ANL/SPO--91/5

DE92 007388

ANL/SPO-91/5

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, Illinois 60439-4801

COUNTRY PROFILE: HUNGARY

by

Special Projects Office
Engineering Research

September 1991

Prepared for

International Energy Organizations/Policy Development Division
Office of International Affairs and Energy Emergencies
U.S. Department of Energy

COUNTRY PROFILE: HUNGARY

List of Tables vi
List of Acronyms viii
Notice to Reader ix
Preface xi
Executive Summary xiii

Statement of the Problem xiii
Outline of the Report xiii
Observations xiv

1.0 Indigenous Energy Resources 1-1

1.1 Coal 1-7

1.1.1 Production 1-7
1.1.2 Supply and Demand 1-8

1.2 Oil 1-9

1.2.1 Production 1-9
1.2.2 Supply and Demand 1-11

1.3 Natural Gas 1-15

1.3.1 Production 1-15
1.3.2 Supply and Demand 1-16

1.4 Nuclear Power 1-17

1.4.1 Uranium 1-17
1.4.2 Generating Capacity 1-17
1.4.3 Nuclear Power Programs 1-19

1.5 Hydro Power 1-19

1.5.1 Hydro Resources 1-19
1.5.2 Electricity Generating Capacity 1-20
1.5.3 Hydro Programs 1-20

1.6 Electric Power 1-20

1.6.1 Generating Capacity 1-21
1.6.2 Transmission and Distribution 1-22
1.6.3 Development Plans 1-23

1.7 Alternative Energy Resources 1-24

1.7.1 Solar 1-24
1.7.2 Wind 1-24
1.7.3 Biomass 1-25
1.7.4 Geothermal 1-25

2.0 Energy Usage in the Hungarian Economy 2-1

2.1 Industrial and Manufacturing 2-1

2.1.1 Structure 2-1
2.1.2 Labor 2-3
2.1.3 Role of the European Community 2-4

2.2 Utilities 2-4

2.2.1 Structure 2-5
2.2.2 Labor 2-6
2.2.3 Technology 2-6
2.2.4 Waste Systems 2-7
2.2.5 Energy Flows 2-7

2.3 Agriculture 2-10

2.4 Services and Retail 2-11

2.5 Residential 2-12

2.5.1 Geography and Demographics 2-12
2.5.2 Technology 2-13
2.5.3 Waste Systems 2-14
2.5.4 Energy Flows 2-15

2.6 Transportation 2-16

2.6.1 Structure 2-17
2.6.2 Technology 2-18
2.6.3 Waste Systems 2-18
2.6.4 Energy Flows 2-19

3.0 Opportunities 3-1

3.1 Potential Improvement in Energy Efficiency 3-2

3.1.1 Industrial and Manufacturing 3-4
3.1.2 Utilities 3-4
3.1.3 Agriculture 3-5
3.1.4 Residential 3-5
3.1.5 Transportation 3-6

3.2 Opportunities for Alternative Energy Sources 3-6

3.2.1 Utilities 3-7
3.2.2 Residential 3-7
3.2.3 Transportation 3-8

3.3 Opportunities for Foreign Investment 3-8

3.3.1 Economic Status 3-8
3.3.2 Investment Climate 3-9
3.3.3 Legislation 3-11
3.3.4 Financial Markets 3-12
3.3.5 Marketable Technologies 3-15
3.3.6 Labor Market Assessment 3-16

Appendix A: Map of Hungary's Energy Infrastructure A-1
Appendix B: Firms to Remain State-Owned B-1
Appendix C: Bibliography C-1
Appendix D: Conversion Factors D-1

LIST OF TABLES

Table 1.0.a	Primary Energy Production by Fuel Type	1-1
Table 1.0.b	Percentage Share of Primary Energy Production by Fuel Type	1-1
Table 1.0.c	Primary Energy Demand by Fuel Type	1-2
Table 1.0.d	Percentage Share of Primary Demand by Fuel Type	1-2
Table 1.0.e	Net Energy Imports	1-3
Table 1.0.f	Net Energy Imports as Percent of Primary Demand	1-3
Table 1.0.g	Soviet Imports as a Percent of Primary Energy Demand	1-4
Table 1.0.h	1988 Soviet Energy Export Prices: Official vs. Effective East European Exchange Rate	1-5
Table 1.0.i	Comparison of Energy Efficiency for Selected European Countries	1-6
Table 1.0.j	Foreign Debt in Selected East European Countries, 1988	1-6
Table 1.1.a	Production of Anthracite (Hard) Coal vs. Lignite and Subbituminous (Brown) Coal	1-7
Table 1.1.b	Total Coal Production--Million Tonnes Oil Equivalent (MTOE) and Annual Percentage Change	1-8
Table 1.1.c	Hard Coal and Coke Imports from the USSR	1-9
Table 1.2.a	Hungarian Refining Capacity	1-10
Table 1.2.b	Refining Flows 1982 to Present	1-10
Table 1.2.c	Oil Imports from the Soviet Union	1-11
Table 1.2.d	1988 Reliance on Oil Imports for the CMEA Six	1-12
Table 1.2.e	Oil Imports as Percentage of Hard-Currency Exports	1-12
Table 1.2.f	Crude Oil Imports from non-Communist Countries, Selected East European Countries	1-13
Table 1.3.a	Natural Gas Production in Selected East European Countries, 1979-1989	1-15
Table 1.3.b	Natural Gas Domestic Shortfall 1979-1989, Selected East European Countries	1-16
Table 1.4.a	Nuclear Power Reactors	1-17
Table 1.4.b	Percentage of Total Primary Energy Requirements Met by Nuclear Sources, Selected Countries	1-18
Table 1.5.a	1986 Production of Hydroelectricity for Selected East European Countries	1-19
Table 1.6.a	Soviet Electricity Exports, 1986-1989	1-20
Table 1.6.b	Regional Distribution of Soviet Electricity Exports, 1989	1-21
Table 1.6.c	Net Electricity Generation by Type of Energy Carrier	1-22
Table 1.6.d	Production and Consumption in the Hungarian Power System	1-22
Table 1.6.e	Distribution of Electric Power in Hungary, 1990	1-23
Table 1.6.f	Comparative Electricity Network Losses, 1985	1-23
Table 2.2.a	Changes in Energy Demand in Hungary 1970 to 1988	2-8
Table 2.2.b	Volumes of Fuels Consumed for Electric Generation and Heat Supply	2-8
Table 2.2.c	Percentage Share of Final Energy Consumption by Type of Energy Carrier	2-9
Table 2.5.a	Habitation of Dwellings by Type of Resident in 1980	2-14
Table 2.5.b	Sources of Financing for New Housing Construction	2-14
Table 2.5.c	Sources of Housing/Municipal Energy Use	2-16

Table 2.5.d Comparison of East European Households: Percentage of Oil-Heated Homes Among the Domestic Population 2-16
Table 2.6.a Length of Roadways, Rail Lines, and Navigable Waterways in 1986 2-17
Table 2.6.b Comparison of Diesel Fuel Consumption by East European Railways 2-17
Table 2.6.c Fuel Consumption in Public Transportation 2-19
Table 2.6.d Fuel Consumption in Public Transportation by Traffic Type--1984 2-20
Table 2.6.e Final Energy Consumption in Transportation Sector by Fuel in 1987 . . . 2-20
Table 2.6.f Consumption of Oil Products by the Freight Transport Sector in 1986 . . . 2-21
Table 3.1.a Average Annual Change in Energy Requirements as a Percent of National Income, 1981-1983, Selected Countries 3-3
Table 3.3.a Components of 1988 Gross Domestic Product 3-8
Table 3.3.b Major Trading Partners 3-9

LIST OF ACRONYMS

b/cd	Barrels per calendar day
b/d	Barrels per day
BDOE	Barrels per day oil equivalent
BP	British Petroleum
CMEA	Council for Mutual Economic Assistance
EC	European Community
GDP	Gross Domestic Product
GJ	Gigajoules
GNP	Gross National Product
GWh	Gigawatt hours
IAEA	Inaternational Atomic Energy Agency
ISIC	International Standard Industrial Clasification
kWh	Kilowatt hours
LPG	Liquified Petroleum Gases
m^3/d	Cubic meters per day
MDF	Hungarian Democratic Forum
MTOE	Million tons of oil equivalent
MVMT	Magyar Villamos Muvek Troszt
MW	Megawatts
MWe	Megawatt electric
OECD	Organization for Economic Cooperation and Development
OKGT	National Oil and Gas Trust
OPEC	Organization of Petroleum Exporting Countries
OTA	Office of Technology Assessment
PJ	Petajoules
TOE	Tons of oil equivalent
TWh	Terawatthours

NOTICE TO READER

This report presents information on Hungary's energy balance including energy production, imports, demand, and utilization for various energy types. The tabular data have been collected from a variety of journal articles, books and other publications. A review of the data has revealed some inconsistencies for comparable information from different sources. Such discrepancies in the data, which appear to be on the order of 5 to 10 percent, should not be unexpected. In addition, since dissemination of information in Eastern Europe has until recently, been under control of the government, there is little standardization of reporting procedures or cross-validation of statistics. Note also that the data for the specific energy sources are presented in the units reported by the primary source since several assumptions must be made in developing the conversion factors to translate the information into common units.

PREFACE

Country Profile: Hungary has been prepared as a background document for use by U.S. Government agencies and U.S. businesses interested in becoming involved with the new democracies of Eastern Europe as they pursue sustainable economic development. The focus of the Profile is on energy and highlights information on Hungary's energy supply, demand, and utilization. It identifies patterns of energy usage in the important economic sectors, especially industry, and provides a preliminary assessment for opportunities to improve efficiencies in energy production, distribution and use by introducing more efficient technologies. The use of more efficient technologies would have the added benefit of reducing the environmental impact which, although is not the focus of the report, is an issue that effects energy choices.

The Profile also presents considerable economic information, primarily in the context of how economic restructuring may affect energy supply, demand, and the introduction of more efficient technologies.

The Profile was prepared under the auspices of the Office of International Affairs and Energy Emergencies in the U.S. Department of Energy who tasked the Special Projects Office (SPO) of Argonne National Laboratory to prepare the Profile. The primary research and assimilation of the collected information into a cohesive whole was performed at Tufts University under the general direction of Dr. Arpad von Lazar, Professor of International Energy, Environment and Development at the Fletcher School of Law and Diplomacy. Participants in this effort included Ms. M. Flaherty, Mr. C. Shaw, Ms. J. Toth, and Ms. J. Wayne. The Tufts' activity was supervised by Ms. Melanie Tompkins of SPO who performed additional research, wrote several sections, and edited the final document. Dr. Ralph Stajdohar, Deputy Director of SPO was the overall program manager.

EXECUTIVE SUMMARY

Statement of the Problem

Hungary faces formidable challenges at the outset of the 1990s. With economic, and now political, liberalization well underway, expectations for change are high. But the costs of the transition from a central economy to a free-market democratic system have only begun to be calculated. Reduction of subsidies, reform of regulation, tax, trade and industrial restructuring and the revitalization of the financial system all demand significant attention from policymakers and the private sector. Hungarian consumers face not only reduced subsidization of the cost of living but high inflation, credit shortages and a dearth of hard currency for imports.

Among the most significant obstacles which reformers must tackle is a shortage of energy resources. Not only has the Soviet Union, the major supplier of energy for the country, been unreliable with deliveries but, as of January 1, 1991, the USSR demanded hard currency payment for all energy imports. Reducing dependence on Soviet energy supplies is one of the main objectives of Hungary's industrial restructuring program. Toward that end, Hungary has launched a multi-level effort to develop new energy sources while simultaneously reducing energy demand through conservation and the introduction of fuel efficient technologies.[1] As Hungary prepares to face the twin challenges of a deteriorating economy and an unprecedented shortage of affordable energy supplies, the nation will be forced to examine every option.

Outline of the Report

The report is divided into three chapters which cover the following subject areas:

Chapter 1: *Indigenous Energy Resources.* This section provides a basic inventory of the country's energy resources. The sources of data are a variety of published documents that list the production and consumption information for various fuels, including natural gas, oil and nuclear power. This section provides the overview of Hungary's energy situation and the foundation on which the subsequent analysis is built.

Chapter 2: *Energy Usage in the Hungarian Economy.* This portion of the report aims to integrate the information on energy resources into the existing economic infrastructure of Hungary. The technological, organizational and environmental factors affecting energy consumption are analyzed for specific sectors of the economy.

Chapter 3: *Opportunities.* The concluding portion of this profile attempts to assimilate the quantitative data from Section 1.0 and the end-use data from Section 2.0 and identify potential areas for technological cooperation and/or investment opportunities. Specific to the energy area, improvements in energy efficiency and expansion of alternative energy sources are presented.

Three appendices accompany the report. The first is a map of Hungary's energy infrastructure which shows the pipeline network, location of energy resources, and energy-related industries. Appendix B lists the names of the companies on Hungary's "exception list" which are to remain state-owned either 100 percent or through a controlling interest of 51 percent. A complete list of the references used in preparing

---

[1] Celeste Bohlen, "Hungary's Premier Says Economy Is in 'Extremely Grave' Condition," *New York Times* 5 December 1990, A3.

the report is provided in the Bibliography in Appendix C. In order to facilitate converting between the various units, a set of conversion tables is given in Appendix D.

Observations

Hungary's economic development has relied on mining and heavy industry which accounted for over 35 percent of gross domestic product and 45 percent of final energy consumption in 1989. This means of development has been tantamount to intensive and inefficient energy use, as well as, extensive pollution. Because of Hungary's dependence on foreign energy supplies, increasing energy efficiency in conjunction with conservation in the industrial sector is a critical factor in the success of the economic restructuring program.

Toward this end, the government has proposed a program for restructuring its leading energy-intensive industries and encouraging growth in other sectors of the economy. Obsolete technologies are scheduled to be replaced by modern processes in the iron smelting, aluminum and chemical industries. Through modernization and development, Hungary plans to expand the production of plastics, pharmaceuticals, electronics and food processing. Growth in less energy-intensive industries and services along with increased efficiency in heavy industries, could significantly reduce Hungary's energy demand.

Changes in energy consumption patterns are already apparent from the shift in emphasis toward services. While total electric energy use grew by 16 percent between 1970 and 1988, electric intensity remained relatively constant. This is at least in part attributable to the shift away from energy-intensive industries.

Attempts to increase domestic energy resources has met with little success. Notwithstanding Hungary's extensive investment in better extraction techniques for natural gas, output from its largest field in Algyo is expected to decrease significantly over the next 10 to 15 years. The fall in domestic production may be mitigated, however, by improving exploration tools and methods. While joint ventures with Western firms are an obvious way to acquire advanced natural resource exploration, extraction, and recovery technologies, Hungary's current laws preclude this option. The government has liberalized oil imports, trade and prices, relieving the National Oil and Gas Trust (OKGT) of its responsibility as sole supplier of crude oil. Uncertainty still surrounds the extent to which mining activities concerning strategic assets will be privatized or open to foreign investment.

Hungary remains in the preliminary stages of absorbing technology capable of producing energy from alternative sources. The government is subsidizing the development of geothermal resources, while at the same time encouraging private investment in this area. Biomass technology is already being used at a cogeneration plant in the industrial center of Tatabanya. While Hungary has no biomass-fired gas turbines at this time, environmentalists are supporting the introduction of this technology currently being developed in the US. Further development of gasification and liquifaction technologies is required before biomass can be widely used in combustion turbines.

Environmental concerns have also been a motivating factor in the development of clean-coal technologies. Coal grinding processes and coal dust burners are in widespread use, while fluidized bed burners are in the planning stage. Expansion of hydroelectricity on a large-scale, such as the Gabcihovo-Nagymaros Dam project is unlikely in the near term, however, small hydroelectric installations, the current trend, may be a viable option, both from a financial and environmental viewpoint.

Capital constraints have precluded the utilities from acquiring many of the advanced technologies employed in Western countries. Economic considerations, as well as the relatively short lead time have put gas turbine power plants at the foreground of Hungary's plans to increase electric generating capacity. Combined cycle cogenerating plants that could be integrated into existing district heating systems offer

a promising investment opportunity. The prospect is particularly good for applying flue gas heat recovery to industrial furnaces, a process which can be realized with a gas turbine topping cycle.

