania to commit itself to imports from OPEC countries – paid for with foreign currency at international rates. The chemical and refining industries have nevertheless remained priorities within Romania's industrialization programme. A few figures can be given concerning the refining industry. Romanian refinery capacity is of the order of 33 million tons per year and is based mainly at Pitesti, Brazi, Ploesti, Borzesti, etc. Secondary refining processes are relatively well-developed in Romania as compared with other Eastern European countries. However, the Romanians would appear to have encountered a certain number of difficulties in pursuing their programme of modernization of the refining industry during the eighties.

Such a strategy along with the country's reserves of hydrocarbons explain the importance of oil and natural gas in final energy consumption.

**Table 9: Structure of Final Energy Consumption by Energy Form in 1986 (%)**

Coal	Oil	Gas	Electricity	Heat–steam	Total
14.4	18.9	29.0	9.4	28.3	100

Financial constraints have limited Romania's capacity to import oil, forcing it to impose very strong restrictions on consumption, particularly in the transport sector. With the exception of 1980 and 1982, oil consumption in this sector was largely below the level of the seventies. For this reason V. Merkin emphasizes the fact that diesel consumption for rail transport fell by 11.4 % between 1975 and 1983<sup>5</sup>.

<sup>5</sup> V. Merkin, *Petroleum conservation in Eastern Europe, Part II*, Delphis Associates, 1988, p.307.

**Table 10: Industrial Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	1.7	3.9	6.8	1.8	7.1	21.3
1972	1.8	4.0	6.3	2.0	8.1	22.0
1973	2.1	4.4	6.2	2.2	8.2	23.0
1974	2.1	3.3	6.0	2.5	9.1	23.0
1975	2.4	3.5	6.8	2.7	10.0	25.4
1976	2.6	3.9	7.4	2.9	11.0	27.9
1977	2.6	4.5	7.3	3.1	11.5	29.1
1978	2.6	5.2	7.1	3.3	12.2	30.5
1979	2.9	7.1	7.1	3.4	12.3	32.8
1980	3.0	6.2	7.5	3.6	12.4	32.7
1981	3.0	5.8	8.0	3.7	13.3	33.7
1982	3.0	5.1	7.9	3.6	12.1	31.8
1983	3.1	4.0	8.2	3.7	10.1	29.1
1984	3.6	3.8	8.6	3.9	12.2	32.2
1985	3.6	4.3	8.6	3.9	12.0	32.4
1986	3.6	4.6	8.8	4.2	12.6	33.7
1987	(1)	(1)	(1)	4.2	(1)	-

(1) Not available

**Table 11: Transport Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	0.6	2.0	0.0	0.1	0.0	2.7
1972	0.6	2.2	0.0	0.1	0.0	2.8
1973	0.5	2.3	0.0	0.1	0.0	2.9
1974	0.5	1.9	0.0	0.1	0.0	2.4
1975	0.2	2.0	0.0	0.1	0.0	2.3
1976	0.2	2.4	0.0	0.1	0.0	2.7
1977	0.2	2.1	0.0	0.1	0.0	2.4
1978	0.2	1.9	0.0	0.1	0.0	2.2
1979	0.2	1.9	0.0	0.1	0.0	2.2
1980	0.3	2.2	0.0	0.2	0.0	2.7
1981	0.3	1.6	0.0	0.2	0.0	2.0
1982	0.3	2.1	0.0	0.2	0.0	2.5
1983	0.3	1.8	0.0	0.2	0.0	2.3
1984	0.3	1.5	0.0	0.2	0.0	2.0
1985	0.3	1.7	0.0	0.2	0.0	2.2
1986	0.3	1.8	0.0	0.2	0.0	2.3
1987	(1)	(1)	(1)	0.2	(1)	-

(1) Not available

**Table 12: Housing–Service–Agriculture Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	3.0	1.2	1.5	0.5	1.1	7.3
1972	2.9	1.3	2.0	0.6	1.3	8.1
1973	3.1	1.6	2.5	0.6	1.3	9.2
1974	3.2	1.6	2.3	0.6	1.5	9.2
1975	3.4	1.6	2.4	0.6	1.8	9.7
1976	3.4	1.8	2.7	0.7	1.9	10.5
1977	3.5	1.8	2.7	0.7	2.2	10.9
1978	3.4	1.7	2.8	0.8	2.3	11.1
1979	3.4	1.8	3.0	0.8	2.5	11.6
1980	3.5	1.9	3.5	0.8	2.7	12.3
1981	3.5	2.1	3.7	0.8	2.9	13.0
1982	3.7	2.1	3.7	0.8	2.8	13.1
1983	3.7	1.9	3.8	0.9	2.4	12.7
1984	4.2	1.8	4.0	0.8	3.1	13.9
1985	4.2	2.1	4.0	0.9	3.2	14.3
1986	4.2	2.2	4.1	0.9	3.3	14.7
1987	(1)	(1)	(1)	0.9	(1)	-

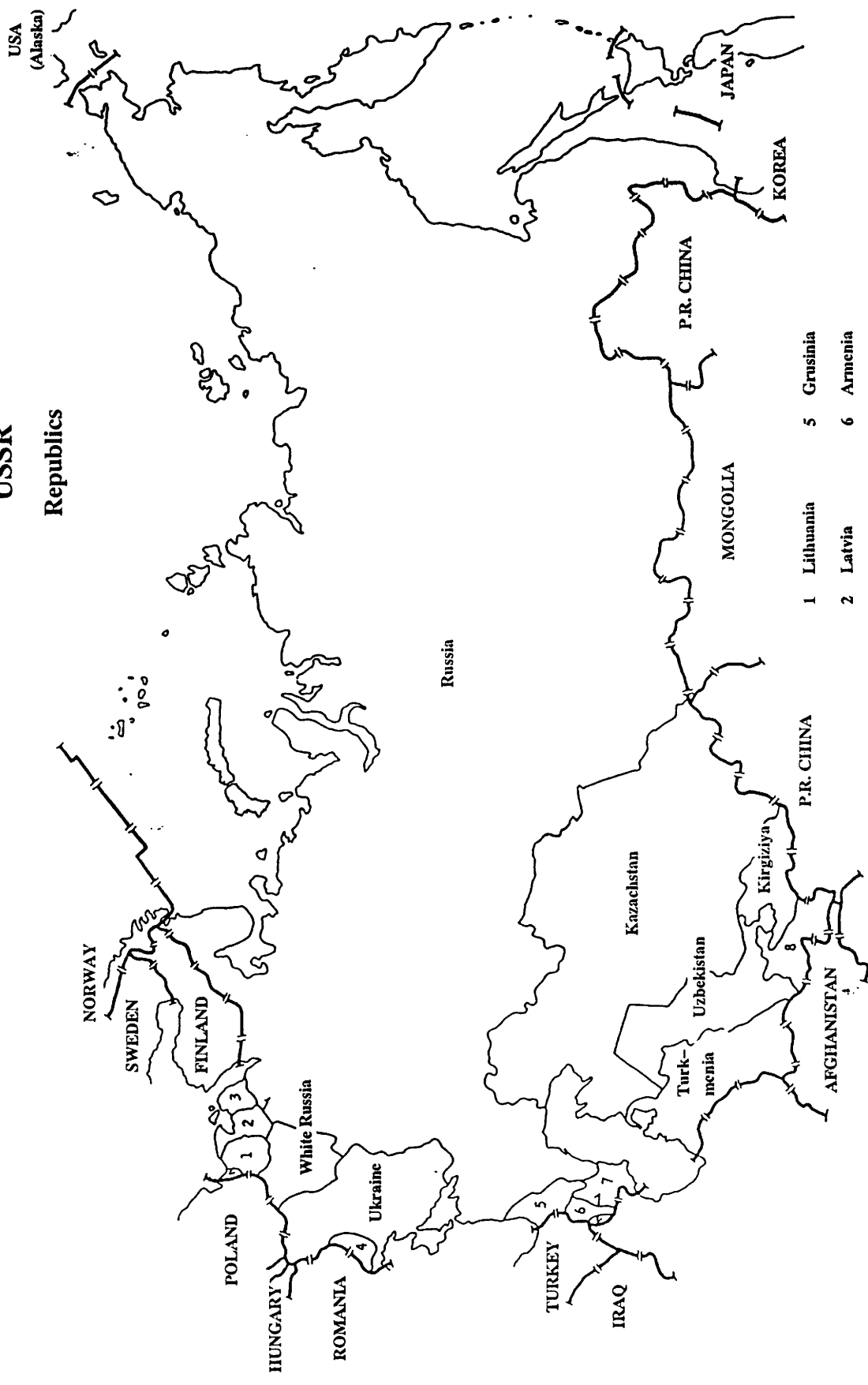
(1) Not available

**USSR**

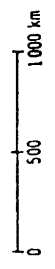
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# USSR Republics