Utilities also represent opportunities for investment in the area of equipment sales aimed at improving electric power transmission and distribution. Hungary's system losses, approximately 10.0 percent of net generation, are high even by European standards and are an obvious area for significant energy savings.

Thus far, Hungary's attempts to increase end-use energy efficiency have been price-centered such as increasing the price of heating fuels and gasoline to more accurately reflect world market prices. Since many price-induced conservation measures have been accomplished, future gains in energy efficiency can only be obtained through structural change in conjunction with continued market pricing.

In terms of end-use energy demand, the residential sector is the highest non-productive energy consumer. Home heating, lighting and cooking are very inefficient in Hungary. Energy consumption could be dramatically reduced by setting efficiency standards for appliances, implementing household metering and the introduction of conservation measures. An obvious example of the type of inefficiencies is the lack of thermostats for regulating heat. Distribution networks for both heat and hot water are rarely insulated. The introduction of more energy efficient appliances such as refrigerators, televisions and lighting would help reduce household demand.

Despite the government's emphasis on improving the efficiency of private transportation, experts predict higher oil demand in the transportation sector. Though buses made by one of Hungary's most successful companies, the Ikarus Bus Company, are exported around the world, automobile engines are sub-standard in terms of gas mileage for developed countries. In addition, truck sizes and power often do not correspond effectively to the loads being transported. Through more efficient use of fuels in the transportation sector and the introduction of better engines, it is estimated that energy efficiency in road transportation could increase by as much as 50 percent.

Labor productivity in Hungary is approximately 60 percent of the level of the European Economic Community. This has prompted the government to enact new employment reforms which focus on increasing labor productivity and competitiveness. Increasing unemployment, particularly displacement of unskilled and manual labor, is predicted as a by-product of Hungary's economic restructuring program. In addition to providing unemployment benefits, efforts are currently underway to develop placement and training programs to ease the situation in the interim. Managers, and also workers, must learn the importance of such basic concepts of free enterprise as profit, cash flow and market-value assets.

In conclusion, Hungary has one of the most liberal financial and commercial systems in Eastern Europe, making it particularly attractive to Western investors. Increasing energy efficiency is a fundamental element of Hungary's economic program. Large-scale fuel-substitution projects, electrification of railways, the importation of Western coal-fired power equipment and the networking of 100,000 to 120,000 residences to natural gas supplies are currently being funded by the government. Notwithstanding the challenges facing Hungary in its economic restructuring program, the time is propitious for expanded US cooperation and investment to assist in that transition.

1.0 INDIGENOUS ENERGY RESOURCES

Hungary's domestic energy production does not meet its primary energy demand; in fact, Hungary currently supplies slightly more than half of the energy it uses.[1] Most of Hungary's energy imports come from the Soviet Union which now requires payment in hard currency at world market prices for all types of energy. Since historically, the Soviet Union has provided energy supplies to its Eastern European customers at less than world market prices and in terms of soft currency or trade, this new energy policy can be expected to have a severe impact on the Hungarian economy. The rising cost of energy is already being met with political unrest; further economies by simple conservation measures are not expected to be very effective; and the Hungarian foreign debt is expected to increase.

Detailed supply and demand data for each fuel type is presented following the brief overview of Hungary's energy balance and energy-related economic problems. A map of Hungary's energy infrastructure can be found in Appendix A.

Internal production of primary energy sources by fuel type for 1980 to 1989 is summarized in Tables 1.0.a and 1.0.b. Since the electric sector contribution to total primary energy production is almost entirely nuclear, the growth in energy production over the 1983-1989 period reflects the development of nuclear power.

TABLE 1.0.a. PRIMARY ENERGY PRODUCTION BY FUEL TYPE
(000 BDOE)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	137	139	139	132	132	125	121	121	111	107
Oil	51	51	52	51	51	51	52	50	50	49
Gas	102	99	108	103	108	116	111	112	99	96
Electric	1	1	1	15	22	37	42	62	75	84
Other	7	7	8	8	7	7	7	7	6	6
Total	298	297	308	309	320	337	332	352	341	342

Source: PlanEcon, *Long-Term Energy Outlook*, Winter 1990.

TABLE 1.0.b. PERCENTAGE SHARE OF PRIMARY ENERGY PRODUCTION BY FUEL TYPE

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	46.0	46.8	45.1	42.7	41.3	37.1	36.4	34.4	32.6	31.3
Oil	17.1	17.2	16.9	16.5	15.9	15.4	15.4	14.2	14.7	14.3
Gas	34.2	33.3	35.1	33.3	33.8	34.4	33.4	31.8	29.0	28.1
Electric	0.3	0.3	0.3	4.9	6.9	11.0	12.7	17.6	22.0	24.6
Other	2.4	2.4	2.6	2.6	2.1	2.1	2.1	2.0	1.7	1.7

[1]Juergen Salay, "Hungary--Restructuring the Energy System," *Radio Free Europe Report on Eastern Europe*, 31 August 1990, 16-21.

Whereas world energy demand for all but the centrally planned economies increased from 1970 to 1986 by 26.5 percent,[2] demand in Hungary as in other East European countries increased much faster. Hungary's thirst for primary energy sources increased 38 percent over the period, from 479 BDOE in 1970 to 661 BDOE in 1986. Between 1970 and 1986, Poland's energy demand increased by 56 percent and Czechoslovakia's by 32 percent.

While total energy demand during the eighties remained relatively flat, the composition changed considerably, with the share of primary electric demand increasing from 6.6 percent in 1980 to 21.3 percent in 1989. Hungary's primary energy demand by fuel type for the years 1980 to 1989 is summarized in Tables 1.0.c and 1.0.d.

TABLE 1.0.c. PRIMARY ENERGY DEMAND BY FUEL TYPE
(000 BDOE)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	180	179	172	165	164	173	169	159	147	142
Oil	223	209	208	183	186	193	197	204	190	186
Gas	167	165	173	171	170	180	188	191	184	191
Electricity	41	44	49	65	79	97	101	121	138	142
Other	7	7	8	7	7	7	6	7	6	6
Total	618	604	610	591	606	650	661	682	665	667

Source: PlanEcon, *Long-Term Energy Outlook*, Winter 1990.

TABLE 1.0.d. PERCENTAGE SHARE OF PRIMARY ENERGY DEMAND BY FUEL TYPE

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	29.1	29.6	28.2	28.9	27.1	26.6	25.6	23.3	22.1	21.3
Oil	36.1	34.6	34.1	31.0	30.7	29.7	29.8	29.4	28.5	27.9
Gas	27.0	27.3	28.4	28.9	28.1	27.7	28.4	28.0	27.7	28.6
Electric	6.6	7.3	8.0	11.0	13.0	14.9	15.3	17.7	20.8	21.3
Other	1.2	1.2	1.3	1.2	1.1	1.1	0.9	0.9	0.9	0.9

Source: PlanEcon, *Long-Term Energy Outlook*, Winter 1990.

Hungary is heavily dependent on foreign sources for energy products. While the country exports small quantities of hard coal, refined oil products, and natural gas, Hungary is a net importer of each fuel. The export trade is primarily with non-socialist countries. Net energy imports between 1980 and 1989 have

[2]*Oil and Energy Trends Annual Statistical Review 1987*, Energy Economics Research Ltd., Reading, England, May 1988.

remained relatively constant, both in absolute terms and as a percent of primary energy demand. The net energy import information provided in Table 1.0.e represents the difference between demand (including exports) and domestic production. To illustrate the degree of Hungary's reliance of foreign energy sources, the data are expressed as a percent of primary demand in Table 1.0.f.

TABLE 1.0.e. NET ENERGY IMPORTS
(000 BDOE)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	43	39	34	33	32	53	51	39	36	35
Oil	171	158	156	132	135	142	147	154	140	137
Gas	65	66	64	67	62	64	76	78	85	95
Electric	41	44	48	50	57	54	55	59	63	58
Total	320	307	302	282	286	313	329	330	324	325

Source: PlanEcon, *Long-Term Energy Outlook*, Winter 1990.

TABLE 1.0.f. NET ENERGY IMPORTS AS A PERCENT OF PRIMARY DEMAND

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	23.9	21.8	18.7	20.0	19.5	30.6	30.2	24.5	24.5	24.6
Oil	76.7	75.6	75.0	72.1	72.6	73.6	74.6	75.5	73.7	73.7
Gas	38.9	40.0	37.0	39.2	36.5	35.6	40.4	40.8	46.2	49.7
Electric	100.0	100.0	98.0	76.9	72.2	55.7	54.5	64.5	45.7	40.8
Total	51.8	50.8	49.5	47.7	47.2	48.2	49.8	48.2	48.7	48.7

All entities involved in the production, distribution, and trade of energy are government owned and controlled. The primary ministries affecting energy policy are the Ministry of Industry, the Ministry of Foreign Trade, and the State Energy Inspectorate. Since much of Hungary's energy is imported, the Foreign Trade ministry is closely linked to the energy sector.

Historically Hungary's main source of energy imports has been the Soviet Union. Hungary is linked with the Soviet Union via electricity grids and natural gas and oil pipelines. Despite efforts to increase trade with the West, the volume of imports from Western countries is negligible. Table 1.0.g illustrates the extent of Hungary's dependence on the Soviet Union by expressing the volume of imports as a percent of total primary demand. Thus, in 1989, nearly 50 percent of Hungary's primary energy demand was met by Soviet imports.

In making comparisons between Tables 1.0.f and 1.0.g note that the percentages in Table 1.0.f are net imports, defined as total imports minus total exports, divided by primary demand. The data in Table 1.0.g are gross imports, unadjusted for exports, originating from the Soviet Union divided by primary demand. Both tables depict Hungary's dependence on foreign energy sources to satisfy domestic demand, with Table 1.0.g highlighting the extent of reliance on the USSR. Used in conjunction with each other, the data indicate that Hungary imports more oil from the Soviet Union than it uses to satisfy domestic demand. In this case, Hungary is poor in crude oil but has refining capacity to produce goods for exports. Hungary

exports nearly one million tons annually of refined oil products, mainly heavy fuel oil and middle distillates.

TABLE 1.0.g. SOVIET IMPORTS AS A PERCENT OF PRIMARY ENERGY DEMAND

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Coal	9.4	8.4	9.3	10.3	9.2	10.4	11.8	10.7	14.3	12.7
Oil	83.4	84.2	81.7	83.1	89.8	84.5	88.8	87.3	88.4	87.6
Gas	37.7	38.2	21.4	37.4	36.5	36.1	40.4	40.3	47.3	50.8
Electric	82.9	84.1	75.5	58.5	53.3	49.5	45.5	39.7	36.2	33.8
Total	48.5	48.2	46.7	45.9	47.2	45.2	48.0	46.9	49.0	48.9

Source: PlanEcon, *Long-Term Energy Outlook*, Winter 1990.

In 1989, based on the international exchange rate for the ruble, Hungary imported $992 million worth of energy products from the USSR but still Hungary ranks as the second lowest energy importer when compared to other East European countries. As of January 1, 1991, the Soviet Union, Hungary's primary source of energy supply, required payment in hard currency at world market prices for all types of energy. In the past, the prices of energy products traded between Eastern Europe and the Soviet Union were determined by a five-year rolling average of world market prices which were, in turn, settled in rubles. In addition to dampening the effect of price shocks, this method of pricing enabled a more accurate forecast of future energy expenditures.

East European countries also benefitted from energy trade with the Soviet Union because of the inflated ruble/dollar exchange rate set by Moscow. Until January 1, 1991, Soviet oil was the only oil traded internationally that was not priced in dollars. Since Eastern European countries faced a more realistic commercial exchange rate than that officially set by Moscow, the energy prices charged by the Soviet Union were significantly below world prices.

Confusion about whether the Soviets overcharge or undercharge Eastern European countries arises from the disparity between the official ruble per dollar exchange rate and the effective exchange rate between the USSR and for Bloc countries. If East European trade were to take place in hard currency at the official exchange rate, the price of Soviet energy products would be above those to the West. However, when energy prices are converted using the effective exchange rate, the underpricing of energy supplies to Eastern European customers becomes readily apparent. A comparison of energy prices derived using the official and effective rates is given in Table 1.0.h.

Since nearly all of Hungary's imported oil, gas and electricity originate from the Soviet Union, the price distortions precipitated by the artificial exchange rate were severe. These price distortions will be gradually eliminated as Hungary moves toward a market economy. Due to the extent of Soviet subsidization, however, a temporary reduction in economic performance is expected until the adjustment process is complete. Katalin Kardos, a leader of the Democratic Forum's (MDF) energy policy board, stated that the economy's division into nine sections, with each section subsidized for energy costs in a different way, has created a labyrinth of differential prices.[3] In her view, the challenge facing policymakers is threefold: determining a unit price of energy, reducing consumption (Hungary reportedly has four to five times

[3]Gellert Tamas, "Hungary's Power Plight," *Independent Energy*, September 1990, 68-69.

higher energy consumption than comparable countries[4]) and diversifying imports so as to eliminate reliance on the Soviet supply network.

TABLE 1.0.h. 1988 SOVIET ENERGY EXPORT PRICES: OFFICIAL VS. EFFECTIVE EAST EUROPEAN EXCHANGE RATE
Measured in relation to Soviet export prices to the West (=100)

	Official Rate	Effective Rate
Crude Oil	127	30
Refined Products	166	51
Natural Gas	222	68
Hard Coal	161	49
Coke	146	45
Electric Power	206	63

Source: Jan Vanous, ed., *PlanEcon Report*, Vol. VI, No. 22-23 (June 1990).

As part of Hungary's political and economic transition out of the Soviet sphere, manufacturers have been given quotas on exports to the Soviet Union. Unable to find alternate markets in the short run, this policy has led to a fall in production and rise in unemployment. Moreover, Soviet energy deliveries have become increasingly unpredictable making Hungary's goals of reducing dependence on the Soviet Union critical.

The nation has not been immune from political unrest as a result of rising prices. Retail prices for gasoline are set by the Hungarian Oil and Gas Trust (OKGT). In late October 1990 the OKGT increased gasoline prices 65 percent and diesel 90 percent bringing the Hungarian price to approximately half the world market price. In reaction to the announced increases, Hungarian taxi and truck drivers staged a two-day protest, blocking traffic nationwide and forcing hundreds of people to sleep in their cars.[5] As police refused to use force against the protesters, government officials were forced to reduce price increases to 35 percent for gasoline and 60 percent for diesel.[6]

Gasoline prices are uniform throughout Hungary and there is no discrimination against foreign-registered cars, as in Czechoslovakia. Although there is no legal requirement to sell fuel at uniform prices, all distributors buy their gasoline from the same source. The consumer tax on gasoline is extremely high in Hungary, 40-44 forints per liter. With less than a 2 percent gross profit margin, there is little flexibility or competition in terms of price. By the end July 1991, the price for gasoline was approximately 54 forints per liter or $0.86 per liter, almost up to the level targeted in the OKGT's October announcement.[7]

On a general primary energy level, Hungary already exhibits greater efficiency than her East European neighbors, ranking first among the six countries which made up Eastern Europe (East Germany, Poland, Hungary, Czechoslovakia, Romania and Bulgaria) as well as the Soviet Union. The term efficiency in this context is a unitless measure defined as the dollar amount spent on energy divided by the dollar value of

---

[4]Ibid.

[5]"Gas Price Protest Cripples Hungary," *New York Times*, 28 October 1990, 14.

[6]"Jump in Gasoline Prices is Softened in Hungary," *Associated Press*, 29 October 1990.

[7]Personal communication with Andras Barna, a lawyer in the Budapest office Arent, Fox, Kinter, Plotkin & Kahn, July 1991.

all goods and services produced. This energy efficiency measure for selected European countries is listed in Table 1.0.i. As shown in the table, Hungary has achieved significant gains in terms of efficiency surpassing other East European countries but remains far behind more developed countries, like West Germany.

TABLE 1.0.i. COMPARISON OF ENERGY EFFICIENCY FOR SELECTED EUROPEAN COUNTRIES
(Total Primary Energy Requirements Per US $1,000 GNP)

West Germany	0.33
Hungary	0.49
Czechoslovakia	0.61
Poland	0.76

Source: Mohnfeld, *Intereconomics*[8]

It is worth noting per capita energy use is significantly higher in the developed OECD nations than in Hungary and other East European countries. Still, compared to Western industrialized countries, Hungary is, on average, half as energy intensive given the traditional emphasis on heavy industry and subsidized energy.

The foreign debt of Hungary is behind Poland and East Germany in gross dollar terms. However, foreign debt per capita or per GNP is higher in Hungary than in any of the other CMEA Six. At $1,950 external hard-currency debt owed per capita in 1989, the burden is nearing the highest per population in the world. In 1989, total convertible currency debt amounted to $20.6 billion. Table 1.0.j. compares Hungary's external debt burden with that of Poland and Yugoslavia for 1988.

TABLE 1.0.j. FOREIGN DEBT IN SELECTED EAST EUROPEAN COUNTRIES, 1988

	External Debt (millions)	Debt as % of GNP	Debt per Capita
Hungary	$17,561	67%	$1,657
Poland	$42,137	60%	$1,112
Yugoslavia	$21,684	36%	$ 919

Source: World Development Report 1990. The World Bank. Oxford: Oxford University Press, 1990. From Table 1 (p. 178,9) and Table 21 (p. 218,9)

While the external debt position is a major factor influencing foreign investment, Western businessmen perceive Hungary's economy as very strong among the CMEA Six. The only East European institution or business rated by one of the two main US rating agencies is Moody's rating of the National Bank of Hungary. Apprehension about Hungary's economic future surfaced following Moody's down-grade of the bank when, in July 1990, Moody issued the following statement: "the speed of political and economic change in Eastern Europe has reduced the country's capacity to service its existing debt burden." Hungary is also rated by the Japan Credit Rating Agency, which has given the country high marks.

---

[8]Jochen H. Mohnfeld, "Energy and Oil in Eastern Europe--Status and Prospects," *Intereconomics* July/August 1990, 205-210.

1.1 Coal

As recently as 1965, coal constituted 70 percent of primary energy consumption in Hungary.[9] By 1980, that figure had dropped to under 30 percent, as coal production and consumption declined within the energy balance of Hungary and other East European nations (except Romania, where coal has remained a mainstay). The reasons for the decline across the region are twofold: easily exploitable deposits have been depleted substantially over the years, and the declining caloric content of the coal that is produced.[10] One ton of anthracite coal, known as hard coal, may have more than 2 times the energy value of a ton of subbituminous or soft coal.

The Ministry of Industry and Trade controls the eight coal mine enterprises. Coking coal is produced by the Mecsek coal mines. Hungary's coal supply includes small deposits of hard coal near Pecs and a much larger volume of exploitable lignite, also known as brown coal in Dorog and Tatabanja, in Transdanubia, and near the Slovak frontier.

The Hungarian government has identified a need in the coal fields for modern equipment and even basic machinery in some cases. The principal needs for coal technology include: a balance between drift driving and stripping, uniform mechanized safety systems and machine oriented technology for working and ripping lines.[11]

1.1.1 Production

Since 1980, when Hungary actually surpassed production targets, Hungarian coal mining has fallen short of expectations and actual targets were missed for the years 1983 through 1985.[12] In the most recent period, production has continued to wane considerably (Tables 1.1.a, 1.1.b), and Hungary bears the dubious distinction of being the only country in the region to have produced less coal in 1985 than in 1980; production of hard coal in 1986 represented a 44 percent drop over 1970 levels.[13]

TABLE 1.1.a. PRODUCTION OF ANTHRACITE (HARD) COAL VS. LIGNITE AND SUBBITUMINOUS (BROWN) COAL
(Million Tonnes)

	1985	1988	1989
Anthracite	2.6	2.3	2.2
Lignite/Brown	21.4	18.6	18.2

Source: BP, *BP Statistical Review of World Energy*, June 1990

---

[9]John M. Kramer, The Energy Gap in Eastern Europe, Lexington Books, Lexington, MA, 1990, 70.
[10]Ibid.
[11]"Energy Profiles of Czechoslovakia, Hungary and Poland, and Their Emerging Free-Market Economies," *United States Senate: Committee on Energy and Natural Resources*, June 1991.
[12]Ibid., 79
[13]Ibid.

TABLE 1.1.b. TOTAL COAL PRODUCTION* -- MILLION TONNES OIL EQUIVALENT (MTOE) AND ANNUAL PERCENTAGE CHANGE

Year	Production	Change
1984	7.0	--
1985	6.7	-4.3
1986	6.4	-4.5
1987	6.4	0.0
1988	5.8	-9.4
1989	5.7	-1.7

*Commercial solid fuels only.
Source: BP, *BP Statistical Review of World Energy*, June 1990.

Hungary has traditionally supplied a small portion of the world's coal supply, providing less than 1.0 percent of the 1989 total.[14] The production shortfalls were exacerbated by the fact that investment in mine development has been focused on higher, and less plentiful, grades of coal to maximize the investment return. Economies of scale obtainable through development of soft coal reserves have not been realized.

If the current trends continue, the outlook for indigenous coal production as a solution to Hungary's energy shortage is dubious. The Ministry of Industry and Trade in June 1991 announced the closing of all unprofitable mines. The short-run loss in domestic production will be replaced by an increase in imports, however the government indicated that it has long-term plans to open new mines.[15] The Hungarian coal sector is also beset by problems of labor productivity: the work force is declining and 40 percent of machinery was judged obsolete in 1985.[16] Coal workers are idle an estimated 50 percent of the time due to equipment failure and breakdowns [17]

1.1.2 Supply and Demand

With the decline in indigenous supply, Hungary's imports of hard coal from the Soviet Union have increased in recent years (Table 1.1.c).

The figures for coal and coke imports indicate that Hungary's reliance on the Soviet Union for extra resources has varied considerably year to year. Hungary's coke trade relationship with the Soviets is unique among all East European countries except the former East Germany, which historically has imported approximately twice as much Soviet coke as Hungary. Poland is a supplier of coke to the Soviets; in all other East European countries trade is minimal.

---

[14]BP, *BP Statistical Review of World Energy*, June 1990.

[15]"Government Approves New Energy Policy," *Budapest MTI*, 19 June 1991, (as found in *Foreign Broadcast Information Service: East Europe*, 20 June 1991.

[16]Kramer, 78, quoting Laszlo Kovacs, Secretary General of the Trade Union of Mining Industry Workers. Kovacs reportedly characterized the 1980-1986 period as one of "enforced, exploitive mining."

[17]Kramer, 79. The figures cited were reported on Radio Budapest in 1985 and confirmed in RFE *Situation Report* (Hungary), 3 January 1986.

TABLE 1.1.c. HARD COAL AND COKE IMPORTS FROM THE USSR

	1986	1987	1988	1989
Hard Coal:				
Thousand Metric Tons	979	925	1234	1384
Percentage Change	--	-5.5	33.4	12.2
Coke:				
Thousand Metric Tons	542	397	477	481
Percentage Change	--	-26.8	20.2	0.8

Source: *PlanEcon Report*, June 1990.

1.2 Oil

The prospects for increased domestic production of oil are meager despite continued government investment in exploration and drilling. The yields from Hungary's largest oil field, located in Algyo, have been disappointingly low and are expected to decrease significantly over the next ten to twenty years. Although primary oil demand has tapered somewhat over the past ten years, Hungary remains heavily dependent on imported crude.

The crude oil produced in the great plain region surrounding Budapest is then sent via the Algyo product pipeline to the refinery in Százhalombatta. Crude oil imports from the Soviet Union are shipped through the Friendship II pipeline and products are shipped through the Beregovo-Nyirehaza-Leninváros pipeline.[18]

In December 1990, the government liberalized the import, trade and pricing of oil products. This step relieves the National Oil and Gas Trust (OKGT) from the sole responsibility of supplying the country with these products and abolishes the central pricing system. Importers, however, are required to hold a portion of their total imports in reserve. Five percent of all crude oil imports and eight percent of oil derivatives are the compulsory reserve levels for 1991. Since these are much lower than the levels in other West European countries, it is anticipated that the government will increase the reserve requirements in 1992.

1.2.1 Production

Hungary currently fills between 20 and 30 percent of its petroleum requirements through domestic production.[19] Of the East European countries, Hungarian oil production is second only to Romania. As world production has increased six-fold since 1950, however, Hungary's production has increased only

---

[18]"Hungary," Cambridge Energy Associates. Information obtained from the Embassy of the Republic of Hungary, Office of the Commercial Counselor, August 1991.

[19]Estimates vary. See Mohnfeld and Davey.

four-fold. Production seems to have reached a plateau of approximately 40 thousand barrels per day since 1980; whether the slowdown is due primarily to infrastructure limitations, quotas or well productivity remains unclear.[20]

Hungary currently operates three refining plants: Dunai KV-Százhalombatta, Tiszai KV-Leninváros and Zalai KV-Zalaegerszeg (Table 1.2.a). In addition, there are two smaller specialized units at Komarom and Nyibogdany.[21] Together the plants have been responsible for maintaining a small but steady flow of refined products since the early 1970s (Table 1.2.b). While there is some discrepancy in throughput figures for Hungary's refining sector, there is general agreement that the refining capacity is underutilized. Hungary's refineries are relatively unsophisticated and in need of modernization.

TABLE 1.2.a HUNGARIAN REFINING CAPACITY
(000 b/cd)

	Crude Capacity	Catalytic Reforming	Catalytic Cracking
Dunai KV-Százhalombatta	150	20	23
Tiszai KV-Leninváros	60	--	--
Zalai KV-Zalaegerszeg	23	--	--
Total	233	20	23

Source: *International Petroleum Encyclopedia 1990.*

TABLE 1.2.b. REFINING FLOWS 1982 TO PRESENT

	Thousand b/d	Million tons/yr
1982	312	15.5
1983	311	15.5
1984	312	15.5
1985	242	12.1
1986	242	12.1
1987	242	12.1
1988	220	11.0
1989	220	11.0
1990	220	11.0

Source: *International Petroleum Encyclopedia 1990.*

---

[20]International Petroleum Encyclopedia, PennWell Publishing Co., Tulsa, OK, 1990.
[21]"Hungary," Cambridge Energy Associates.

The data for Hungary shows that capacity has not changed much since the early 1980s, indicating that the infrastructure of these refining plants may not have been upgraded for some time. As demand for energy increases with the progression of economic reform, significant potential exists for Hungary to increase its refining capacity and market the products of these operations in other parts of Eastern Europe and beyond.

1.2.2 Supply and Demand

Hungary's supply of petroleum has not kept up with consumption despite a tapering of oil demand throughout the eighties. Preliminary 1990 figures indicate that oil demand fell to just over 170 thousand barrels per day. The decline in consumption has been attributed to the fall in industrial output as well as significantly higher fuel costs. Hungary possesses an internal supply of petroleum adequate to provide approximately one-fifth of its oil consumption;[22] the nation currently purchases the balance from the Soviet Union (Table 1.2.c) and a few other sources.

TABLE 1.2.c. OIL IMPORTS FROM THE SOVIET UNION
(000 Metric Tons)

Year	Crude Oil	Refined Products
1986	7,430	1,426
1987	7,470	1,429
1988	6,920	1,434
1989	6,321	1,471

Source: *PlanEcon Report* June 1990.

Hungary is one of two CMEA Six nations not totally reliant on foreign oil imports. Hungary produced as much as 20 percent of its domestic demand in 1988. In contrast, Bulgaria, Czechoslovakia, Germany (East), and Poland were dependent solely on foreign imports of oil.[23] Table 1.2.d lists the magnitudes of oil dependence for each of the CMEA countries.

Hungary's hard-currency debt and balance of payments are not as radically affected by changes in the per-barrel price of oil as other CMEA countries. Hungary's lesser dependence on imported oil means that it is in a better position to withstand oil price increases. Table 1.2.e shows the share of hard-currency exports required to cover oil imports at various world market oil prices.

Production constraints stemming from the restructuring of the Soviet economy have curtailed petroleum deliveries in past years; more recently, drastic cuts have led to rationing and price hikes in the last year. In October, Hungarian government officials attempted to increase gasoline prices by 65 to 70 percent to approximate the world price and were thwarted by a nationwide blockade instigated by taxi and truck drivers which forced the government to limit increases to 50 percent. Following the new regulations imposed by the Soviet Union after January 1, 1991, under which CMEA countries must pay hard currency

---

[22]W. G. Davey, "Energy Issues and Policies in Eastern Europe," *Energy Policy*, February 1987, 59-72.

[23]"High Price for Energy Freedom," *New York Times*, May 1990.

at a market price for petroleum (and other imports), supply constraints grew stiffer as Hungary was forced to look to its meager foreign exchange reserves for payment.

TABLE 1.2.d. 1988 RELIANCE ON OIL IMPORTS FOR THE CMEA SIX

	Domestically Produced Oil Consumption (000 b/d)	Imported Oil Consumption (000 b/d)	Imported Oil as a Percent of Total Consumption
Bulgaria	0	340	100%
Czechoslovakia	0	320	100%
Germany (East)	0	400	100%
Hungary	40	160	80%
Poland	0	330	100%
Romania	190	330	63%

Source: "High Price for Energy Freedom," *New York Times*, May, 1990

TABLE 1.2.e. OIL IMPORTS AS PERCENTAGE OF HARD-CURRENCY EXPORTS

	Oil Prices (per barrel)		
	$10	$20	$30
Bulgaria	40	80	120
Czechoslovakia	30	60	90
Germany (East)	22	44	66
Hungary	7	14	21
Poland	11	22	33
Romania	4	8	12

Source: "Ailing Eastern Europe Sails Into an Oil Slick," *Financial Times*, August, 1990

Supply from the Soviet Union was supposed to total 6.48 million tons in 1990.[24] The reduction of July deliveries by 30 percent and an overall shortfall estimated at 22 percent was a major factor in the Hungary's economic decline during 1990.

Hungary has been a leader in Eastern Europe, however, for development of alternative suppliers. As an original proponent of the Adria pipeline project in 1965, Hungary placed high hopes on the prospects for

[24]"Lights Going Dim in Eastern Europe," *Financial Times*, 17 September 1990.

this source. Middle East oil would be shipped by tanker to Yugoslavia and then sent to Hungary via the Adria pipeline. Despite Hungary's efforts to expand its alternative sources of crude oil, the current utilization rate of the Adria pipeline is well below the 640 thousand barrels per day capacity (30 million tonnes annual capacity). The project proved unfeasible in its original design given the political upheaval in the Middle East during the 1970s, and OPEC's desire to trade exclusively in hard currency. The Adria pipeline, however, did begin operating in 1987 and supplied Hungary 1.5 million tons of oil in 1990. Direct supplies of Middle Eastern oil to East Europe ballooned during the 1970s, from 2.3 million tons to 17 million tons in 1980.[25] Hungary drew upon these new supplies, although not to the same degree as some of its neighbors (Table 1.2.f).

The data indicate that there was considerable variation in annual oil imports for most countries during the seventies, with the exception of Poland. That Hungary had developed supply links at all with the Middle East, with all of the supporting infrastructure, bodes well for the opportunities to increase supplies from noncommunist sources, now that Hungary effectively must purchase all energy imports at world market prices.

TABLE 1.2.f. CRUDE OIL IMPORTS FROM NON-COMMUNIST COUNTRIES, SELECTED EAST EUROPEAN COUNTRIES
(barrels per day)

	Hungary	Czechoslovakia	Poland
1970	7,940	7,920	0
1971	9,800	16,740	0
1972	17,540	13,280	0
1973	15,840	22,600	11,400
1974	13,820	7,280	16,540
1975	29,480	6,720	48,480
1976	21,200	15,320	69,000
1977	16,440	27,000	72,740
1978	29,260	17,300	76,300

Source: National Foreign Assessment Center (CIA), *Energy Supplies in Eastern Europe: A Statistical Compilation*, (ER79-10624, December, 1979); Kramer, 95.

The Middle East countries which have the highest trade volume with Hungary are Saudi Arabia and Iraq. Hungarian exports to Saudi Arabia in 1988 were $47 million in 1988 and were believed to be over $70 million in 1989.[26] In February 1990, Iraq paid off a portion of a $32.5 million loan owed to Hungary with 210,000 tons of oil, becoming Hungary's number two supplier of petroleum.[27]

---

[25]Kramer, 93.
[26]"Ailing Eastern Europe Sails Into an Oil Slick," *Financial Times*, 15 August 1990.
[27]Ibid.