- |   |           |   |              |
|---|-----------|---|--------------|
| 1 | Lithuania | 5 | Grusinia     |
| 2 | Latvia    | 6 | Armenia      |
| 3 | Estonia   | 7 | Azerbaïdjan  |
| 4 | Moldaviya | 8 | Tadzhikistan |



**GOPA**

Statistisches Bundesamt 87 0087



## 2.7 USSR

## 2.7.1 Selected Economic Indicators (1988)

- GDP per capita (PPP-concept, 1980 prices) (EEC range: 4810 to 12040 US\$)	5810 US\$
- Population and Employment	
. Resident Population	286.7 mill.
. Total employment (1987) (men 16-59 years, women 16-54 years)	56.2 %
. Workers and Employees	117.2 mill.
. Kolchosniki in the Social Sector Production	11.7 mill.
. Percentage of Female Workers and Employees (1987)	50.6 %
. Percentage of Female Kolchosniki (1987)	45.1 %
. Employment Ratio	46 %
. Population Density (Persons per km <sup>2</sup> )	12.8
. Growth of Population	0.8 %
. Sectoral Employment Shares	
Agriculture and Forestry	19 %
Industry and Construction	39 %
Transport, Post and Communication	8 %
Trade and Community Supply	8 %
Health, Sports, Social Affairs, Education, Culture, Arts and Science	19 %
Administration, Credit Facilities and Social Assurance	2 %
Other Sectors	5 %
- Sectoral Output Shares (1987)	
. Agriculture	19.3 %
. Industry	35.2 %
. Productive Services	25.7 %
. Non-productive Services	19.8 %
- Selected Natural Resources and Basic Materials Production	
. Iron Ore	250.0 mill. t
. Steel	163.0 mill. t
. Manganese Ore	9.1 mill. t
. Chrome Ore	3000 thousand t
. Mineral Fertilizer	37.1 mill. t
. Cement	139.0 mill. t
. Chemical Fibers	1.6 mill. t

### 2.7.2 National Energy Resources

The Soviet Union possesses the biggest coal reserves in the world. About 80 % of these reserves are to be found in the Asian part of the country, mostly in Siberia. The estimates concerning the potential coal stocks vary between  $5.7 \cdot 10^{12}$  and  $6.8 \cdot 10^{12}$  tons; the proved reserves amount to 250 billion tons with hard coal holding a share of 58 %. The reserves known up to now are in the magnitude of about 240 billion tons (170 million toe) for hard coal and about 90 billion tons for brown coal. In the European part of the USSR, the most important coal stocks are located in the areas of Donezk, Petshora, Moscow, Dnjepr and Lwow. In the Ural Region main stocks are at Tsheljabinsk, Kiseljorsk and in Southern Ural. In Kazakhstan the biggest reservoirs are in Ekibastuz, Karaganda, Maikjuben and Turgai. In West Siberia, only the Kuznezsk district has to be mentioned, whereas in East Siberia many very important districts have been developed, among which the biggest one is at Kansk-Atshinsk where about 1.2 billion tons of brown coal are supposed to be found.

The territory of the USSR is rich in crude oil. The most important field lies in the area of Tjumen (West Siberia), others are in Azerbajdzan, Kazakhstan, Komi ASSR, Udmurtian ASSR, Tshetsheno-Ingusetian ASSR, Bashkirian ASSR, Perm, Kujbyshev, Orenburg, Ukraine, Uzshbekistan, White Russia, Grusinia and Turkmenia, in the depths of the Black Sea, Caspian Sea and nearby Sachalin Island. The total reserves in the West Siberian regions are estimated at several billion tons; however, since the late 1940s, Soviet officials do not publish any meaningful figures on crude oil reserves. Instead, they pretend that the largest oil fields still have to be investigated in West Siberia. For instance, the Tjumen area, which covers more than 1 million km<sup>2</sup>, is said to have been explored to the extent of 20 % only.

In the second half of the eighties, 77 new oil fields had to be investigated in West Siberia, others in East Siberia, Archangelsk and in the Caspian Sea (according to a statement in the Pravda from 3rd March, 1986).

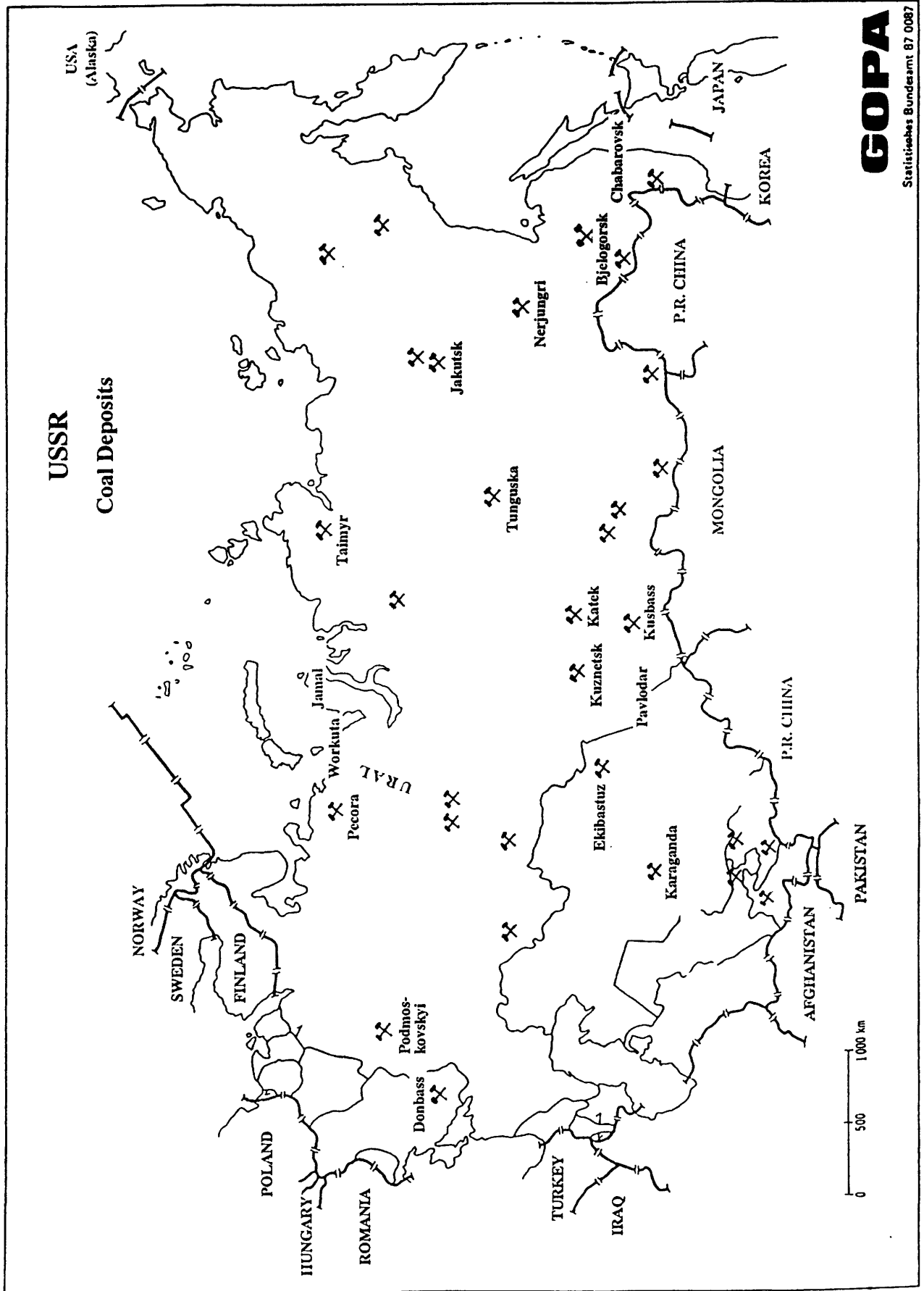
The Soviet stocks of natural gas are considered to be the largest in the world. The potential gas reserves are estimated at  $100 \cdot 10^{12}$  m<sup>3</sup>; 40 % of them are located in West Siberia. The proved and probable reserves currently account for  $30 \cdot 10^{12}$  to  $40 \cdot 10^{12}$  m<sup>3</sup>; this corresponds to one third of worldwide gas reserves. More than 80 % of these reserves are located in the Asian part of the USSR. Among the most important locations where natural gas has been found up to now are Medveze, Urengoj, Vyngapur, Yamburg and Komsomolsk, all of them belonging to the Northern parts of West Siberia (Tjumen region). There, total gas reserves are estimated at about  $18 \cdot 10^{12}$  m<sup>3</sup>, with the Urengoj field alone having a share of more than  $5 \cdot 10^{12}$  m<sup>3</sup>.

In 1989, two important gas fields have been found: one in the Barents Sea (Shtokmanovskaya) 400 km north of Murmansk, the other one in the Kara Sea east of Novaja Zembja (Russanovskaya).

Other important gas-carrying regions are in Turkmenia, Uzbekistan, Baskiria, West- and South-East Ukraine, Transkaukasias and South-West Ural (Orenburg).

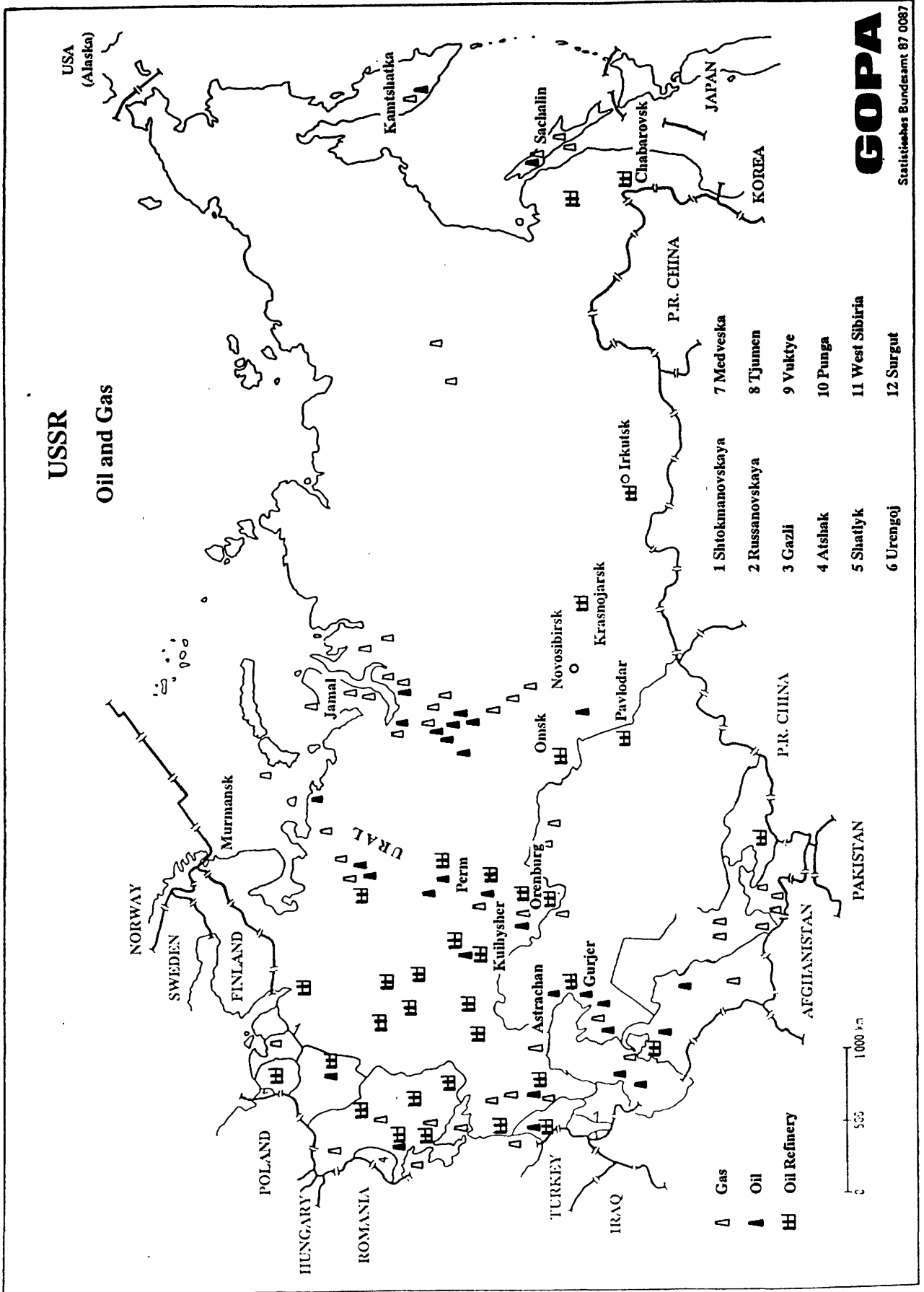
Due to its military importance, data on uranium (stocks, geographical distribution, processing capacities, etc.) are not available from the Soviets. International experts assume that the reserves of uranium which can be mobilized at costs of up to US\$ 35 per kg amount to 1 million tons (which is about 17 % of worldwide reserves). Stocks of uranium ore are estimated at 4 to 5 million tons.

Approximately 12 % of the hydropower potential of the world are located in the USSR. Officials estimate this potential at 900 mill. MWh of electrical energy annually. One third of the resources are located in the Far East, where only 2 % of the economic potential is being exploited. In the European part of the USSR this factor is close to 50 %. With an installed hydropower capacity of 64 GW in 1988, this renewable energy source covered 13.5 % of the total electricity generation. Nationwide, only 20 % of the economically exploitable sources are utilized.



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### 2.7.3 Primary Energy Production

During the 5-year-plan period 1981–1985, shortfalls in nearly all primary energy production targets were recorded. For the final year of the plan period, 1985, the production performance looked as in table 1. The overall achievement rate was 96%, but in some areas the targets were missed by larger margins (especially coal and nuclear energy).

**Table 1: Production of Primary Energy in the USSR  
Target of the 5-Year-Plan and Production in 1985**

	Unit	Plan	Prod.	Difference	Achieved %
Coal (net)	mill. t	700	648	-52	92.6
Oil	mill. t	630	595	-35	94.4
Gas	bill. m <sup>3</sup>	630	643	+13	102.1
Nuclear	bill. kWh	220	167	-53	75.9
Hydro	bill. kWh	230	215	-15	93.5
Total <sup>1)</sup>	mill. TCE	2.323	2.232	-91	96.1

1) incl. wood, peat, slate

Source: DIW – Vierteljahreshefte zur Wirtschaftsforschung 1987

This poor performance is also reflected by the time series of annual growth rates of primary energy production, which are given in the following:

1971 – 1975:	5.3 %	
1976 – 1980:	4.2 %	
1981 – 1985:	2.6 %	
1986 – 1990:	3.6 %	(plan figure)

In 1986, however, the trend shifted towards a sustained increase in energy production (with the exception of nuclear energy), and in 1987/88 this development even was enforced by further significant output growth rates, as can be deduced from the following tables:

**Table 2: Primary Energy Production in the USSR  
(Million tons oil equivalent, 1970–1990)**

	1970	1980	1985	1986	1987	1990 (Plan)
Oil	353	603	595	615	624	635
Gas	163	360	520	555	588	688
Coal	303	334	308	318	322	360
Hydro	32	42	49	49	50	51
Nuclear	1	17	38	37	46	73

Source: Narodnoye Khozyaistvo 1987, Pravda

**Table 3: Planned and Actual Primary Fuel Production in the USSR (1987 and 1988)**

	1987		Jan.-June 1988	
	Plan	Production	Plan	Production
Oil (mt)	617	624	307.7	312
Natural Gas (bcm)	712	727	372.5	383
Coal (mt)	744	760	378.5	393

Source: Pravda July 24, 1988

The growth rate of primary energy production peaked at about 4.4 % in 1986. The decline in crude oil production was stopped and an increase of 20 million tons was realized. Thus, with a production volume of 615 million tons, the Soviet Union remained first rank of oil-producing countries (with a share in the world output amounting to 21 % in 1986). In the following years, oil production figures were once again raised to 617 and 624 million tons. It is worthwhile to mention that by the end of 1986 oil output from West-Siberian fields was well above the plan targets. Many of the large fields there have already passed their production ceiling so that more and more smaller fields have to be exploited, which makes production more difficult and expensive.

Production of natural gas is on an expansionary path. In 1988, gas production amounted to 770 billion m<sup>3</sup>, thus clearly exceeding the target of 767 billion m<sup>3</sup>. By early 1989, natural gas for the first time surpassed oil as the USSR's major fuel and gained a share of around 38 % of Soviet primary energy production.