The Middle East crisis has also had a direct effect on Hungarian supplies of petroleum. Prior to the invasion of Kuwait by Iraq on August 2, 1990, Hungary had been close to finalizing an agreement with Kuwait through which Kuwaiti oil would be refined in Hungary, Kuwait would supply Hungary with a guaranteed volume of energy, and Hungary would gain access to Kuwaiti retail markets.[28] The agreement indicates that Hungarian refining capacity remains unfilled and the government's attempts to secure new supplies will continue to be frustrated for the short term. In the longer term, Hungary will remain frustrated in its ability to purchase oil on world markets at world market prices, given constraints on the supply of foreign reserves; the nation will continue to seek countertrade agreements. Reliance on this type of transaction cannot constitute a long-term solution, however, given the rise in relative power of the corporate sector and the obvious instability of such agreements.

Crude oil bought on the world market, however, has two drawbacks for Hungary: it is very expensive, due largely to high transportation costs, and it necessitates changes in Hungary's refinery system. The Hungarian Oil and Gas Trust (OKGT) is interested in joint ventures with western oil companies to add conversion and desulfurization equipment to its refineries. Refinery modernization would allow Hungary to take greater advantage of high quality crude oil purchased on the world market. Hungary is interested in expanding its capability to produce lighter products, particularly lead-free gasoline.

Prior to January 1, 1991, all oil imports and exports were controlled by the state-owned monopoly, Mineralimpex. That monopoly was abolished and trade restrictions on oil have been lifted. The biggest competitor for Mineralimpex is AGEL, a newly formed trading subsidiary of the OKGT. The OKGT is responsible for the refining and distribution of crude oil and oil products. Although the management teams of both firms are well-versed in free market practices, Mineralimpex has more knowledge and experience concerning futures and options trading. Both companies are currently active in the futures market with the help of several Western trading firms.

Hungary ranks in the middle of East European countries for consumption of petroleum, but comparatively high for intensity per capita. Using oil consumption per capita as a measure of living standards, Hungary is twice as energy-intensive as Poland, but only half that of West Germany.[29] As the Hungarian standard of living increases, it is expected that its per capita oil consumption will also rise. To prevent serious economic problems that could jeopardize the potential increase in Hungary's standard of living, the increased oil use should be coupled with efficiency gains. Future gains in efficiency of petroleum use, however, will be a direct function of both structural transformation in the society and market pricing.

Although some energy experts would argue that Hungary's progress in oil use efficiency will pave the way for even greater gains in efficiency down the road, others have expressed greater pessimism. Victor Merkin, of Delphic Associates in Falls Church, Virginia, concluded that Hungary had already tapped two-thirds of the potential savings made possible through technical adjustments.[30] Savings from alterations in high-volume uses of liquid fuel in the industrial sector, agriculture and transportation were effected through direct planning from the central authorities. Marginal savings through incentives to conserve in less obvious sectoral processes will undoubtedly prove to be more difficult.

---

[28]Ibid.

[29]Mohnfeld, "Energy and Oil in Eastern Europe--Status and Prospects," 205-210.

[30]Victor Merkin, *Petroleum Conservation in Eastern Europe*, Delphic Associates, Inc., Falls Church, VA, 1987.

1.3 Natural Gas

The output of Hungary's largest natural gas and oil field in Algyo is expected to decrease significantly over the next 10 to 15 years. The Algyo gas fields, at the current extraction rate of three billion cubic meters per year, provide over half of the country's hydrocarbon production. Hungary's intensive research in better extraction techniques has brought little results. The chairman of the Nagyalfold Crude Oil and Natural Gas Extraction Enterprise, Pal Valastyan, indicated that the fall in domestic production may be mitigated by improving exploration tools and methods.[31] While joint ventures with Western firms are the most expedient way to acquire advanced technologies, economic barriers in the form of legislation governing natural resource recovery activities currently preclude such options.

1.3.1 Production

During the eighties Hungary's production rate of natural gas averaged nearly 17 million cubic meters per day meeting just over 50 percent of its demand. Unlike Yugoslavia and Romania whose production dramatically increased over the last decade, 300 and 100 percent, respectively, Hungary's production has remained steady, more similar to the production trend exhibited by Poland and Czechoslovakia (Table 1.3.a).

TABLE 1.3.a. NATURAL GAS PRODUCTION IN SELECTED EAST EUROPEAN COUNTRIES, 1979-1989
(millions m^3/d)

	Hungary	Poland	Czechoslovakia
1979	17.8	20.1	2.3
1980	16.8	17.3	1.7
1982	18.2	15.1	1.8
1983	17.8	15.1	1.7
1984	18.9	16.7	2.1
1985	20.4	17.5	2.0
1986	19.2	16.0	2.0
1987	19.5	15.9	2.1
1988	17.3	15.6	1.9
1989a	16.9	14.6	2.3

a = Estimate

Source: CIA, *International Energy Statistical Review*, October 1990.

The flat production rate of Hungarian natural gas contrasts sharply with world production trends. Global production has increased steadily since 1979; the total increase amounts to 32.4 percent over 1979 levels. Leading the trend is the Soviet Union, the world's largest producer, where production grew 92 percent over the decade and constituted 37.5 percent of the world supply of natural gas in 1989 (the United States is the second largest producer, generating 25.5 percent of the world's supply). British Petroleum estimates that the Soviet Union and East Europe hold 50 years' worth of supply, contrasting sharply with North

---

[31]"Current Status of Fuel Supplies Analyzed," *Magyar Nemzet* in Hungarian, 30 October 1990, (English translation as found in *Foreign Broadcast Information Service: East Europe*, 6 November 1990).

America, with approximately ten years' supply and the Middle East, where supplies could last more than 350 years.[32]

1.3.2. Supply and Demand

As is the case with petroleum, Hungarian demand for natural gas has outstripped domestic supply, forcing Hungary to make up the difference through imports. Since 1979, the gap has widened; in 1989 Hungary exhibited a shortfall of 16.4 million m^3/d (Table 1.3.b.).

Hungary imports nearly 50 percent of the 33 million cubic meters per day of natural gas it consumes (1989). Although more current figures could not be obtained, residential heat in 1984 accounted for nearly 13 percent of all natural gas consumption. The trend appears to be toward natural gas heat which could be expected to increase the share consumed by households. The government has reported that approximately 700,000 residences are being connected to the gas network each year. In 1990, Hungary's natural gas prices were 90 percent of world market levels, heavy fuel 71 percent and diesel fuel just 69 percent.[33]

Since nearly 33 percent of all Hungarian households were heated with natural gas in 1990, there is significant seasonal variation in natural gas demand. During the summer of 1990, with Hungary's storage tanks filled to capacity in preparation for the winter heating season, limits had to be imposed on domestic production. Measures are already underway to reduce Hungary's dependence on the Soviet Union, its only external supplier of natural gas imports. Dr. Valastyan has recommended opening new storage tanks so that more natural gas could be purchased in the summer months when prices are low.[34] Natural gas imports from the Soviet Union which totaled 6.2 billion cubic meters in 1990, are expected to fall to 5.2 billion in 1991.

TABLE 1.3.b. NATURAL GAS SHORTFALL 1979-1989, SELECTED EAST EUROPEAN COUNTRIES
(millions m^3/d)

	Hungary	Poland	Czechoslovakia
1979	7.5	10.9	10.0
1980	11.1	14.7	23.0
1982	10.7	15.5	24.0
1983	11.1	16.4	24.6
1984	10.5	16.4	28.7
1985	11.0	16.2	29.7
1986	13.1	19.5	30.8
1987	13.6	20.6	31.8
1988	15.2	16.6	32.5
1989a	16.4	18.2	33.8

a = Estimate

Source: CIA, *International Energy Statistical Review*, October 1990.

---

[32]BP, *BP Statistical Review of World Energy*, July 1990, 20.
[33]*Regional Energy Listener*, Energy Information Ltd., 15 August, 1990.
[34]"Current Status of Fuel Supplies Analyzed," 30 October 1990.

Construction of a pipeline between Gyor in western Hungary and Austria, which will provide an additional 2-2.5 billion cubic meters of natural gas annually, is expected to be completed by 1992. The project, funded by the World Bank, is estimated to cost $45 million. The second phase of the project, scheduled for completion in 1995, will connect Hungary and Czechoslovakia to Algeria and carry 4 billion cubic meters of natural gas annually to Hungary. With the growing number of homes connected to the national gas network, Hungary's import requirements are expected to exceed 10 billion cubic meters by the year 2000. Operating an electric power station on the natural gas that is unsuitable for the network because of low pressure levels is a solution to Hungary's fuel supply shortage that is currently being considered.

The natural gas industry, in an effort to increase revenues and its product base, has been actively involved in developing extraction techniques to obtain propane-butane and other raw materials valuable to the chemical industry from natural gas. The result has been an expansion in products manufactured on the basis of natural gas from seven to seventeen.[35]

1.4 Nuclear Power

Hungary's first nuclear power reactor began commercial operations in 1983. The Paks power station consists of four Soviet reactors, details of which are provided in Table 1.4.a. By 1988, nuclear power generated 12.7 billion kWh and accounted for 46 percent of Hungary's net electricity generation.

TABLE 1.4.a. NUCLEAR POWER REACTORS

Station Name	Reactor Type	Gross Capacity (MWe)	First Commercial Operation
Paks 1	Pressurized Water	440	8/83
Paks 2	Pressurized Water	440	11/84
Paks 3	Pressurized Water	440	12/86
Paks 4	Pressurized Water	440	10/87

Environmental and safety considerations are some of the obstacles preventing the expansion of nuclear power capacity. Supplies of enriched uranium, currently provided by the Soviet Union, are not assured for the future; in addition Hungary has problems of nuclear waste disposal.

1.4.1 Uranium

Small uranium deposits were discovered near Pécs in 1953. The uranium is sent to the USSR for processing for use in Hungary's nuclear power reactors. Hungary's uranium deposits are thought to be sufficient to supply the Paks nuclear power station until the year 2020.

1.4.2 Generating Capacity

Prior to 1987, little hard data on the nuclear capacity of Hungary and the other Socialist countries was obtainable by outside parties. With the advent of a major study under the auspices of the International Atomic Energy Agency (IAEA), and with the loosening of information flow from within the USSR and from the CMEA countries, the nuclear power capacity and potential has become clearer.

---

[35]Ibid.

Hungary ranks among the highest of East European countries with respect to the proportion of domestic power production supplied by nuclear technology. In terms of meeting overall primary energy requirements, also, Hungary ranks at the top of CMEA countries and near to the former Federal Republic of Germany (Table 1.4.b).

The design of the Hungarian nuclear plants is based on Soviet prototypes, but, according to Imre Szabò, Hungary's Undersecretary of State for Industry, they meet Western safety requirements.[36] A recent effort by German authorities to ensure the safety of Soviet-designed plants in the former East Germany led to the decision to shut down five nuclear reactors there and several contingents of American nuclear executives have visited plants in other East European countries. Although closure of the Hungarian facilities is not anticipated, Hungarian officials are concerned that pressure may build to replace the nuclear capability with coal and gas-fired electricity utilities. A Hungarian embassy spokesman in Washington, Gabor Szentivanyi, said in response to the recent effort, "We are really in bad shape regarding our long-term energy needs. Our reactors have some self-containment [for radiation leaks] and are relatively safer than those earlier Soviet types. We hope we don't have to shut them down."[37]

TABLE 1.4.b. PERCENTAGE OF TOTAL PRIMARY ENERGY REQUIREMENTS MET BY NUCLEAR SOURCES, SELECTED COUNTRIES

Hungary	10%
Bulgaria	10%
Czechoslovakia	8%
GDR	3%
Poland	--
Romania	--
Average Eastern Europe	1%
Soviet Union	3%
FRG	11%

Source: Mohnfeld, *Intereconomics*, 1990.

Unlike many of its neighbors, Hungary does not have any major plants under construction as of mid-1990. Reports in 1987 of a Hungarian investment in additional reactors at the Paks site and in additional Soviet capacity[38] from which Hungary could rely on a steady source of electricity have not materialized. A second station reached the design stage before being scrapped by the pre-reformist government, for unspecified reasons.[39]

---

[36]Miller, "A Green Wind Hits the East," 56.

[37]"US Heads Effort for Nuclear Safety in Old East Bloc," *The Boston Globe*, 30 October 1990.

[38]Davey, "Energy Issues and Policies in Eastern Europe."

[39]Istvan Lang, "Environmental Future in Hungary," Hungarian Academy of Sciences, a paper presented at the 11th World Conference of the WFSF, 27-31 May 1990, Budapest.

1.4.3 Nuclear Power Programs

Hungary's scheduled expansion of it's nuclear power capabilities has faltered due to environmental and safety problems. Plans to construct two additional power reactors, to be operated by France, have been postponed until 1996. Through international cooperation, Hungary hopes to assure supplies of enriched uranium while at the same time solving it's waste disposal problems. Spent nuclear fuel elements are stored for five years in basins next to the Paks power station before being transported to the Soviet Union. Since these basins are now filled to capacity, Hungary must now find another solution. Following environmental protests in 1989, the government decided against Ofala as a possible storage site.

Agreements have been signed with Cuba, Czechoslovakia, France, former GDR, Romania and the Soviet Union to further cooperation in the peaceful uses of atomic energy. In September 1990, Hungary and Germany signed an agreement on cooperation in nuclear safety and preventing radiation leaks. As a member of the International Atomic Energy Agency (IAEA), Hungary does adhere to the guidelines and safety standards established by the Agency.

1.5 Hydro Power

Hydropower has not constituted a major source of energy for Hungary, despite great hopes pinned on this technology by the Hungarian government early in the 1970s. Despite major investment in hydroelectric generating capacity, Hungary supplies less of its domestic energy through hydro sources than any other East European country (Table 1.5.a). In 1986, Hungary produced 0.64 percent of all the hydroelectricity produced in Eastern Europe.

TABLE 1.5.a. 1986 PRODUCTION OF HYDROELECTRICITY FOR SELECTED EAST EUROPEAN COUNTRIES

	Production (millions of kWh)	Percent of Total Production Electricity	Percent of Domestically Produced	Percent of Exploited Reserves
Hungary	154	0.5	0.5	5.5
Poland	3,784	15.9	2.7	27.2
Czechoslovakia	3,990	16.7	4.7	42.2

Source: *Statisticheskii Ezhegodnik Stran-chlenov Soveta Ekonomicheskoi Vzaimopomoshchi*, 77; *Hospododarske Noviny*, No. 40 (1985), in Kramer, 84.

1.5.1 Hydro Resources

Hungary's main hydro resource is in the Danube. In 1977, Hungary signed an agreement with Czechoslovakia to build a large hydroelectric dam on the Czechoslovakian side of the Danube at Gabcikovo and on the Hungarian side in Nagymaros. The project was to include a reservoir, a 10-mile-long channel for commercial boat traffic, and the two dams with a capacity of 750 MW of electricity for distribution to both countries. Originally slated for completion in 1991, the project began to falter in 1981 when Hungary suspended construction of the Nagymaros plant, intending to suspend construction until 1990. Under intense pressure from Czechoslovakia, Hungary agreed to resume work and contracted with Austria for the provision of equipment, finance and labor in exchange for two-third's of Hungary's share of the generated electricity, or approximately 1.2 billion kilowatt hours beginning with the plant's revised

onset date in 1996. By the late 1980s, the project was nearing completion and each country had spent approximately half a billion dollars on it.

Opposition to the plant surfaced in Hungary well before the reformist government took power in 1989. Citing environmental threats to the water table, fertile agricultural land and forests from flooding, public opposition culminated in a series of large protests, convincing the government to suspend the project again in May 1989. Strong pressure from Czechoslovakia continues. Talks scheduled between the two countries have been delayed continuously, and the debate has taken on nationalist overtones in Hungary.[40]

1.5.2 Electricity Generating Capacity

Had the Nagymaros plant materialized, it would have harnessed a considerable energy resource. The resulting reservoir would have measured 62 km^2 and contained 200 million m^3 of water, extending upstream to Bratislava. The resulting discharge power of the entire 25.2 km channel would have been 5200 m^3/second. The multiannual average flow of the Danube at Bratislava/Pozsony is 2025 m^3/second.[41] The resulting capacity at the Gabcikovo/Bos plant would have peaked at 720 MW while the lower river dam would have generated power with 160 MW generated capacity.