In contrast to crude oil production, natural gas production is increasingly based on the exploitation of large new fields. The incremental output of 210 billion m<sup>3</sup>, which is to be generated in 1986-1990, shall mostly come from the gas fields in Yamburg, where production started in 1986.

The long-lasting crisis of the Soviet coal industry was put to an end in 1985, when the coal production reached its 1980 level after some years of recession. In 1986, coal (gross) output amounted to 751 million tons, thus exceeding the target by 17 million tons. In 1987 and 1988 production levels were also well above the plan targets. However, in fall 1989, huge strikes in the mining sector took place, which dampened coal output figures significantly. The miners asked for an increase in the subsidies for the mining sector, which are now estimated at 1.4 billion roubles annually.

During the 12th Five-Year-Planning-Period 1986-1990 coal production is to be increased especially in the East of the country, i.e. in Kusnezsk, Ekibastus and Kansk-Atschinsk. Besides these districts, mining in Donezk is of great importance, as can be seen from the following table:

**Table 4: Regional Distribution of the Soviet Coal Production  
(Mill. t Gross Production)**

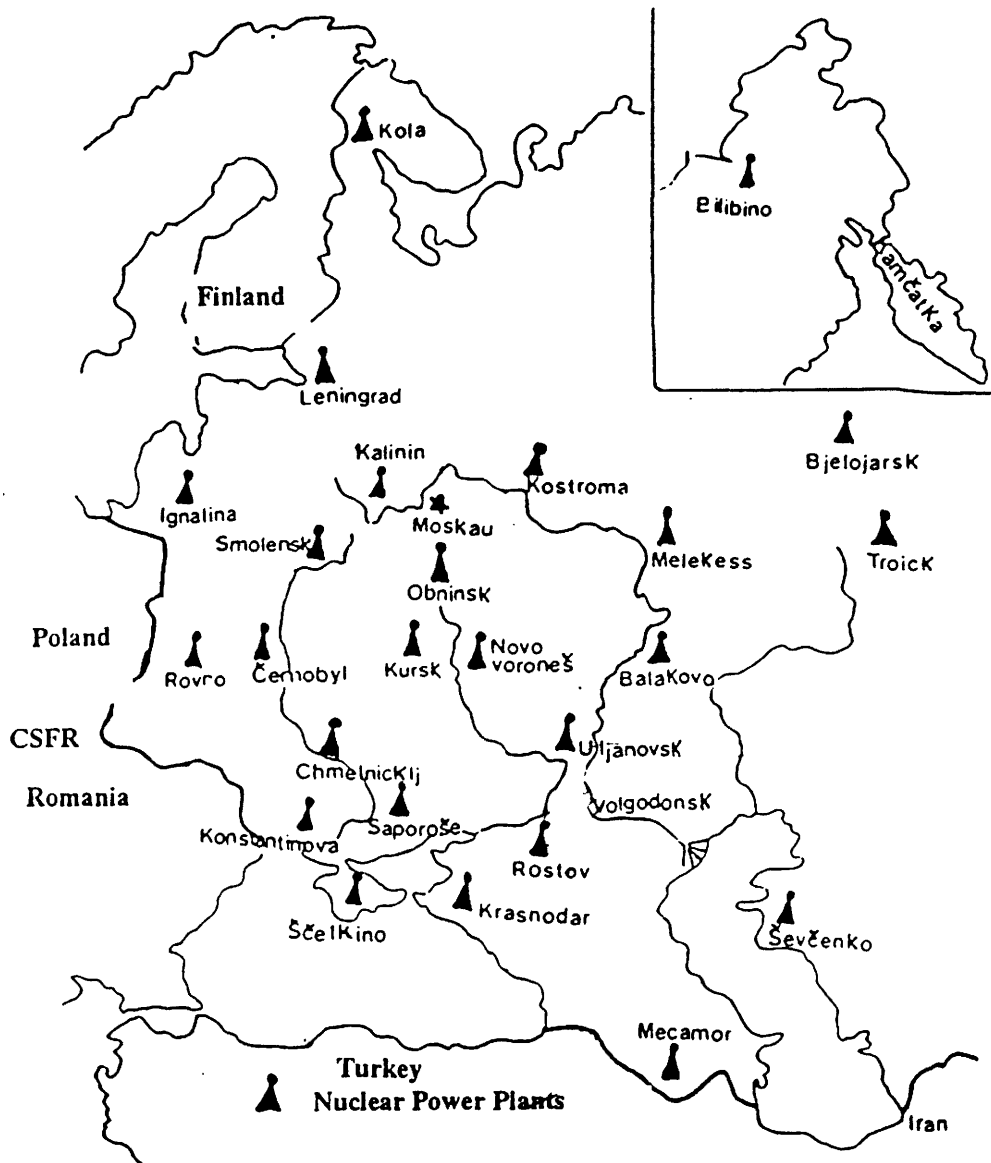
	1980	1985	1990 <sup>1)</sup>	1985-1990
USSR (total)	716	726	795	69
Underground mining	445	421	429	8
Open-pit mining	271	305	366	61
Kusnezsk	145	145	160	15
Ekibastus	67	81	96	15
Kansk-Atschinsk	28	41	65	24
Donezk	204	197	193	-4
Others	272	262	281	19
1) Plan				

Sources: Theodore Shabad: News Notes. in: Soviet Geography, April 1986, p. 266, and Energija, No. 12/1986, p. 2

In Kusnezsk, coal is of very good quality with net heating values between 7,000 and 8,500 kcal/kg, whereas in Ekibastus the figure is only about 4,200 kcal, and the brown coal of Kansk-Atschinsk is of even poorer quality with just 3,000 to 3,400 kcal/kg. In Donezk, about 80 % of coal output is coke coal.



Figure 1: Nuclear Power Plants in the USSR



Source: H. Liely, Die Energiewirtschaften sozialistischer Länder (forthcoming)

The projection that nuclear energy will hold a 5 %–share in total primary energy production by the end of 1990 is most probably too optimistic. Instead of a projected capacity of 70,000 MW for 1990 only about 50,000 MW can be expected due to time-consuming modifications in the construction of the plants according to new safety regulations and due to bottlenecks in supplying the necessary components.

The complete plan targets established in 1986 for primary energy production in 1990 are given in the following table:

**Table 5: Production of Primary Energy in the USSR:  
Targets of the 5-Year-Plan for 1990 Compared to 1985**

	Increase in 1990/85 Unit	Production 1985	Plan 1990	Mill. tce	%
Coal (net) <sup>1)</sup>	mill. t	648	715	46	10.3
Coal (gross)	mill. t	726	795	46	9.5
Oil	mill. t	595	635	57	6.7
Gas	bill. m <sup>3</sup>	643	850	246	32.2
Nuclear	bill. kWh	167	390	74	133.5
Hydro	bill. kWh	215	245	10	14.0
Others <sup>2)</sup>	mill. tce	39	40	1	2.6
Total	mill. tce	2,232	2,666	434	19.4
1) Net production for 1990 estimated (= 90 % of the gross production)					
2) Wood, peat, slate; 1990 estimated					

Sources: Narodnoe chozjajstvo SSSR; Pravda, 19th June 1986

Solar radiation only is sufficient for energy production in the southern parts of the USSR. One solar-thermal power plant with a production of 10 Mill. kWh annually is installed, further ones with capacities of up to 320 MW are being planned. Approximately 100 projects deal with photovoltaics (maximum 500 Wp).

Geothermal energy is used for heating purposes and electricity generation mainly in agriculture and on a local basis. A 5 MW power plant is operated on Kamchatka for 20 years, another one south of Petropavlosk was built in 1985 and has a capacity of 150 MW: Further geothermal power plants with capacities up to 500 MW are under construction.

Windpower plays a minor role in agricultural applications. The windpower potential, especially along the coastlines, is considerable.