1.5.3 Hydro Programs

In 1989, Hungary's parliament canceled construction of the Gabcihovo-Nagymaros Dam project. While there are no current plans to expand hydroelectric generating capacity, further development programs are likely in the future, particularly in view of Hungary's need for more complete utilization of its energy resources. The current trend in hydroelectric power stations is construction of small plants with sufficient flexible capacity to cover daily peak demand requirements. Financial, as well as environmental, considerations, may make hydroelectric facilities viable for Hungary in the future, however, energy experts do not anticipate a significant increase in hydropower in the near term.

1.6 Electric Power

As a result of the problems plaguing the hydroelectricity sector, Hungary has been forced to import a large proportion of its electricity. The main supplier has been the Soviet Union, and Hungary remains the largest buyer of Soviet electricity exports (Tables 1.6.a, 1.6.b).

TABLE 1.6.a. SOVIET ELECTRICITY EXPORTS, 1986-1989 (million kWh)

	1986	1987	1988	1989
Hungary	10,000	10,530	11,050	11,000
Poland	2,485	3,774	6,382	3,866
Czechoslovakia	1,900	3,700	4,300	5,800
CMEA Six	23,635	28,598	33,607	32,696

Source: *PlanEcon Report*, June 1990.

---

[40]"On the Danube, Unbuilt Dams But Pent-Up Anger," *New York Times*, 5 December 1990.

[41]Don Hinrichsen and Gyorgy Enyedis, *State of the Hungarian Environment*, Budapest: Hungarian Academy of Sciences, the Ministry for Environment and Water Management, and the Hungarian Statistical Office, January 1990, 86.

TABLE 1.6.b. REGIONAL DISTRIBUTION OF SOVIET ELECTRICITY EXPORTS, 1989
(% of Total, Total = 39.3 billion kWh)

Hungary	28.0%
Czechoslovakia	14.8%
Romania	14.8%
Finland	12.9%
Other Socialist Countries	26.1%
Other non-Socialist Countries	3.4%

Source: *PlanEcon Report*, June 1990.

Hungary is a member of th CMEA interconnected power system. Among the CMEA countries electric energy deliveries are made in a synchronized mode of operation. In comparison, the Austrian and Hungarian power systems are connected in an islanded or coursed mode of operation. Approximately equal ammounts of electricity are transferred between Austria and Hungary with supplemental stand-by agreements to increase deliveries to cover peak load demand. All electric import/export activities are managed by the Magyar Muvek Villamos Tröszt (MVMT) which is authorized with all rights for foreign trade.

1.6.1 Generating Capacity

The major share of electric generation, 92 percent, takes place in three geographic regions: the Budapest area (14 percent), the North-Eastern region (24 percent), and the Trans-Danubian region (54 percent). Hungary's internal generating capacity is approximately split evenly between nuclear and carbon-based systems (Table 1.6.c.), a reliance on nuclear that is unique among CMEA countries. Power generated by the MVMT in 1990 accounted for 28,067 gigawatt hours (GWh), equal to 72 percent of domestic consumption (Table 1.6.d).

TABLE 1.6.c. NET ELECTRICITY GENERATION BY TYPE OF ENERGY CARRIER

	GWh		Percent of Total Generation	
	1980	1990	1980	1990
Coal Total	10,847	8,154	47.6	29.7
Energetic Brown Coal	4,821	4,607	21.2	16.8
Lignite	4,721	2,605	20.7	9.5
Hard Coal	1,305	942	5.7	3.4
Hydrocarbon Total	11,873	5,400	51.7	19.7
Fuel Oil	5,609	914	24.6	3.4
Natural Gas	6,174	4,486	27.1	16.3
Fossil Fuels Total (Coal Plus Hydrocarbons)	22,630	13,554	99.3	49.4
Hydro Power	150	178	0.7	0.6
Nuclear	--	13,731	--	50.0
Total	22,780	27,463	100.0	100.0

Source: MVMT, *Technical Data 1990*, Vol. 28, 1991.

TABLE 1.6.d. PRODUCTION AND CONSUMPTION IN THE HUNGARIAN POWER SYSTEM (GWh)

	1980	1989	1990
Gross Domestic Consumption	30,952	40,328	39,224
Production of Power Stations in the MVMT Power System	23,548	29,235	28,067
Production of the Industrial Power Stations + Purchasing	16	9	10
Import Balances	7,528	11,084	11,147
Network Losses	4,219	4,143	4,036

Source: MVMT, *Technical Data 1990*, Vol. 28, 1991.

1.6.2 Transmission and Distribution

The uses of electricity vary according to the development of individual sectors. Worth noting in particular is the fact that transmission losses amount to 10.9 percent of total electricity distribution, nearly as much energy as used in each of Hungary's two leading industries, metallurgy and chemical (Table 1.6.c). This degree of network losses is high, even by European standards, and represents an area for significant energy savings (Table 1.6.f).

TABLE 1.6.e. DISTRIBUTION OF ELECTRIC POWER IN HUNGARY, 1990

Sector	GWh	Percent Share
Transmission Losses	4,036	10.9
Households	9,169	24.7
Agriculture	1,930	5.2
Street Lighting	617	1.7
Other	4,907	13.2
Traction	1,186	3.2
Water Supply	908	2.5
Food Industry	1,320	3.6
Light Industry	1,440	3.9
Chemical Industry	3,750	10.1
Building Material Industry	1,010	2.7
Machine Industry	1,730	4.7
Metallurgy	3,350	9.0
Mining	1,693	4.6
Total	37,046	100.0

Source: MVMT, *Technical Data 1990*, Vol. 28, 1991.

TABLE 1.6.f. COMPARATIVE ELECTRICITY NETWORK LOSSES, 1985

	Percent Losses	Ranking
Netherlands	4.2	1
GDR	4.7	2
Romania	5.7	4
Czechoslovakia	7.6	9
West Germany	7.8	10
USSR	8.3	16
Yugoslavia	8.9	19
Bulgaria	9.0	20
Hungary	10.0	22
Poland	10.8	25

Source: *Poland: Reform, Adjustment and Growth*, World Bank, August 1987.

1.6.3 Development Plans

The long-term development plans for electricity generation remain unclear. Given the controversy surrounding nuclear generation and limits on Soviet willingness to import radioactive waste, and the clear determination of the Hungarian authorities to block further development of hydro resources, the natural solution would be the construction of additional fossil fueled electricity generators. With the advent of

world market prices for oil and petroleum products, Hungary might be tempted to turn to its internal reserves of soft coal, which remain plentiful. But the environmental impacts of increasing soft coal consumption at a rate which would meet electricity demand will probably surpass the ability of the public and governmental officials to accept coal as a solution.

Hungarian academics and research scientists are well aware of the need to mitigate the effects of an historical reliance on coal, especially soft coal, in the development of new coal burning techniques which produce less pollution.[42] Coal grinding processes and coal dust burners, for example, have been introduced on a large scale.[43] Other processes suited for the expected increase in the use of lignite and other highly polluting materials, including fluidized bed burners, are in the planning stages.

Investment in waste-to-energy production technology, biomass burning and other alternative energy resources seems to pose a far more politically acceptable and economically viable solution. Hungary could also realize immediate gains by upgrading electricity transmission networks and improving end-use efficiency in such a way as to reduce the growth of marginal demand and net losses to near zero.

1.7 Alternative Energy Resources

Use of alternative energy sources of all types is limited in Eastern Europe. One estimate is that the CMEA countries supply 0.2 percent of their energy needs via alternative resources.[44] Hungary remains in the preliminary stages of absorbing technology capable of producing energy from alternative sources on a scale that will meet domestic demand.

The move toward alternative energy use has been driven more by concern for the environment and the results of decades of unchecked carbon emissions than by an anticipated increase in the price of fossil fuels. However, the anticipated introduction of greater nuclear capability in the form of additional blocks at Paks, an increase in natural gas imports from the Soviet Union, coal washing, unleaded petrol and rail electrification have not yet materialized.[45]

1.7.1 Solar

Hungary at present benefits from no solar technologies on any scale worth noting. The weather patterns in the East European region are not as conducive to either active or passive solar collection as in regions of the United States where these technologies have been most fully utilized.

1.7.2 Wind

Hungary has also not yet researched or developed an understanding of the full potential of wind resources. Potential for harnessing wind energy also relies on weather patterns and frequency and intensity of sunlight. Although several energy ministers and researchers have expressed a strong interest in both wind and solar technologies, no evidence exists of actual research to date.

---

[42]Hinrichsen and Enyedi, *State of the Hungarian Environment*, 62.

[43]Ibid.

[44]Kramer, 89.

[45]Hinrichsen and Enyedi, *State of the Hungarian Environment*, 64. At the time of publication (January 1990), these measures were all discussed as methods of reducing sulfur emissions.

1.7.3 Biomass

The potential for biomass technology is great for Hungary. Janos Vargha, a leader in the environmental movement in Hungary and the head of the Budapest office of the Panos Institute, an international research organization dedicated to sustainable development, noted in 1990 that Hungary's production of biomass is relatively high and could well support the introduction of biomass-fired gas turbines of the sort being developed in the United States.[46] The Hungarian Energetics Institute is at the forefront of developing a biomass capability. One cogeneration plant is already operating in the northwestern industrial town of Tatabanya.

1.7.4 Geothermal

The use of geothermal technology in Hungary is limited but geothermal waters currently provide heat and hot water for six thousand apartments and two industrial plants.[47] As part of its overall energy policy program, the government included funding further development of geothermal.

---

[46]Miller, "A Green Wind Hits the East," 61.

[47]Kramer, 88.

2.0 ENERGY USAGE IN THE HUNGARIAN ECONOMY

The Communist emphasis on heavy industry as the pillar of socialism guided the post World War II economic development of Hungary. According to standard indices used to measure growth in centrally planned economies, Hungary appeared to be a developed industrial state. Poor in natural resources and the raw materials to support industrialization, Hungary became totally dependent on foreign trade. The Communist system, while adequate for producing mediocre goods, has been unable to compete on world markets which demands technologically sophisticated production. Because energy is such a large share of Hungary's foreign trade, increasing energy efficiency in conjunction with conservation is critical to the success of the economic restructuring program.

2.1 Industrial and Manufacturing

Hungary had developed a strong reliance on the heavy industry, as is true for most other East European countries. This means of economic development has been tantamount to intensive and inefficient energy use, as well as being extensively polluting. The manufacturing industry relies predominately on low thermal value coal with high ash and sulfur content to fire their boilers. Hungary's consumption of raw materials and energy is 40 percent higher on average than that of other semi-developed industrialized nations. The most energy and raw material intensive industries are located the industrial axis running from the North-East to the South-West in the Mecsek mountains in close proximity to coal bases.[1]

Hungary is the first Eastern bloc country to encourage and facilitate, through favorable incentives, private investments in their industrial sector. Specifically, the government has been highly encouraging of joint-venture opportunities. Over the past few years, they have enacted a series of liberal investment laws which have created an attractive business climate. Over 900 joint-venture relationships within the industrial, manufacturing and commercial sectors have occurred since 1989 between the US and Hungary.

The key legislation creating this investment impetus is the Foreign Investment Act of 1988. This law creates financial incentives with guarantees and protects against private interests becoming nationalized. Further provisions exempt equipment and hardware that is imported as capital investment from import duties. One hundred percent foreign ownership is possible with no sector off-limits for investment. An investment permit can be granted by the Ministries of Finance and Trade within 90 days.

The highly committed attitude of the Government to the development of a market economy, with its aggressive promoting of foreign investments, is one of Hungary's strongest assets. Skilled and educated labor as well as accessibility of European markets contribute to attracting foreign investment in a variety of industrial sectors. On the down-side, language barriers, poor infrastructure, and non-convertible currency can act as deterrents to investment.

2.1.1 Structure

Industrial production wields significant influence for the Hungarian economy, amounting to $2,010 per capita in 1986, nearly 70 percent of Hungary's national revenue. The current industrial base accounts for 26 percent of the fixed assets of the country, 31 percent of the labor base, and 36 percent of the total

---

[1]Marc S. Miller, "A Green Wind Hits the East", *Technology Review*, MIT, October 1990.

GDP.[2] In 1990, industrial production fell by 10 percent and is expected to fall another 5 percent in 1991. Past decades of backward market conditions have made initiatives for radical restructuring in order. Dominated by heavy industry, Hungary's undeveloped infrastructure is rapidly becoming obsolete.[3] The lack of capital and the inflexibility of end-product processes have hampered Hungary's ability to produce goods of higher quality.

The Ministry for Environment and Water Management has proposed a program for restructuring many of Hungary's leading industries.[4] Some of the details of the government's proposal are given below:

- **Iron smelting:** The introduction of modern, computerized, high-sensitivity measuring and processing systems simultaneous with the phasing out of obsolete technologies remains a high priority for the government. Three blast furnaces and four obsolete rolling trains will be removed from operation in 1991. The entire Siemens-Martin steel production will be eliminated by 1995 beginning with the decommissioning of five furnaces in 1991. The target growth rate of modern sheet production is 30 percent and the share of cold-rolled secondary and tertiary products is also scheduled for expansion.

- **Aluminum:** The technology is to be upgraded with furnace reconstruction.

- **Basic material production for the chemical industry:** Modernization and development of plastic production is planned. Several sulfuric acid plants with environmental problems are to be closed, while others, such as nitric acid plants will be modernized. The government intends to modernize the chemical industry with the ultimate goal of expanding its pharmaceutical and plastics processing capabilities. The modernization of crude oil processing, including de-sulferizing capacities, will be expanded thus improving the quality of fuel and motor oils. The target lead content of gasolines by the end of the nineties is 0.15 g/l.

- **Basic material production for light industry:** Recycling of waste paper has been moderately successful due to a national collection network operating to decrease the use of cellulose. The rate of processing agricultural waste such as straw-cellulose and bleached wood fibers is being extended. Textile mills will be reconstructed with the inclusion of energy efficient technology.

- **Processing:** Machine building sector, which requires major intellectual input with material and energy conservation programs, will be supported. Energy saving consumer goods, appliances will be upgraded.

Obsolete manufacturing technology exacerbates the high energy input at the raw material extractive phase. On average, the six countries of eastern Europe use more than twice as much energy per dollar of national income as even the more industrialized countries of Western Europe.[5] Hungary, whose GDP

---

[2]"Sustainable Development: A Hungarian Approach," *Hungarian Environment and Water Review*, Ministry for Environment and Water Management, Vol. 3, Budapest, 1989.

[3]Ibid, 20.

[4]Ibid, 21.

[5]"East European Pollution: Clearing Up After Communism," *The Economist*, 17 February 1990, 54.

is only a fifth of Spain's, uses more than a third as much energy than does Spain.[6] The consumer sector also has a high margin of energy waste. Inefficient automobiles and poor insulation of buildings are two obvious areas for improvement.[7]

In October 1990, Imre Szabo, the Undersecretary of State for Industry, proposed that the traditional heavy industrial sectors be curtailed in favor of light industries.[8] He suggested, for example, reducing output in the metals industry by half while at the same time becoming increasingly more efficient, thus freeing resources to accommodate economic growth in the electronics and food processing industries.

At a national economic forum held in November 1990, business leaders stressed the importance of continuing the liberalization and privatization process. Cost effective investments and energy conservation were also cited as fundamental to growth in the industrial sector.

2.1.2 Labor

Labor productivity in Hungary, as in most of Eastern Europe, is roughly 60 percent of the level of the European Economic Community,[9] while the consumption of energy and raw materials is significantly higher. This has prompted the socialist countries to take measures aimed at more than doubling labor productivity and substantially reducing the unit consumption of power and raw materials by the year 2000.[10] Due to the vital role labor plays in Hungary's successful transition to a market economy, the government is reshaping its labor policy so as to allow for a more accurate reflection of the competitive incentive structure.[11]

The national companies are known for being grossly overstaffed with rampant inefficient processes. The new employment reforms will focus on minimizing these inefficiencies through the promotion of programs that will increase productivity and competitiveness.[12] The government predicts serious unemployment for the interim; however, efforts are currently underway to develop placement and training programs, as well as funding for unemployment benefits.