**Table 6: Soviet Primary Energy Production by Source of Energy  
1970-1990**

Year	Oil <sup>1</sup> mill. t	Gas bill.m <sup>3</sup>	Coal <sup>2</sup> mill. t	Nuclear bill. kWh	Hydro mill. tce	Total mill. tce
1970	353	198	577	4	94	1.236
1971	377	212	592	8	95	1.297
1972	400	221	604	11	97	1.352
1973	429	236	615	16	96	1.420
1974	459	261	631	22	93	1.502
1975	491	289	645	24	96	1.596
1976	520	321	654	29	92	1.679
1977	546	346	663	42	99	1.763
1978	572	372	664	45	101	1.835
1979	586	407	658	55	106	1.901
1980	603	435	653	73	103	1.959
1981	609	465	638	86	109	2.003
1982	613	501	647	96	100	2.052
1983	616	536	642	110	102	2.102
1984	613	587	636	142	106	2.169
1985	595	643	648	167	110	2.232
1986	615	686	673	161	108	2.330
1987	624	727	670	187	114	2.372
1988	624	770	681	216	120	2.405
1990*	635	850	715	390	121	2.666

\* target

1 including gas condensate production

2 net production

Source: DIW - Wochenbericht 42/87 and internal sources

**Table 7: Soviet Primary Energy Production by Source of Energy Development and Shares, 1970-1990**

Year	Total		Share in %					
	mill. tce	Change %	Oil	Gas	Coal	Nuclear	Hydro	Others
1970	1,236	4.9	40.9	19.1	32.0	0.2	3.3	4.3
1975	1,596	5.3	44.0	21.6	27.9	0.5	2.6	3.4
1980	1,959	4.2	44.0	26.4	23.1	1.2	3.1	2.1
1981	2,003	2.2	43.5	27.7	22.0	1.4	3.1	2.4
1982	2,052	2.5	42.7	29.0	21.8	1.6	2.8	2.1
1983	2,102	2.4	41.9	30.3	21.2	1.7	2.8	2.0
1984	2,169	3.2	40.4	32.2	20.3	2.2	3.1	1.8
1985	2,232	2.9	38.2	34.3	20.2	2.5	3.2	1.8
1986	2,330	4.4	37.8	35.0	20.2	2.3	3.1	1.7
1987	2,372	1.8	37.2	35.7	19.7	2.6	3.1	1.6
1990*)	2,666	3.6	34.1	38.0	18.6	4.8	3.0	1.5

\*) target

Source: DIW-Vierteljahreshefte zur Wirtschaftsforschung 1987

#### 2.7.4. Exports and Imports of Energy

The sale of natural gas to West European countries started in 1968 and within a decade it became the second major item of Soviet exports for hard currency. Today, the USSR has a very well developed system of gas exporting pipelines. Capacities of Orenburg-Uzhgorod (Soyuz), Urengoy-Uzhgorod, Yamburg-West Border of the USSR and other gas mains are considerably larger than the current natural gas exports to East and West Europe. One more export trunkline - Yamal-Torzhok-Uzhgorod - will be constructed in the early 1990s.

**Table 8: Soviet Export Revenues from Selected West European Countries (in Mill. Roubles)**

	1985			1986		
	Total	Oil	Gas	Total	Oil	Gas
Austria	805	159	467	540	64	297
Belgium	858	506	-	627	267	-
Federal Republic of Germany	3,991	2,132	1,379	2,720	1,013	1,263
France	2,175	1,297	698	1,541	748	571
Italy	2,468	1,600	621	1,580	911	408
Netherlands	986	891	-	576	475	-
United Kingdom	1,217	360	-	274	305	-
<b>Total non-CMEA Europe</b>	<b>20,013</b>	<b>11,580</b>	<b>3,740</b>	<b>13,558</b>	<b>6,045</b>	<b>2,882</b>

Source: USSR Foreign Trade in 1986

As the above table shows, oil and gas dominate Soviet exports to Western Europe, in 1985 representing over 76 % of export balance. Their share even exceeded 90 % in the balances of export to the Federal Republic of Germany, France, Italy and the Netherlands. But the 1986 decline in oil prices gravely affected export revenues. In one year, hard currency earnings from exports to Western Europe decreased by 6.5 billion roubles (about 1986 US\$ 10 billion). This trend continued through 1987, but the first half of 1988 showed an increase in export revenues.

The Soviet foreign trade authorities tried to compensate for the losses in export revenues by increasing sales quantities. The total Soviet export of crude oil jumped from 117 million tons in 1985 to 144 million tons in 1988 and that of oil products and synthetic liquid fuel from 49.7 to 61.0 million tons. Gas exports increased considerably from 68.7 to 88.0 billion m<sup>3</sup> (see table below)<sup>1</sup>.

1) Michail B. Korchemkin, Energy Strategy based on Gas, in Petroleum Economist, Oct. 1988

**Table 9: Soviet Energy Exports (1970 - 1988)**

	1970	1980	1985	1986	1987	1988
Crude (mt)	66.8	119.0	117.0	130.0	137.0	144.0
Products (mt)	29.0	41.3	49.7	56.8	59.2	61.0
Gas (bcm)	3.3	54.2	68.7	79.2	84.4	88.0
Coal (mt)	24.5	25.3	28.3	33.5	35.5	39.4
Coke (mt)	4.2	3.8	2.9	2.6	2.2	2.3
Electricity (TWh)	5.3	19.9	29.3	30.2	34.9	38.9

Source: Narodnoye Khozyaistvo 1987

Total export revenues from oil and gas (in million roubles) were as follows in 1985-87:

**Table 10: Total Soviet Export Revenues from Oil and Gas (1985-1987)**

	Oil	Gas	Total
1985	28,200	7,695	35,895
1986	22,500	7,358	29,858
1987	22,800	6,382	29,182

Source: USSR Foreign Trade in 1987

In total, the USSR exported in 1986 about 390 million tce, which is equal to the Federal Republic of Germany's annual energy consumption! With regard to the consumption of mineral oil and natural gas in the EC-countries, the respective imports from the USSR accounted for 13.7 % and 14.5 % in 1986. Both oil and gas are increasingly exported, especially to countries of the Western hemisphere: According to already existing contracts with these countries, natural gas exports to them will soon increase by 40 % (thus reaching 55 billion m<sup>3</sup> p.a.) and oil exports to them are about to approach approx. 90 million tons. In 1989, however, export performance was rather bad, especially with regard to oil products. Consequently, this led to a further worsening of the balance of payment situation. Given the foreign indebtedness of the Soviet Union of 44 billion US\$, this has caused serious economic problems.

In terms of value, 10 % of the Soviet imports from non-socialist countries were energy imports in 1986; the corresponding percentage for socialist countries was 2 % (first of all imports of hard coal from Poland amounting to about 12 million tons per year). Several non-socialist countries deliver oil and gas to the USSR; the estimated yearly quantity of oil imports being 25 million tons, which come from Libya, Iraq, Algeria and Saudi Arabia. Afghanistan is the only gas exporter to the Soviet Union (2.5 billion m<sup>3</sup> p.a.).

**Table 11: Exports and Imports of Energy\***

Country/Region	1970	1975	1980	1984	1985	1986	1970	1980	1986
<b>Mineral Oil Exports</b>	<b>in mill. tons</b>						<b>in %</b>		
<b>Total</b>	95.8	130.4	161.8	180.1	164.9	179.0	100.0	100.0	100.0
<b>thereof:</b>									
<b>Socialist Countries</b>	50.4	77.7	96.2	89.4	86.7	89.7	52.6	59.5	50.1
<b>thereof: CMEA</b>	46.9	72.1	90.0	82.7	81.6	84.2	49.0	55.6	47.0
<b>OECD countries</b>	41.4	45.8	59.6	81.2	67.4	77.5	43.2	36.8	43.3
<b>thereof: EC</b>	23.3	27.8	39.4	60.2	48.8	55.2	24.3	24.4	30.8
<b>Developing countries</b>	3.6	4.5	5.9	9.2	10.5	11.5	3.8	3.6	6.4
<b>Natural Gas Exports</b>	<b>in bill. m3</b>						<b>in %</b>		
<b>Total</b>	3.3	19.3	57.2	69.5	71.0	83.1	100.0	100.0	100.0
<b>thereof:</b>									
<b>Socialist countries</b>	2.3	11.2	31.4	37.7	38.0	43.4	69.7	54.9	52.2
<b>thereof: CMEA</b>	2.3	11.2	29.5	33.8	34.1	39.5	69.7	51.6	47.5
<b>OECD countries</b>	1.0	8.0	25.7	31.7	32.9	39.6	30.3	44.9	47.7
<b>thereof: EC</b>	0.0	5.4	21.8	26.9	27.9	34.4	0.0	38.1	41.4
<b>Total Energy Exports (in mill. tce)</b>	n.a.	n.a.	327	370	354	390			
<b>Total Energy Imports (in mill. tce)</b>	n.a.	n.a.	19	45	42	52			

\* Source: DIW-Wochenbericht 42/87

## 2.7.5 Primary Energy Consumption

Table 12: Primary Energy Consumption

Year	Total		Shares					
	Mtce	Growth rate	Oil	Gas	Coal	Nuclear Energy	Hydro-power	Others
1970	1084	4.8	34.4	21.7	35.1	0.3	3.6	4.8
1975	1377	4.9	37.8	24.1	30.9	0.6	2.7	3.9
1980	1650	3.7	38.8	27.5	26.5	1.5	3.3	2.5
1981	1679	1.8	38.6	28.5	25.2	1.7	3.3	2.8
1982	1729	3	37.6	30.2	25.1	1.8	2.9	2.5
1983	1777	2.8	36.5	31.7	24.5	2	2.9	2.4
1984	1857	4.5	35.1	33.6	23.5	2.5	3.2	2.1
1985	1925	3.6	33.4	35.6	22.9	2.9	3.2	2
1986	1977	2.7	33.2	36.3	22.9	2.7	3	2
1987	2028	2.6	32	38	23.1	3	2.8	1.1



## 2.7.6 Electricity Production

Table 13: Power Generation and Energy used for Power Generation (in Mtoe)

	Power Generation	Heat generation		
1971	57.4	131.5		
1972	62.4	138.3		
1973	66.9	151.0		
1974	70.9	167.7		
1975	76.7	177.3		
1976	81.6	181.2		
1977	83.2	189.1		
1978	84.9	198.3		
1979	87.0	210.9		
1980	89.2	227.5		
1981	90.6	232.5		
1982	94.2	237.6		
1983	97.0	238.9		
1984	98.6	261.9		
1985	99.9	246.5		
1986	105.1	252.6		
1987	108.1	(1)		

(1) Not available

Energy used for power generation (in Mtoe) – Soviet Union				
	Coal	Oil	Gas	Total
1971	151.2	66.2	75.1	103.5
1972	155.7	76.3	80.0	111.3
1973	161.8	87.9	91.5	123.3
1974	164.4	91.5	100.5	117.8
1975	167.0	95.3	113.7	122.0
1976	168.7	99.3	128.2	133.4
1977	171.4	103.4	141.5	144.0
1978	175.7	107.7	147.8	148.0
1979	174.4	119.1	159.1	154.6
1980	171.1	131.7	162.0	148.1
1981	166.7	133.3	173.5	150.5
1982	170.8	132.3	187.3	158.6
1983	170.4	127.2	198.6	160.3
1984	169.5	122.7	217.4	149.1
1985	198.8	121.3	303.6	277.4
1986	205.7	121.3	324.7	294.0
1987	(1)	(1)	174.1	-

(1) Not available

The electricity sector has been characterized by strong growth in production during the seventies (6.1 % between 1971 and 1980), followed by a clear slowdown during the eighties (2.1 % from 1980 to 1987). Systematic delays in the nuclear program's targets partly explain this. For example, the 11th five year plan fixed a target of 30,000 MW of installed capacity for 1985 and only 27,245 MW were actually put into service.

The rapid development of nuclear power is without any doubt the second major feature. Its share of electricity production has gone from 2 % in 1975 to 11 % in 1985 and about 13 % in 1988. In 1971 the Soviet Union decided that the nuclear option had to provide a response to two major problems:

- the increasing distance between centers of production and consumption,
- the exhaustion of oil deposits and rises in their production costs.

The structure of fuel consumption in Soviet fossil-fueled power stations is indeed dominated by hydrocarbons. At the beginning of the eighties, oil accounted for 36 % of consumption by fossil-fueled power stations and gas accounted for 24 %.

In the face of oil production problems, the eighties have been marked by a policy of substitution of natural gas for oil for electricity production. This has had a certain success. Natural gas, which now accounts for 46 % of fuel destined for electricity production from fossil fuels is now the dominant energy form.

This requires two remarks. Firstly, substitutions have been slower than planned. Secondly, the Chernobyl accident and the revision of the nuclear program which resulted has meant that fuel oil power station which should have been shut down have been maintained in service.

It would appear that the electricity sector has to face up to three main types of problem at the moment:

- an inadequacy of supply as compared with real electricity demand with imperfect peak cover,
- chronic delays in commissioning new productive capacity - the most obvious example being nuclear power. Installed capacity targets have rarely been achieved in the past - as was the case under the 12th five-year plan (1986-1990) independent of the delays which followed Chernobyl,
- the increase in electricity losses during transmission.

According to official figures, these rose from 6.9 % in 1965 to 8.10 % in 1978 and 9.4 % in 1984. This increase is largely explained by the increase in transmission distances resulting from the fact that a great number of fossil-fueled power stations are situated near coal deposits in Siberia.

**Table 14: Installed Capacity (MWe)**

	<b>Total capacity</b>	<b>Hydro</b>	<b>Nuclear</b>
1960	66721	17781	-
1970	166150	31368	1612
1975	217484	40515	5546
1980	266757	52300	13425
1985	315100	61700	27245
1986	322000	62100	
1987	332000	62700	34500

Sources: Soviet electricity statistical yearbooks, various years.

### 2.7.7 Final Energy Consumption

**Table 15: Final Energy Consumption (Mtoe)**

	<b>Coal</b>	<b>Oil</b>	<b>Gas</b>	<b>Electricity</b>	<b>Heat</b>	<b>Total</b>
1971	197.6	193.2	109.8	55.4	131.5	687.5
1972	202.2	205.8	113.9	59.2	138.3	719.3
1973	193.8	215.1	115.3	63.1	151.0	738.3
1974	195.1	233.2	117.8	67.3	167.7	781.1
1975	198.6	248.2	122.2	71.1	177.3	817.4
1976	195.7	254.4	131.4	76.5	181.2	839.2
1977	198.5	264.0	135.5	78.8	189.1	865.8
1978	192.6	279.3	141.4	81.8	198.3	893.4
1979	193.9	275.2	149.0	83.9	210.9	913.0
1980	185.5	275.2	157.4	87.7	227.5	933.1
1981	185.2	278.2	168.6	90.0	232.5	954.4
1982	185.9	281.4	182.0	92.6	237.6	979.5
1983	185.1	285.5	193.1	96.0	238.9	998.7
1984	182.4	286.7	211.4	100.8	261.9	1043.2
1985	158.5	285.2	169.0	103.9	246.5	963.1
1986	161.3	283.9	175.0	108.2	252.6	980.9
1987	(1)	(1)	274.8	112.3	(1)	-

(1) Not available

Before analyzing final consumption in the Soviet Union, it should be pointed out that this country does not publish any detailed official energy balance. The only balances available are the aggregated ones made available to the EEC-UNO in Geneva for 1985, 1990 and 2000. It is, however, possible to make a comparison for 1985.

**Table 16: Final Energy Consumption in 1985 (Mtoe)**

	Solid Fuel	Oil	Gas	Elec- tricity	Heat- Steam	Total
Official balance	144	228	137	98	245	852
EEC-UNO difference	158.5	285.2	169	103.9	246.5	963.1
EEC-UNO/ Soviet balance	14.5	57.2	32	5.9	1.57	111.1

The figures used are essentially estimates. Given the extent of the differences in final consumption, we have tried to make comparisons on the basis of data published by the IEA.

**Table 17: Final Energy Consumption in 1985 (Mtoe)**

	Solid Fuel	Oil	Gas	Elec- tricity	Heat- Steam	Total
Official balance	144	228	137	98	245	852
IEA Difference	185.7	326	228.3	102.7	91.3	934
IEA/Soviet Balance	41.7	98	91.3	4.7	-153.7	8

It should be noticed that, looked at energy-by-energy, the differences are much smaller with the EEC-UNO data than with the IEA data. That the converse is the case when we look at the total is the result of the fact that IEA gives much lower Heat-steam figures than those given in the official Soviet balance. These compensate for differences in other energies. Under such conditions, it seems more appropriate to use the EEC-UNO data which leave less room for errors energy-by-energy.

The Soviet Union's final energy consumption shows two main features in terms of the energy form used and sector shares.

When looking at the structure of final energy consumption by energy form, it should be noted that electricity plays a minor role (11 % in 1986) and that solid mineral fuels are still non-negligible.

**Table 18: Structure of Consumption by Energy Form in 1986 ( %)**

Coal	Oil	Gas	Electricity	Heat-steam	Total
16.5	28.9	17.8	11.0	25.8	100

The main features of the various sectors' relative shares of consumption are the importance of the industrial sector (58 %) and the smallness of the transport sector (12 %). Such a structure is of course very different from that of OECD countries.