Hungary has a strong "gray" or "shadow" labor sector, which makes any statistical analysis of national accounts suspect. For example, the economy of after-hours work is for the most part, unaccounted for in gross output. Production managers at state-owned enterprises will secure agreements with the workers to work after hours. The pay for this gray market labor is significantly higher than the regular pay-rate, with quality and productivity for this extra work significantly higher. Similarly, farmers at cooperatives are given access to machinery for use on their own land after hours, enabling them to earn extra money or use the crops as a means of barter.[13]

---

[6]Ibid.

[7]"Sustainable Development: A Hungarian Approach," *Hungarian Environment and Water Review.*

[8]Miller, "A Green Wind Hits the East."

[9]Aleksandr Samorodov, "Coping with the Employment Effects of Restructuring in Eastern Europe," *International Labor Review*, Vol. 128, No. 3, 1989.

[10]Ibid, 358.

[11]Casaba Lalmos, "Political and Economic Reform and Labor Policy in Hungary," *International Labor Review*, Vol. 129, 1990.

[12]Ibid, 41-57.

[13]*Survey of Business Journal*, Vol. 25, Fall 1989, 38-45.

2.1.3 Role of the European Community

As Hungary embraces the next decade, shrouded in a renewed sense of nationalism, it quickly becomes apparent that many of its vital interests are addressed by looking beyond its national boundaries. This outward view is most obviously and immediately filled by the policies and programs of the European Community (EC). Hungary's proximity to the EC and its overtures for membership make its industrial development agenda for the next 10 years intricately linked to the countries of western European as well as to substantial investments from the United States. The Hungarian Prime Minister, Jozsef Antall, has declared that membership to the EC is its foreign policy priority.[14] Presently, the EC is Hungary's second largest trading partner after the Soviet Union.

In their original form, centrally planned economies such as Hungary's are based on the premise of public ownership, thus placing the responsibilities of rulemaking and enforcement within the purview of the same entity. An example of how this has resulted in deteriorating incentives for energy efficiency and pollution control is an analysis of the state-owned enterprises of Hungary. Specifically, a result of the state being regulator and owner is that Hungary's 1987 emissions regulations on air pollution exempted power stations burning high sulfur coal.[15]

2.2 Utilities

Due to recent reforms, Hungary may no longer be accurately described as having a centrally planned economy. However, the economy continues to use both materials and energy intensively. Energy intensity is a result of the lasting form of production taken on in Eastern Europe after World War II as well as low productivity of the workforce. For the utilities, this translates into both less effective generation of electricity as well as inefficient use of power by industry and residents.

Hungary contains the indigenous resources to produce enough electricity to meet its domestic demand. Electricity consumption is projected to grow by as much as 1.5 percent per year through the year 2000.[16] Hungary had intended to meet this demand with construction of two additional Soviet-built, 1,000-megawatt reactors at the Paks nuclear facility as well as a project of hydroelectric power stations. The construction had begun on the two hydroelectric power stations on the River Danube in a joint project with Czechoslovakia (the Gabcikovo-Nagymaros Danube Water Project), which would have given Hungary an additional capacity of 438 megawatts. Both the nuclear facility expansion and the hydroelectric projects have, however, been halted.

There were public protests against the Gabcikovo-Nagymaros dam as soon as construction began. The project was not only considered an ecological threat to areas along the Danube but was also eating up huge sums of money in government investments. After years of lively public debate, Hungary ceased its participation in the Danube project in the fall of 1989. Shortly after this decision, financial considerations and increasingly serious problems with Soviet production and deliveries of nuclear-power

---

[14]"Hungary Exemplifies a New Era in East-West Relations," *Europe*, January/February, 1989, 30.

[15]*Eastern Europe: Environmental Briefing*, Environmental Resources Limited, London, January 1990, 35.

[16]Juergen Salay, "Restructuring the Energy System," *Report on Eastern Europe*, 21 August 1990, 20.

equipment forced the Hungarian government to cancel its plans to build two additional Soviet-made reactors at Paks.[17]

2.2.1 Structure

Due to the past state planning structure of the economy, all utilities are state-owned. In order of decreasing volume, electricity is produced by thermal, nuclear, and hydroelectric power. As of 1988 data, there was relatively no geothermal electricity generation. Thermal power is declining in importance. Nuclear energy only became a source for electrical generation in 1983 with the commissioning of the Paks nuclear station, which currently runs four reactors.

In 1988, the production of electricity by thermal energy made up 53 percent of all sources of energy production in Hungary. This share steadily declined in the 1980's with the growth in nuclear power. By 1988, Hungary had 1,760 MWe installed nuclear capacity which accounted for 49 percent of electric generation. Hydroelectric facilities developed along the Danube accounted for less than 1 percent of total electricity production in 1988. Construction of the Gabcikovo-Nagymaros power station has been halted as a result of the environmental movement.

Electricity is generated both in power plant (public utilities) and at end-use sites (self-production). Self-produced electricity is exclusively thermal in Hungary. Self production accounted for 7 percent of total thermal installed capacity in 1988.[18] This share of thermal production was relatively constant over the previous half-decade.

At the current rate of increase in electric generating capacity, Hungary will not be able to sustain electricity demand in the future. Hungary must reduce the growth in electricity consumption and peak capacity requirements. Rather than hold industrial demand constant, structural change of the energy sector to better incorporate supply-and-demand pricing and efficiency improvement must be undertaken.[19]

It is estimated that 1300 megawatts of combined cycle power generation capacity could be developed by 2005. This capacity would produce some 10 terawatt hours of electricity. If combined cycle capacity displaced coal-fired capacity, the carbon emissions reduction would total some 0.9 to 1.1 million tons of carbon per year, 3 to 5 percent of current emissions.[20]

At present, the Hungarians are discussing ways of compensating for the canceled projects at Paks and Gabcikovo-Nagymaros. Hungary has already received several Western offers to construct nuclear reactors at Paks to replace the two canceled Soviet ones. The most widely discussed alternative thus far has been an offer from the French state-owned enterprise Electricite de France. It has proposed constructing two 900-megawatt reactors for a total cost of 150-200 billion forint at current prices, of

---

[17]Ibid, 20.

[18]United Nations, Energy Statistics Yearbook, 1989.

[19]Tamas Jászay, *Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030*, Report prepared for the U.S. Environmental Protection Agency by Pacific Northwest Laboratory, May 1990, 3.

[20]Ibid.

which 70 percent would be financed by the French.[21] In return, Hungary would deliver the electricity produced to the French firm for the next 15 to 20 years. Other possible sources of electricity under consideration include the construction of a thermal power plant heated by lignite or natural gas. Finally, Hungary is also considering the feasibility of connecting its electricity grid to Western grids through Austria and Yugoslavia. During the summer of 1990, the European Investment Bank announced that it would grant Hungary a loan of $18,000,000 to upgrade its electricity grid and eventually connect it with Western grids.[22]

Within Eastern Europe, Hungary is a particularly heavy user of nuclear power, along with Bulgaria. Energy performance of nuclear reactors has been studied by industry experts. While safety has been a major concern, it appears that the reactors are technically efficient and deliver high performance levels. Thomas finds that "by the standards of reactors in the rest of the world, the performance of reactors in the Comecon countries is extremely good."[23] The annual load factor, weighted by reactor size, is one of the criteria used by Thomas to measure performance. Thomas, as further supporting evidence, notes that reactors in the Comecon countries have a low forced shut-down frequency.

2.2.2 Labor

Little information is available regarding the level of skill of the labor pool currently being used by the utility industry. The general industrial structure, however, leads the utilities to be relatively labor intensive. The power industry is characterized by a large number of small installations with little or no automation of basic technological processes. This industrial framework leads to a relatively high staffing level in the electric power stations.[24]

2.2.3 Technology

The equipment and technology employed in the public utilities would be largely obsolete in the West. There is room for Western involvement in this area, particularly in terms of consulting services and equipment sales. This is not to say that the Hungarian system is completely backward. Capital constraints are more the cause of the lack of advanced technology than the inability of the infrastructure to adapt to newer systems.

Mr. Wenzel writes:[25] "About 700 megawatts new electric power generating capacity has to be installed in Hungary in the 1990s to meet increasing power demand. The needed new power plant capacity might exceed substantially even this figure in case the large scale import power (1850 MW) from the Soviet Union, available at the time being, is going to decrease. Economic aspects and the short lead time put the erection of gas turbine power plants in the foreground. Even of these the most promising investments

---

[21]The forint is the Hungarian unit of currency. The January 1990 exchange rate was 62.5 forints per US dollar.

[22]Salay, 20.

[23]Steve Thomas, "Comecon Nuclear Power Plant Performance: A Comparison with the USA and Japan," *Energy Policy*, July/August 1990, 520.

[24]Vladimir I. Voloshin, "Electric Power in the Comecon European Countries," *Energy Policy*, October 1990, 741-742.

[25]Personal communications with Jessica Toth. Mr. Wenzel is employed by EGI Contracting and Engineering, a Division of Energotechnology, Budapest.

could be combined cycle cogeneration plants that could be integrated into existing district heating schemes. By this way the additional hydrocarbon fuel requirement could be minimized and also investment costs could be saved as the new combined cycle units would make avoidable the -- otherwise badly needed -- reconstruction or retrofitting of the heat sources of these schemes."

2.2.4 Waste Systems

There is little quantitative data published regarding waste streams from energy production facilities, however, waste quantities can be estimated through extrapolation techniques. Treatment and disposal capacities are not subject to stringent environmental regulations in Hungary. Information on the extent of waste-related activities, as well as revenues generated, is scarce as much of this commerce is handled through the underground economy.

With the environmental and "green" movements gaining momentum, pressure will be put on the government to develop infrastructure to manage the environmental and commercial implications of waste generation. The US Environmental Protection Agency has set up a Regional Environmental Center for Eastern Europe in Budapest to address problems in Eastern Europe. The US Agency for International Development, the Hungarian government, and the European Community have also contributed money and management assistance to the project.

2.2.5 Energy Flows

The energy crisis of the 1970s was delayed in Hungary due to the pricing method of averaging world market prices over the previous five years. While fluctuations in the world price of energy products is dampened in Eastern Europe, the effect is that energy intensity does not adequately reflect supply and demand. This is another reason for inefficient utilization of electricity by end-users.

Total electric energy use grew by 16 percent between 1970 and 1988. During the same period, electric energy intensity, the amount of electricity used to produce one unit of output, remained relatively constant,[26] in part attributable to the efficiency measures undertaken in the last two decades. It is also a reflection of the shift toward the service sectors.[27] Jászay quantified the effects of different factors on the change in energy demand from 1970 to 1988. The following table (Table 2.2.a) shows Jászay's analysis.

Low quality coal is a chief source of fuel for power stations.[28] In the past, coal was the most heavily subsidized energy source in Hungary. As subsidies are removed and market prices dominate, power generating facilities will predictably experience pressure to lessen their reliance on coal. The changes in the share of the hydrocarbon fuels and the rise in nuclear energy are shown by the data in Table 2.2.b. In Eastern Europe, 25 percent of all primary energy consumption is used in the generation of electricity.[29] The average figure for developed countries is 35 to 40 percent.[30]

---

[26]Jászay, 2.

[27]Jászay, 2. The service sector's use of energy demand in Hungary has increased steadily over the last decade from 32% of the country's total demand in 1980 to 38% today.

[28]Jászay, 4.

[29]Voloshin, "Electric Power in the Comecon European Countries," 740.

[30]Ibid.

TABLE 2.2.a. CHANGES IN ENERGY DEMAND IN HUNGARY 1970 TO 1988
(Petajoules per Year)

Induced by Rising GDP	+524
Industrial Structural Change	- 73
Improved Industrial Energy Efficiency	-285
Increased Industrial Energy Demand	+166
Increased Service Sector Demand	+240
Total	+572

Source: Tamas Jászay, *Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030*, Report prepared for the US Environmental Protection Agency by Pacific Northwest Laboratory, May 1990.

Table 2.2.b VOLUMES OF FUELS CONSUMED FOR ELECTRIC GENERATION AND HEAT SUPPLY*

	Lignite and Brown Coal**		Hard Coal By-Products 1 Mt=10.99PJ		Fuel Oil 1 Mt=40.34PJ		Natural Gas[1] Gm^3=30.84PJ		Nuclear Fuel	Fuels as Total
	10^3t	TJ	10^3t	TJ	10^3t	TJ	10^3t	TJ	TJ	TJ
1975	14,146	132,727	1797	19,314	1579	63,859	1471	52,526	-	268,426
1985	14,434	121,830	1352	14,815	1479	59,769	2761	84,976	72,736	354,126
1986	14,493	122,030	1727	18,670	1492	59,770	2970	92,100	80,200	362,600
1987	14,607	125,018	1688	18,252	1209	48,440	2513	77,775	119,547	389,032
1988	13,392	116,246	1611	17,472	660	26,335	2435	74,845	147,331	382,229
1989	13,025	111,094	1449	16,684	513	20,432	2660	82,048	150,994	381,252
1990	12,824	108,266	1469	16,129	466	18,573	2382	73,847	148,366	365,121

* The abbreviation Mt stands for million short tons.
** For lignite 1 Mt=6.75 PJ and for brown coal 1Mt=9.75 PJ.

Source: MVMT, *Technical Data 1990*, Vol. 28, 1991.

Hungary's network losses, 10.9 percent of the electricity distributed for sale in 1990, are among the highest in Europe. Average losses associated with medium and low voltage lines vary between 7 and 9 percent, while losses of high voltage lines (400 kV and 200 kV) are in the order of 2.5 percent. Despite the steady increase in length of 400 kV line, from 950 km in 1980 to 1375 km in 1987, Hungary's network losses have remained around 10 percent. From the aggregate information published by the MVMT, it is impossible to determine whether the system's poor performance is due to inefficient transformers, the preponderance of low voltage lines or the quality of the materials. Although further analysis of network losses in each power distribution region at each voltage level precludes any specific

recommendation as to the best investment projects aimed at reducing transmission and distribution losses, it is an obvious area for significant savings. Not only will the increase in efficiency lead to lower fuel consumption but it will also defer the investment in new capacity to meet peak demand.

In addition to oil and natural gas pipelines, the Soviet Union's extensive electricity grids supply electricity to Hungary. Though Hungary has enormous foreign debt with most of the world, the country actually holds a 1 billion rubles surplus with the Soviets.[31] This has resulted from the Soviet Union's inability to provide desirable goods to the Hungarians. Either the quality of Soviet products is too shoddy or supply of desirable goods (such as oil) is limited and sporadic.

Hungary has reached agreements with the USSR for its supply of electricity similar to those for natural gas in which Hungary provided the money and equipment to build the facilities, then is to be repaid in natural gas. In return for investment in the construction of the Khmelnicky nuclear power plant in western Ukraine, Hungary will receive 1,100 megawatts of electricity annually until 2004. For 1990, the USSR has agreed to deliver an additional 750 megawatts. It is still unclear, however, whether Hungary will be able to get more than the agreed 1,100 megawatts per year from 1991 onward. According to a recent interview with the General Manager of the Hungarian Electricity Producers' Trust, the Soviets have not yet stated that these 750 megawatts will be reduced during the next five-year period (1991-1995). Given the constraints placed on the USSR's supply of electricity in the past year, however, it would not be surprising if deliveries to Hungary were cut.[32]

In 1978, the government restricted oil use and required that domestic coal, imported electricity, and natural gas be substituted. This scheme had a profound and lasting impact on energy economics in Hungary. According to Jászay, the policy caused 40 percent of all investment by the industrial sector to be devoted to securing energy supply in 1986.[33] The effect on utilities was also significant. Utilities provided 27 percent of total energy distribution in 1970; in 1988, they were providing 45 percent (Table 2.2.c). The growth in utility distribution of energy is a direct result of declining coal and oil demand over the period.[34]

TABLE 2.2.c. PERCENTAGE SHARE OF FINAL ENERGY CONSUMPTION BY TYPE OF ENERGY CARRIER

	1970	1975	1980	1988
Utilities (subtotal)	27	33	40	45
Natural Gas	13	17	22	25
District Heat	6	7	8	9
Electric Power	8	9	10	11
Other Energy Carriers (oil and coal)	73	67	60	55

Source: Tamas Jászay, *Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030*, Report prepared for the US Environmental Protection Agency by Pacific Northwest Laborator y, May 1990, 3.