**Table 19: Structure of Consumption by Sector in 1986 ( %)**

Industry	Transport	Housing-service-agricultural	Total
58.4	12.3	29.3	100

**Final energy consumption in the industrial sector****Table 20: Industrial Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	105.0	66.9	75.9	37.4	99.9	385.1
1972	107.0	66.0	77.9	39.6	105.1	395.6
1973	100.5	72.1	77.8	41.9	113.5	405.7
1974	103.2	75.7	76.5	44.4	127.4	427.2
1975	104.5	81.4	77.1	46.3	134.7	444.0
1976	106.8	81.2	79.0	49.3	137.7	454.1
1977	108.1	83.4	79.2	50.2	143.7	464.5
1978	104.2	88.8	81.0	51.9	149.5	475.4
1979	102.1	78.4	86.3	52.8	160.3	479.8
1980	100.1	75.1	91.6	53.7	176.1	496.6
1981	97.6	68.6	98.2	55.0	179.7	499.0
1982	100.0	70.7	106.0	56.0	183.7	516.3
1983	99.8	72.2	114.6	58.0	184.7	529.2
1984	99.5	69.9	125.4	60.7	202.4	558.0
1985	85.9	56.3	85.2	62.0	180.3	469.7
1986	87.8	55.3	87.9	64.1	184.7	479.8
1987	(1)	(1)	201.0	66.7	(1)	-

(1) Not available

Energy consumption in the industrial sector was 480 Mtoe in 1987, i.e. 58.4 % of final consumption. This was 62.2 % in 1971. Its importance can be explained by the Soviet mode of industrialization: priority to "heavy industries" which require a lot of energy. The "steel" sector alone accounts for nearly 30 % of final industrial consumption, and in the case of coal this figure exceeds 50 %. 64 % of electricity is assigned to the industrial sector. As well as playing an important role in Soviet industrial production, heavily energy-consuming industries also have high levels of specific energy consumption. Although it is not possible to give an exhaustive description, various partial indications can be found.

A quick calculation, even if based on estimates, shows the importance of specific energy consumption in steel production: 0.960 toe/ton in 1985.

This level of consumption can be explained by the type of technology in use, among other factors. The highly energy-consuming Open hearth process still accounts for roughly 50 % of Soviet steel production.

The industrial sector has been marked by a policy of energy substitutions with massive penetration of natural gas in some areas such as chemicals.

Clearly the most important factors affecting the industrial sector's energy consumption are:

- problems related to modernization and obsolete equipment (e.g. according to G. ROLAND, 3/4 of Soviet rolling mills are obsolete.),
- industrial structure, characterized by the importance of highly energy-consuming industries such as steel, metallurgy, chemicals, petrochemicals.

**Table 21: Transport Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	3.1	68.8	0.7	5.0	0.0	77.5
1972	2.8	73.6	0.7	5.3	0.0	82.4
1973	2.5	78.8	0.9	5.6	0.0	87.8
1974	2.2	83.0	0.9	5.9	0.0	92.0
1975	1.9	87.4	0.9	6.4	0.0	96.7
1976	1.4	92.1	1.2	7.1	0.0	101.7
1977	1.0	96.9	1.2	7.5	0.0	106.7
1978	0.7	102.1	1.3	7.8	0.0	111.9
1979	0.7	103.8	1.4	8.3	0.0	114.2
1980	0.7	105.6	1.3	8.8	0.0	116.4
1981	0.7	107.5	1.4	9.2	0.0	118.7
1982	0.7	109.3	1.5	9.6	0.0	121.1
1983	0.7	111.2	1.5	9.9	0.0	123.3
1984	0.7	113.1	1.6	10.2	0.0	125.7
1985	0.0	109.9	0.0	10.3	0.0	120.2
1986	0.0	110.0	0.0	10.8	0.0	120.8
1987	0.0	(1)	1.8	11.3	0.0	-

(1) Not available

**Table 22: Residential-Tertiary-Agriculture Energy Consumption (in Mtoe)**

	Coal	Oil	Gas	Electricity	Heat	Total
1971	88.0	28.1	22.7	13.1	31.6	183.4
1972	90.8	29.1	24.7	14.3	33.2	192.1
1973	89.0	30.4	26.1	15.6	37.5	198.7
1974	87.8	32.8	28.3	17.1	40.2	206.3
1975	90.1	34.9	31.3	18.4	42.6	217.2
1976	85.3	35.6	36.2	20.1	43.5	220.6
1977	86.9	35.6	39.1	21.1	45.4	228.0
1978	85.2	38.7	41.5	22.1	48.8	236.3
1979	88.6	39.5	43.4	22.9	50.6	245.1
1980	82.2	41.5	47.4	25.1	51.4	247.7
1981	84.6	44.8	50.8	25.8	52.8	258.8
1982	82.8	45.4	54.9	26.9	53.9	263.9
1983	82.2	45.4	56.1	28.1	54.2	266.0
1984	79.9	47.4	61.4	29.9	59.4	278.1
1985	69.0	62.7	52.1	31.6	66.2	281.6
1986	70.0	62.4	53.6	33.4	68.0	287.3
1987	(1)	(1)	72.0	34.4	(1)	-

(1) Not available

### **3. Cross-Country Data**



Table 1: Overview of Installed Capacities in Power Stations (in MW)

	1970	1980	1981	1982	1983	1984	1985	1986	1987	1988
Bulgaria	4117	8197	9059	9499	9633	9798	10243	10243	10743	11309
Hungary	2733	5407	5344	5504	6050	6411	6411	6871	733	7363
GDR	12569	20454	21367	21857	21790	22264	22759	22754	23596	23586
Poland	13891	25292	25523	26840	27875	28857	30107	30921	31316	32056
Romania	7346	16109	16612	17470	17988	18824	---	---	---	---
USSR	166150	266757	276722	285492	293558	303693	314888	321671	332266	338929
CSFR	10808	16626	17962	18941	18863	19395	20323	21232	21667	21697
<b>thereof in Hydropower-based Stations (in MW)</b>										
	1970	1980	1981	1982	1983	1984	1985	1986	1987	1988
Bulgaria	816	1868	1895	1895	1895	1975	1975	1975	1975	1975
Hungary	20.1	47.8	47.8	47.8	47.8	4.8	47.8	47.8	47.8	47.8
GDR	682	1421	1719	1771	1767	1767	1767	1767	1767	1767
Poland	770	1327	1327	1837	2007	2005	2005	2005	2005	2005
Romania	1200	3455	3533	9734	3885	4062	4421	---	---	---
USSR	31368	52311	54149	55889	56985	59239	61742	62141	62695	63839
CSFR	1542	2217	2666	2928	2930	2929	2976	2982	2982	3058

Source: Statisticeskij ezegodnik stran clenov SEV, 1984, S. 111 und 1989, S. 138; 1985, S. 133

Table 2: Electricity Generation per Capita (kWh)

Year	Bulgaria	GDR	Poland	Romania	USSR	CSFR	Hungary
1970	2298	3966	1984	1733	3052	3151	1408
1980	3931	5904	3426	3040	4873	4750	2229
1981	4158	6018	3203	3183	4953	4798	2267
1982	4531	6163	3246	3066	5063	4864	2311
1983	4770	6284	3441	3115	5203	4948	2404
1984	4985	6604	3652	3163	5424	5071	2459
1985	4646	6839	3702	3160	5564	5202	2509
1986	4668	6935	3746	3307	5706	5456	2634
1987	4845	6861	3872	3229	5881	5511	2798
1988	5013	7100	3812	3268	5967	5602	2752

Source: Statisticeskij ezegodnik stran clenov SEV, Moskau 1984, S. 106; 1988, S. 131; 1985, S. 128

**Table 3: Index of Industrial Gross Production in the Electricity and Heat Generating Sector and in the Fuels Industry (1980 = 100)**

Year	Bulgaria	GDR	Poland	Romania	USSR	CSFR	Hungary
<b>Electricity and Heat Generating Sector</b>							
1980	100	100	100	100	100	100	100
1981	108	103	102	104	102	101	103
1982	120	104	109	103	106	103	105
1983	127	109	119	106	109	105	108
1984	130	114	130	113	116	108	113
1985	124	118	134	115	120	112	116
1986	127	121	139	125	123	118	118
1987	141	127	145	126	129	121	123
1988	148	130	145	135	132	123	123
<b>Fuels Industry</b>							
1980	100	100	100	100	100	100	100
1981	93	106	88	99	100	99	99
1982	97	110	97	105	102	99	104
1983	95	115	101	116	103	99	102
1984	95	120	104	121	104	99	104
1985	93	124	107	118	105	98	107
1986	101	127	110	124	109	97	107
1987	107	126	109	129	111	97	110
1988	104	125	107	n.a.	114	98	105