---

[31]Jászay, 2.

[32]Salay, "Restructuring the Energy System," 19.

[33]Ibid.

[34]Ibid, 3.

2.3 Agriculture

The agricultural sector of Hungary is comprised of three main categories of farms: state farms, cooperative farms, and small farmers. Together, these farms are engaged in primary agriculture and food production, accounting for about 20 percent of the GDP and 19 percent of the total labor force.[35] The primary opportunity for energy efficiency and energy alternatives within the agricultural sector should be directed at improving productivity through management strategies and technological improvements.

Agriculture was the lead performer in total GDP for much of the late 1970s and early 1980s, with sustained growth at close to 5 percent per year. Weather conditions brought drought and frost during 1984 through 1986. The weather, combined with a reduction in both government subsidies and fertilizer application, resulted in a rapid turnaround for these once favorable growth rates. Since 1983, growth in agricultural GDP, on average, has declined.[36]

The Government, under the jurisdiction of the Ministry of Agriculture and Food, has recently undertaken policy and program initiatives to assist the agriculture sector in regaining its favorable growth rates. Subsidies through state investments and pricing mechanisms, as well as favorable world market conditions, have been the basic formula of successful agricultural growth in the past. The current Government is attempting to maximize these proven strategies to increase agricultural GDP and its share of convertible currency.

Government emphasis on investment opportunities with the following focus is recommended by the World Bank:[37]

1. Viable large farms with export-oriented activities
2. Viable enterprises arising out of a program for restructuring weak cooperatives
3. Support for small farms
4. Continued restructuring of agro-processing enterprises
5. Restructuring and investment support of marketing trusts

More specific prescriptions, provided by the World Bank in August of 1989 in *Agricultural Sector Strategy for Policy and Structural Change*, include:

- **Productivity improvements and technological change:** For primary agriculture, yield improvement measures alone will not be enough. They must be cost effective and must be assessed for their potential capacity for profit generation and improved economic efficiency. For food industry, where total factor productivity has been declining for more than a decade, restructuring initiatives are critical.

- **Production promotion for self-sufficiency:** This objective can no longer be justified on its own -- especially where imported inputs are required. Explicit account must be taken of their potential competitiveness in exports or in substitution for imports. Domestic

---

[35]*Hungary, Agricultural Sector Strategy for Policy and Structural Change*, World Bank, Report No. 7320-HU, August 1989.

[36]Ibid, iii.

[37]World Bank, vii.

production should, therefore, be set against an international efficiency standard rather than domestic costs of production.

- **Improving the share of agricultural exports that are denominated in convertible currency:** Rather than the present consignment or "passive trading" approach, more imaginative ways to actively encourage export penetration in convertible currency markets are needed. There is also the need to develop more flexible measures to respond to changing world market conditions.

- **Enterprise restructuring and management improvement:** Successful measures to increase the independence of agricultural enterprises require not only profit orientation but also changed management-worker relationships consistent with increased managerial autonomy and accountability at the farm or enterprise level. However, because of their linkages, the changing roles of state farms, cooperatives and the private small holder would also need to be re-evaluated.

- **The use of pricing, taxes and subsidies as instruments for resource allocation and production incentives:** In largely dismantling central controls at the production level with the new economic mechanism, indirect controls (involving pricing, taxation and subsidy instruments) have become so complex and cumbersome that efficiency and resource allocation effects can hardly be discerned. The need is for a streamlining of these indirect control instruments. Most important would be the reduction and rationalization of subsidies rather than using them as compensatory payments to mitigate taxes or to promote non-economic activities.

2.4 Services and Retail

Hungary is continuing economic reforms that de-emphasize reliance on heavy, labor-intensive industry. Within this framework, the role and contribution in terms of GDP of the service and retail industries will increase. The International Standard Industrial Classification (ISIC) divides the commercial services in the following manner:

1. Wholesale and retail trade, restaurants and hotels
2. Transport, storage, and communication
3. Financing, insurance, real estate, and business services
4. Community, social, and personal services

Although development of the services sector has been hindered by the lack of adequate data,[38] the opening of Eastern Europe to Western markets and investment opportunities is expected to improve the quality of information. Trade and tourism are growing areas of the service sector, particularly in terms of attracting foreign investment. Foreign participation in catering and services is not yet viable under current licensing procedures since these operations would require active capital in the production realm. Joint ventures in the tourist industry have flourished despite some state coordination to prevent loss of revenue.

---

[38]Trade in Services: Economic Determinants and Development-related Issues, *World Bank Staff Working Paper*, No. 480, August 1981.

2.5 Residential

The residential sector represents the largest share of energy demand in the non-productive sectors. Nearly all households, 99 percent, have electricity. While state-owned apartment buildings currently dominate Hungary's housing market, this trend is shifting toward privately-owned detached single-family homes. With the living space per household increasing, residential demand for energy is also expected to rise.

2.5.1 Geography and Demographics[39]

Terrain: Hungary's closest Western neighbor, both in proximity and in size, is Austria. Hungary occupies 93,000 square kilometers (36,000 square miles) in the heart of Eastern Europe. Budapest, the capital is located in the north, with the Danube River dividing Buda and Pest.

Lake Balaton, in the west, is the largest fresh water lake in Eastern Europe. The Danube River, which is integral to much of Hungary's economic and agricultural activity, is the main waterway and runs down the middle of the country. The Danube and two of its tributaries (the Rába and Drava Rivers) run from the Alpine Mountains. The second major river in Hungary, the Tisza River, is to the East. The Tisza and its tributaries rise in the Carpathian Mountains. Three-fifths of the land in Hungary is regularly cultivated. The rivers are an important factor in farming. The Danube floods twice annually -- in early spring and summer. Large irrigation systems have been built up along the Tisza.

There are four main geographical regions in Hungary: the Little Hungarian Plain, the Great Hungarian Plain, Transdanubia, and the Northern Mountains. The Little Hungarian Plain (Kis Alföld) to the northwest and the Great Hungarian Plain (Nagy Magyar Alföld) in central and southeastern Hungary are lowland areas. They are separated by a low mountain system which crosses southwest to northeast for 400 kilometers (250 miles). The highest peak in the range is 1,015 meters (3,330 feet) above sea level. The Little Hungarian Plain is better endowed with natural resources than the Great Plain. As a result, there is more industrial and agricultural activity in the Little Plain. The Great Plain is made up of isolated farmlands and some oil and gas production sites.

Transdanubia lies to the west of the Danube. Lake Balaton is located in Transdanubia and, as a result, tourism is important in this region. The city of Pécs, located in Transdanubia, is a mining and industrial center key to the Hungarian economy. The fourth region, the Northern Mountains, contains two major industrial basins: Nógrád and Borsod. Besides heavy industry, tourism and agriculture, especially vineyards, are also key in the Northern Mountains.

Location of natural resources:[40] Hungary's main bituminous coal field is located in Transdanubia (in the southwest) at Mecsek. Lignite and brown coal resources are more abundant and widespread than bituminous, with the main fields in the Little Hungarian Plain (in the northwest) at Tatabanya and Dorog. Other lignite and brown coal fields are mined in the Northern Mountains at Nógrád and Borsod.

Oil and gas is found principally in the Algyo field in the Great Hungarian Plain (in the southeast). This field provides 70 percent of the country's supply of oil and 50 percent of its gas. Other fields are located around the Algyo field. Production of the crude products is done in nearby Szeged.

---

[39]"Hungary," The New Encyclopædia Britannica, Vol. 20, 1990, 693-695.

[40]*Energy USSR and Eastern Europe 1986/87 Yearbook*, The Economist Intelligence Unit, The Economist Publications Ltd, London, 1986, 44-48 and centerfold maps.

Population dispersion: More than half of the population of Hungary lives in cities with more than a third residing within the Budapest metropolitan area. Most towns have populations of less than 40,000 people. Budapest has the largest industrial work force and is several times the size of other major cities in Hungary.

Demographic trends:[41] Consistent with most of Western and Eastern Europe, Hungarian population growth in the 20th century has been relatively low. The government is trying to encourage a higher birth rate through a number of measures. The steps taken include making abortions difficult to obtain, housing preference given to families with children, and improved employment rights for mothers. However, legislation has not improved the birth rate significantly, mostly due to economic worries for the future.

The problem of low population growth was exaggerated in the 1980s, when the death rate exceeded the birth rate. Unlike trends found in most regions of the world, male life expectancy at birth is not increasing in Hungary. Female longevity is increasing, but at a slowing pace.

Urbanization and the female surplus: Migration has been predominantly from the villages into the cities. Urbanization has risen from 33 percent in 1930 to 56 percent in 1984.[42] Most urbanization moves are made by the younger population and by men.

With the diminishing population growth rate, the number of people over 60 years old is increasing. In particular, with the young migrating to the cities, the aging population trend is highlighted in rural areas.

Since the 19th century, there has been a larger population of women than men in Hungary. This was aggravated by the advent of the two World Wars, when there were large losses to the male population. Though more men migrate to the cities, there are far more women residents of Budapest. Aside from the capital, the female surplus is most obvious in rural areas.

2.5.2 Technology

In 1980, the percentage of one-room homes was 28 percent, as compared with 71 percent in 1949.[43] The share of three or more room dwellings was 24 percent in 1980, up from 5 percent in 1949. The improvement in living conditions is also demonstrated by the decline in the number of dwellings shared by more than one family. Though apartment houses were nationalized after World War II, state-owned residences account for only a small portion of housing. In 1980, almost three-quarters of all residences in Hungary were privately-owned. The following table gives the breakdown of Hungarian dwellings by type of resident.

---

[41]The New Encyclopædia Britannica, Vol. 20, 1990, 696 and "Modernization in Hungary in the Long and Short Run Measured by Social Indicators," *Social Indicators Research*, Vol 23, Nos. 1-2, August/September 1990.

[42]"Modernization in Hungary in the Long and Short Run Measured by Social Indicators," *Social Indicators Research*, Vol. 23, Nos. 1-2, August/September 1990, 66-67. The number of settlements classified as urban has increased over the years. Therefore, current figures for urbanization are overstated since a larger part of the population would be considered urban as settlements are administratively reclassified.

[43]"Modernization in Hungary in the Long and Short Run Measured by Social Indicators," 100-102.

TABLE 2.5.a. HABITATION OF DWELLINGS BY TYPE OF RESIDENT IN 1980

Proprietors	71.3%
Tenants	28.5%
Official Quarters	0.2%

Source: *Social Indicators Research*, 102.

Since the 1960s, housing construction increased gradually to peak in the mid-1970s at around 150,000 apartments built per year.[44] Currently, the State has stopped construction on all houses and officials estimate that only 4,000 dwellings were built with other funding sources in 1990.[45] Most new housing is financed by private funds. The following table shows the marked decline in the share of state-owned and state-financed housing in Hungary from 1974 to 1984. It is interesting to note that the majority of this slack was picked up by private construction financed with bank credit.

TABLE 2.5.b. SOURCES OF FINANCING FOR NEW HOUSING CONSTRUCTION
(Percent)

	1975	1984
State-owned and State-financed	38	14
Privately-owned, financed	62	86
by Savings Bank	14	26
with Bank Credit	37	58
without Bank Credit	1	2

Source: *Social Indicators Research*, 102.

There is a chronic housing shortage throughout Hungary. In particular, the cities have a significant problem with scarce housing. The Hungarian Ministry of Social Affairs has a waiting list of 170,000 for housing and it estimates that of those, about 134,000 people currently have no housing at all.[46] There have been recent Western reports of homeless families drifting in the cities, unable to secure adequate shelter.

2.5.3 Waste Systems

Materials Recycling: Conservation is being attempted in recycling with a number of resources. For example, in 1990, officials reported that average annual paper recovery as a percentage of paper consumption was 37 percent in 1987, 1988, and 1989.[47] This is a very high rate and was second in

---

[44]"Waiting Lists Grow," *The Financial Times*, 17 September 1990.

[45]Ibid.

[46]Ibid.

[47]*Environmental Data Report*, United Nations Environment Programme, prepared for UNEP by the GEMS Monitoring and Assessment Research Centre, London, UK, 1990, 470.

Europe only to Finland and Spain. Hungary is also recycling plastic, rubber tires, and steel to a fair degree.

Energy Inefficiency: The residential sector in Hungary lacks the incentive to employ conservation measures and uses technologically obsolete equipment that wastes energy. Heat, electricity, and hot water are used inefficiently. Eastern European living quarters average less than 40 percent of the size of average American living space per citizen. Typically, more living space translates into greater energy used for heating and operating appliances; however, Eastern Europeans consume 25 to 50 percent more energy per square meter of living space than Americans.[48]

There is ample room for home heating, lighting, and cooking unit efficiency gains in Hungary. Energy specialists estimate that without changes in energy use habits, energy demand in the residential sector in Eastern Europe will grow by more than 140 percent in the next thirty-five years.[49] This could be held to an increase of less than 50 percent if efficiency standards are set for appliances, energy is metered by household, and realistic energy prices are established. An obvious example of waste is caused by the lack of thermostats in Hungarian apartments: residents regulate indoor temperature by opening windows.

2.5.4 Energy Flows

Residential heat and electricity supply are typically sourced from local power plants. These facilities usually service the local industrial sector as well. Most plants were constructed long ago and are in need of new equipment and general restructuring.[50]

Coal is by far the greatest source of energy for residential purposes, consistently comprising almost half of total residential energy consumption between 1980 and 1984.[51] Buildings are heated by high quality coal.[52] Polish imports are the source of this hard coal. However, emphasis is gradually shifting away from coal. The use of oil declined from 29 to 22 percent from 1980 to 1984.[53]

Natural gas is capturing a larger part of the heating market replacing some of oil's lost share of residential energy use. Of the 3.8 million housing units in 1990, 1.2 million or 32 percent used natural gas for heating. District heating is used by 600,000 households, 400,000 residences heat with oil and 200,000 have electric heating. The remaining 1.4 million households use coal for heating. Although coal customers pay only 40 percent of the cost of production, the government expects natural gas to deepen its penetration into the residential heating market. In addition, plans are underway to switch the coal-fired district heating stations to cogeneration.[54] The Table 2.5.c gives the volume and shares of Hungarian housing energy consumption by type.

---

[48]William U. Chandler, Alexei A. Makarov, and Zhou Dadi, "Energy for the Soviet Union, Eastern Europe and China," *Scientific American*, September 1990.

[49]Ibid.

[50]Personal communications with Jessica Toth and Mr. G.B. Wenzel, of EGI Contracting and Engineering, a Division of Energotechnology, Budapest.

[51]Proceedings from the World Energy Conference (WEC), 1980 and 1984.

[52]Jászay, 4.

[53]WEC, 1980 and 1984.

[54]*Regional Energy Listener*, Energy Information Ltd., 15 August 1990.

TABLE 2.5.c. SOURCES OF HOUSING/MUNICIPAL ENERGY USE
(MTOE and Percent)

	1980	1984
Oil	1.68 (29%)	1.41 (22%)
Natural Gas	0.84 (15%)	1.18 (19%)
Coal	2.60 (45%)	2.85 (45%)
Electricity	0.65 (11%)	0.92 (14%)
Total	100%	100%

WEC, 1980 and 1984.

Oil use can be further broken down. In 1984, liquid fuels were used in the household sector in Hungary in approximately the following shares: gasoline comprised 45 percent of household liquid fuel consumption; gasoil and light fuel oil comprised 41 percent; and LPG comprised the remaining 14 percent.[55] Residences heated by oil account for a large percentage of all Hungarian households. This is expected to decline as oil prices are no longer subsidized and the future supply of oil is made less certain. However, it is interesting to note the Hungarians continuing heavy dependence on oil for home heating as compared with other former socialist countries, such as depicted in the following table.

TABLE 2.5.d. COMPARISON OF EAST EUROPEAN HOUSEHOLDS: PERCENTAGE OF OIL-HEATED HOMES AMONG THE DOMESTIC POPULATION

	1970	1980	2000
Hungary	15.6	31.6	21.6*
Romania	0.6	3.9	N/A
Czechoslovakia	N/A	7.0	4.0

*Average of high and low projections of 22.7% and 20.5%

Source: Victor Merkin, *Petroleum Conservation in Eastern Europe*, Delphic Associates Inc., Falls Church, VA, 1987, 60.