Source: Statisticeskij ezegodnik stran clenov SEV, Moskau 1989

Table 4: Main Energy Indicators

Indicator	EEC	East and Central European Countries
Primary Production	587.2 Mtoe (1988)	319.7 Mtoe (1987)
Imports	503.9 Mtoe (1988)	171.4 Mtoe, 142.6 Mtoe (1987) from USSR
Primary Consumption	1066.7 Mtoe (1988)	438.4 Mtoe (1987)
Import Quota	45.9 % (1988)	34.9 % (1987)
Primary Energy per Capita	3.5 toe (1989)	5.0 toe (1989)*
Oil Production	115.0 mill. tons (1989)	623.0 mill. tons (1989)*
Electricity Generation	1700.0 bill. kWh (1989)	2292.0 bill. kWh (1989)*
Energy Consumption Shares		
Oil	44.9 % (1987)	19 % (1987)
Coal	21.6 % (1987)	57 % (1987)
Gas	18.7 % (1987)	18 % (1987)
Nuclear	12.8 % (1987)	3 % (1987)
Electricity	2.0 % (1987)	3 % (1987)

Various sources

\* including USSR

***ANNEX I***

***The Conversion Factors Applied***

## Annex I      The Conversion Factors Applied:

In the DIW tables on primary energy the following country-specific conversion factors have been applied:

Type of Energy	Period	Production	Import	Export
		kJ/kg		
<b>Bulgaria</b>				
Brown Coal	1970-1979	7913	-	-
	1980-1987	7327	-	-
Hard Coal	1970-1987	17291	22860	22860
Coke	1970-1987	-	27842	27842
Crude Oil	1970-1987	41031	41910	41910
Mineral Oil	1970-1987	-	41910	41910
Natural Gas	1970-1987	35169	34876	-
Prim. Electr.	1970-1987	11723	11723	11723
<b>Factor of Hard Coal Equival.</b>				
Brown Coal	1970-1979	0.27	-	-
	1980-1987	0.25	-	-
Hard Coal	1970-1987	0.59	0.78	0.78
Coke	1970-1987	-	0.95	0.95
Crude Oil	1970-1987	1.40	1.43	1.43
Mineral Oil	1970-1987	-	1.43	1.43
Natural Gas	1970-1987	1.20	1.19	-
Prim. Electr.	1970-1987	0.40	0.40	0.40
<b>kJ/kg</b>				
<b>CSFR</b>				
Brown Coal	1970-1975	14067	8792	14067
	1976-1980	13481	8792	13481
	1981-1987	12895	8792	12895
Hard Coal	1970-1987	23446	22860	23446
Coke	1970-1987	-	27842	27842
Crude Oil	1970-1987	41031	41910	41910
Mineral Oil	1970-1987	-	41910	41910
Natural Gas	1970-1979	33411	34876	34876
	1980-1987	33411	30500	30500
Prim. Electr.	1970-1987	11723	11723	11723
<b>Factor of Hard Coal Equival.</b>				
Brown Coal	1970-1975	0.48	0.30	0.48
	1976-1980	0.46	0.30	0.46
	1981-1987	0.44	0.30	0.44
Hard Coal	1970-1987	0.80	0.78	0.80
Coke	1970-1987	-	0.95	0.95
Crude Oil	1970-1987	1.40	1.43	1.43
Mineral Oil	1970-1987	-	1.43	1.43
Natural Gas	1970-1979	1.14	1.19	1.19
	1980-1987	1.14	1.04	1.04
Prim. Electr.	1970-1987	0.40	0.40	0.40

Type of Energy	Period	Production	Import kJ/kg	Export		
<b>GDR</b>	Brown Coal	1970-1975	8900	8900	-	
		1976-1981	8850	8900	-	
		1982-1985	8800	8900	-	
		1986-1987	8700	8900	-	
		1970-1987	-	-	19300	
	Hard Coal	1970-1987	20800	26000	26000	
	Coke	1970-1987	-	27000	-	
	Crude Oil	1970-1987	41000	41000	41000	
	Mineral Oil	1970-1987	-	41900	41900	
	Natural Gas	1970-1979	12100	34500	-	
		1980-1987	12100	30500	-	
		1970-1975	10400	10400	10400	
	Prim. Electr.	1976-1979	10200	10200	10200	
		1980-1987	10000	10000	10000	
		<b>Factor of Hard Coal Equival.</b>				
	Brown Coal	1970-1975	0.30	0.30	-	
		1976-1981	0.30	0.30	-	
		1982-1985	0.30	0.30	-	
		1986-1987	0.30	0.30	-	
1970-1987		-	-	0.66		
Hard Coal	1970-1987	0.71	0.89	0.89		
Coke	1970-1987	-	0.92	-		
Crude Oil	1970-1987	1.40	1.40	1.40		
Mineral Oil	1970-1987	-	1.43	1.43		
Natural Gas	1970-1979	0.41	1.18	-		
	1980-1987	0.41	1.04	-		
	1970-1975	0.35	0.35	0.35		
Prim. Electr.	1976-1979	0.35	0.35	0.35		
	1980-1987	0.34	0.34	0.34		
	<b>kJ/kg</b>					
<b>Poland</b>	Brown Coal	1970-1987	8499	8792	8499	
		Hard Coal	1970-1974	25150	22860	25150
			1975-1979	24400	22860	24400
			1980-1984	23600	22860	23600
			1985-1987	23250	22860	23250
	Coke	1970-1987	-	27842	27842	
	Crude Oil	1970-1987	41031	41910	41910	
	Mineral Oil	1970-1987	-	41910	41910	
	Natural Gas	1970-1987	35462	34876	34876	
	Prim. Electr.	1970-1987	11723	11723	11723	
	<b>Factor of Hard Coal Equival.</b>					
	Brown Coal	1970-1987	0.29	0.30	0.29	
		Hard Coal	1970-1974	0.86	0.78	0.86
			1975-1979	0.83	0.78	0.83
1980-1984			0.81	0.78	0.81	
1985-1987			0.79	0.78	0.79	
Coke	1970-1987	-	0.95	0.95		
Crude Oil	1970-1987	1.40	1.43	1.43		
Mineral Oil	1970-1987	-	1.43	1.43		
Natural Gas	1970-1987	1.21	1.19	1.19		
Prim. Electr.	1970-1987	0.40	0.40	0.40		

Type of Energy	Period	Production	Import kJ/kg	Export	
<b>Romania</b>	Brown Coal	1970-1979	8000	-	-
		1980-1987	7300	-	-
	Hard Coal	1970-1987	20808	23446	-
		Coke	1970-1987	-	27842
	Crude Oil	1970-1987	41031	41910	41910
	Mineral Oil	1970-1987	-	41910	41910
	Natural Gas	1970-1987	31700	34876	39858
	Nat. Oil Gas	1970-1987	41800	-	-
	Prim. Electr.	1970-1987	11723	11723	11723
	<b>Factor of Hard Coal Equival.</b>				
	Brown Coal	1970-1979	0.27	-	-
		1980-1987	0.25	-	-
	Hard Coal	1970-1987	0.71	0.80	-
		Coke	1970-1987	-	0.95
	Crude Oil	1970-1987	1.40	1.43	1.43
	Mineral Oil	1970-1987	-	1.43	1.43
	Natural Gas	1970-1987	1.08	1.19	1.36
	Nat. Oil Gas	1970-1987	1.43	-	-
	Prim. Electr.	1970-1987	0.40	0.40	0.40
<b>kJ/kg</b>					
<b>Hungary</b>	Brown Coal	1970-1974	12300	17584	-
		1975-1979	11150	17584	-
		1980-1987	10100	17584	-
	Hard Coal	1970-1974	22000	23446	21000
		1975-1979	21000	23446	21000
		1980-1987	20000	23446	21000
	Coke	1970-1987	-	27842	27842
	Crude Oil	1970-1987	41000	41000	41000
	Mineral Oil	1970-1987	-	41910	41910
	Natural Gas	1970-1979	35170	34500	34500
		1980	35170	30500	30500
		1981-1987	32530	30500	30500
	Prim. Electr.	1970-1987	11723	11723	11723
<b>Factor of Hard Coal Equival.</b>					
	Brown Coal	1970-1974	0.42	0.60	-
		1975-1979	0.38	0.60	-
		1980-1987	0.34	0.60	-
Hard Coal	1970-1974	0.75	0.80	0.72	
	1975-1979	0.72	0.80	0.72	
	1980-1987	0.68	0.80	0.72	
Coke	1970-1987	-	0.95	0.95	
Crude Oil	1970-1987	1.40	1.40	1.40	
Mineral Oil	1970-1987	-	1.43	1.43	
Natural Gas	1970-1979	1.20	1.18	1.18	
	1980	1.20	1.04	1.04	
	1981-1987	1.11	1.04	1.04	
Prim. Electr.	1970-1987	0.40	0.40	0.40	