2.6 Transportation

With the increase in industrialization and urbanization, transportation has become more highly utilized in the infrastructure of the Hungarian economy. Goods and the population in general are increasingly more mobile within and across borders. Roads are being improved to meet the needs of trucking and while some of the main roads are good, the secondary roads are still rather primitive. Over 370 million tons of freight was transported during 1985, of which nearly two-thirds was carried by trucks.

---

[55]Victor Merkin, *Petroleum Conservation in Eastern Europe*, Delphic Associates, Inc., Falls Church, VA, 1987, 63.

2.6.1 Structure[56]

Hungary's transportation networks are highly centralized. All major roads, railroads, and air transport are linked to Budapest. Following is a brief overview of the four main means of transportation in Hungary: railroad, road, waterway, and air transport. The table below gives the lengths of road, rail, water ways in Hungary as of 1986.

TABLE 2.6.a. LENGTH OF ROADWAYS, RAIL LINES, AND NAVIGABLE WATERWAYS IN 1986 (km)

Roadways	90,700
Rail Lines	7,800
Navigable Waterways	1,622

Source: United Nations Environment Programme, *Environmental Data Report*, Prepared for UNEP by the GEMS Monitoring and Assessment Research Centre, London, 434-438.

Railroad. For the most part, Hungary's railroad lines were laid out from 1850 to 1900 in order to link the provincial areas with Budapest. Therefore, lines tend to radiate out from Budapest and transverse lines are still meager. Today, domestic transport is concentrated between Budapest and the northern industrial areas. The most frequented international transport routes by railroad are between Budapest and the Soviet Union, Austria, Czechoslovakia, former East Germany, and Poland.

Hungary's diesel fuel consumption for railway traffic is the lowest among East European countries, despite the fact that only 25 percent of its tracks are electrified. One of the reasons is that Hungary has less tracks than the other East European countries, with the exception of Bulgaria. Diesel fuel consumption by the railways has been declining and is expected to continue to decline into the future in this region. In Hungary, by the year 2000, diesel use by railways is projected to fall by 55 percent from its 1980 levels. The following table shows the expected trends in diesel consumption by East European railways.

TABLE 2.6.b. COMPARISON OF DIESEL FUEL CONSUMPTION BY EAST EUROPEAN RAILWAYS (in Thousand tons)

	1980	1983	1990	1995	2000
Bulgaria	606	480	438	304	N/A
Czechoslovakia	511	462	420	374	N/A
Hungary	235	200	165	118	100
Germany (East)	820	740	520	N/A	215
Poland	913	550	553	410	235

Source: Victor Merkin, *Petroleum Conservation in Eastern Europe*,Delphic Associates, Falls Church, VA Inc., 1987, 19.

---

[56]The New Encyclopedia Britannica, 697-698.

Roads. Similar to the rail system, roads originate in Budapest and then spread out across the country. Travel and transport by roadway has recently become more common than by railroad in terms of volume of freight as well as for use by the population. Hungary had 90,700 kilometers of roads in 1986; however, only 56 percent of these were paved.[57] For every one thousand Hungarian citizens there were 162 vehicles and only 19 vehicles per kilometer of road in 1986.[58] Many more people own cars now than a decade ago. As a result, the roadway system is becoming increasingly strained.

Citizens use cars extensively both for pleasure and business travel. Vienna is a five-hour drive from Budapest. There is now a four-lane highway from Budapest to Lake Balaton, the recreation and resort area. An extensive bus service is available for travel throughout Hungary. The London-Damascus and Hamburg-Bucharest international expressways both cross through Hungary.

Waterways. The only waterway used for transport in Hungary is the Danube River. The main port along the river is in Budapest, Csepel Port. The Danube is heavily employed for freight transportation. A significant amount of river travel and transport is cross-border, particularly with Austria and Czechoslovakia. Tourism is important on other waterways and bodies of water, especially on Lake Balaton. Freight transported exclusively by inland waterways was 2,477 tonne-kilometers in 1986.[59]

Air Transport. There are no domestic air routes. The only air travel is in and out of Budapest through Ferihegy Airport. Malev is the national airline of Hungary. From Budapest, there are direct travel routes to most European cities. The demands on this form of transport are rapidly growing, particularly with the increase of international business links. As a result, the airport facilities are expanding rapidly. The number of aircraft-kilometers flown in 1987 was far below that of all European country's except Luxembourg and Monaco.[60]

2.6.2 Technology

On the railroads, steam power locomotion is occasionally employed. Most trains use diesel power although international routes to Austria and the Soviet Union have been electrified. In 1985, the Hungarian State Railway had 7,766 km of standard-gauge lines, mostly single track.

The roadways are typically paved asphalt. Much of the roads and highways are in need of repair. The increased use of road transport is straining the system to expand. Though buses made by Ikarus, a Hungarian bus manufacturer, are exported around the world, the technology used in automobile engines is sub-standard for developed countries. The technology in transport vehicles in general is in need of improvement in terms of energy efficiency and emissions control.

2.6.3 Waste Systems

Experts predict higher oil demand in the transportation sector.[61] Greater economic activity internally as well as increased international trade will occur as the economy opens. It is hoped that higher energy

---

[57]*Environmental Data Report*, 434.

[58]Ibid. Included are cars, buses, and delivery vehicles.

[59]Ibid, 438.

[60]Ibid, 443.

[61]Jochen Mohnfeld, "Energy and Oil in Eastern Europe -- Status and Prospects," *Intereconomics*, July/August 1990, 210.

demand will be somewhat offset by a reduction in energy waste. This might be achieved through more efficient use of fuels as well as better engines. Also, there is need for greater environmental consideration in controlling emissions. Budapest may be the most air polluted city in Europe.

2.6.4 Energy Flows

Seventy percent of all railroad traffic runs on diesel fuel, according to 1984 figures from the government.[62] A further 22 percent of railway energy is from electricity. Coal use in the railways has declined precipitously in the last decade. In 1984, coal accounted for 8 percent of railroad energy source.[63]

Road traffic relied on diesel fuel for 85 percent of its fuel needs in 1984.[64] Automobile gasoline provided another 10 percent.[65] Electric energy for electrified street cars supplied the remaining 5 percent of energy use on the roadways.[66] Water traffic ran exclusively on diesel fuel in 1984. Air traffic relies on jet fuel. See Table 2.6.c. for the overall trends in energy source use from 1970 to 1984 in the Hungarian transportation sector. Further disaggregation of 1984 fuel consumption by traffic type is provided in Table 2.6.d.

TABLE 2.6.c. FUEL CONSUMPTION IN PUBLIC TRANSPORTATION
(Terajoules)

	Coal	Diesel	Gasoline	Jet Fuel	Electric
1970	34,205	17,676	5,886	1,985	2,076
1975	17,554	23,221	8,798	2,743	3,067
1980	6,339	28,778	8,468	5,535	3,589
1981	4,758	28,955	7,509	5,733	3,717
1982	2,916	29,315	6,077	6,114	3,828
1983	1,836	29,822	4,004	5,620	3,802
1984	977	30,985	2,466	5,876	3,900

Source: *State and Protection of the Environment*, 1986.

---

[62]*State and Protection of the Environment*, Központi Statisztikai Hivatal, Budapest, 1986, 214.
[63]Ibid.
[64]Ibid.
[65]Ibid.
[66]Ibid.

TABLE 2.6.d. FUEL CONSUMPTION IN PUBLIC TRANSPORTATION BY TRAFFIC TYPE--1984
(Terajoules)

Traffic	Coal	Diesel	Gasoline	Jet Fuel	Electric
Railway	977	8,843	--	--	2,758
Road	--	19,917	2,466	--	1,142
Water	--	2,225	--	--	--
Air	--	--	--	5,876	--
Total	977	30,985	2,466	5,876	3,900

Source: *State and Protection of the Environment*, 1986.

In terms of delivered energy, oil is by far the largest source of transportation power in Hungary. In 1987, oil accounted for 91 percent of final energy consumption in the transportation sector.[67] The following table gives the breakdown by fuel type in 1987.

TABLE 2.6.e. FINAL ENERGY CONSUMPTION IN TRANSPORTATION SECTOR BY FUEL IN 1987
(Petajoules)

Coal	0.1
Oil	118
Electricity and Heat (1 kWh = 10,500 megajoules)	12
Total	130

Source: Tamas Jászay, *Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030*, Report prepared for the US Environmental Protection Agency by Pacific Northwest Laboratory, May 1990, 3.

As oil accounts for such a disproportionately large share of transportation fuel use, a closer look at the composition and the use is presented in the following table. Diesel fuel made up 70 percent of oil product consumption in the transportation sector in 1986.[68] The majority of this diesel use was consumed by road traffic. Jet fuel for airplanes and gasoline for automobiles each accounted for 15 percent of total oil consumption by freight traffic in 1986.[69]

---

[67]Jászay.
[68]*Energy USSR and Eastern Europe 1986/87 Yearbook*, 49.
[69]Ibid.

TABLE 2.6.f. CONSUMPTION OF OIL PRODUCTS BY THE FREIGHT TRANSPORT SECTOR IN 1986 (Thousands of Tons)

Traffic	Gasoline	Diesel	Jet Fuel
Railway	-	216	-
Road	140	419	-
Water	-	34	-
Air	-	-	143
Total	140	668	143

Source: *Energy USSR and Eastern Europe 1986/87 Yearbook*, The Economist Intelligence Unit. The Economist Publications Ltd: London, 1986, 49.

3.0 OPPORTUNITIES

Hungary is the most advanced of Eastern European countries in free market economic reforms. Market oriented policies were first introduced in 1968. In May 1990, the new coalition government, led by Prime Minister Jozsef Antall of the Hungarian Democratic Forum, established a parliamentary democracy consisting of the following ministries with the primary task of furthering Hungary's movement toward a market economy.

Ministry	Area of Responsibility
Culture and Public Education	Decentralization of educational system and monitoring of performance
Justice	Judicial system, freedom of information and human rights issues
Industry and Trade	Energy policies, free-market reforms, authority over domestic trade and services, all industries (except food processing), and tourism
Defense	Military, external security functions
Labor Affairs	Employment policies, unemployment benefits, income distribution, development of industrial relations institutions, union representation
Interior	Internal security functions, transformation of national police into civilian police force
Environmental Protection	Provide regulations for environmental management, improving efficiency of resource and energy use, Gabcikovo-Nagymaros Dam project
Agricultural Affairs	Agrarian privatization policies and structure of the agro-food sector, food processing industry
Finance	Currency convertibility, establishment of financial markets, government budget and tax reform, IMF policies
International Economic Relations	Foreign trade policies, liberalization of trade, access to foreign markets
Foreign Affairs	Diplomatic relations, UN and international organizations-related affairs
Transport and Telecommunication	Rural development, highways, information, computer and communications policies
Social Welfare	Income distribution policies, health care, social security, pensions

The Ministry of Industry and Trade is responsibile for all energy and industrial policy. As such it consists of four main divisions: Energy, Economics, Market Policy and Industrial Policy. In view of Hungary's reliance on foreign energy sources, formulation and implementation of external energy policies must be coordinated with the Ministry of International Economic Relations. The Ministry of Industry and Trade also works closely with the Ministry of Agriculture, as many of its policies may have an impact on the agricultural sector.

Privatization and deregulation in Hungary is more advanced than its East European neighbors. By the end of 1990, a new banking system was established, securities laws were passed and a stock market emerged. Hungary's energy sector, under the Ministry of Industry and Trade, has already initiated many reforms

to move energy resources and use toward a market economy. In January 1991, oil supply was deregulated when Hungary terminated the OKGT's state monopoly on oil imports. The OKGT is now open to foreign investors and joint-ventures. Plans to restructure the state-owned electricity industry, the MVMT, which controls all production and distribution of electricity, are underway. The two competing systems being considered are the French EDF model with central management of distribution but not generation and the Austrian-German system with each power plant under different management with different distribution supply contracts.[1]

As part of the new government's economic program, Hungary is striving toward European Community (EC) membership. Central to these ambitions is the Hungarian need to structure economic, environment and energy reforms in a manner consistent with EC policy. The basis of EC policy is the demonstration of a high degree of integration between industrial investment and effective environmental protection.

In the area of developing and implementing energy and environmental policy, the EC is often regarded as a successful regional model. Much of its success lies with its integrative nature of developing environmental policies which simultaneously develop sound economic structures. The organizational structure and supranational legal authority of the EC delegate to it the ability to develop an environmental policy which holds the interconnectedness between the economic and environmental sphere as essential.[2] Hungary's energy policies should build on these successes.

3.1 Potential Improvement in Energy Efficiency

The current and fourth action program in Hungary, (1987-1992), seeks to make environmental protection a fundamental element of economic and social policy. Its main objectives include: a more effective integration of environmental policy with industrial, agricultural, transport, and tourism policies; making environmental standards stricter; and increasing investments related to environmental protection.[3]

In June 1991, the Hungarian government released the details of the new energy policy proposed by the Ministry of Industry and Trade. The policy focuses on reducing and diversifying imports, improving energy efficiency and implementing market principles. More efficient, as envisioned by the policy, energy consumption encompasses both energy conservation and modernization of production methods.[4]

During the 1970's, Hungary promoted energy conservation through two sets of measures: planned standards and controls, and financial mechnisms. In 1979, Hungary along with all CMEA countries except for East Germany, implemented a conservation program aimed at reducing energy consumption by 20 percent. The plan called for the targeting of 12 percent of industrial capital investment to energy efficiency. Half of the earmarked investment reserves was to fund large-scale fuel-substitution projects, electrification of railways, the importation of Western coal-fired power equipment and the networking of 100,000 to 120,000 residences to natural gas supply.[5] The other half was to finance the implementation of energy-saving and fuel-substitution plans at the small enterprise level. In addition to the investment

---

[1]*Energy Profiles of Czechoslovakia, Hungary and Poland, and Their Emerging Free-Market Economies*, Committee on Energy and Natural Resources, United States Senate, June 1991.

[2]Lynton Keith Caldwell, International Environmental Policy: Emergence and Dimensions, Duke University Press, Durham, 1984, 116.

[3]*The European Community and the Environment*, 52.

[4]"Government Approves New Energy Policy," *Budapest MTI*, 19 June 1991, (as found in *Foreign Broadcast Information Service: East Europe*, 20 June 1991).

[5]John M. Kramer, The Energy Gap in Eastern Europe, Lexington Books, Lexington, MA, 1990, 113.

reserves, Hungary also used a World Bank loan totalling $109 million to fund specific projects. The overall effect of the initiative is unclear since the fall in economic growth following 1979 also contributed to the net reductions in energy use.[6]

Hungary's attempts to increase energy efficiency have primarily been price-centered, that is, using price incentives to encourage energy savings measures. At the core of the program was an increase in wholesale prices of energy resources, to more accurately reflect world market prices. The price of home heating fuels increased 55 percent between 1982 and 1985 while gasoline prices rose 26 percent from 1981 to 1984.[7] According to statistics published by Hungary, the annual rate of growth of energy demand averaged 0.9 percent from 1981 through 1985. The results of the program prove encouraging for Hungary's current energy shortage. While such gains compare very favorably with other East European and Western countries over the same period (Table 3.1.a), the effect of conservation is confounded by Hungary's economic downturn. Those who argue that the explanation for this improvement in energy use is grounded in economic malaise rather than conservation cite the 4.3 percent output decline in metallurgy, a high-electricity user, and a 3.2 percent drop in mining in 1981 compared with 1980, as well as a mild winter.

In a dramatic departure from its market-based reforms and conservation measures, in 1985, Hungary implemented strict quotas for energy consumption for the nation's 84 largest industrial consumers, threatening non-compliers with stiff fines.[8] Other new measures included restrictions on television broadcast time, temperatures in public buildings, hot water supply and the use of private automobiles. By 1990, Hungary was expected to have realized 55 percent of its anticipated savings in energy through the development of less energy-intensive industries.

TABLE 3.1.a
AVERAGE ANNUAL CHANGE IN ENERGY REQUIREMENTS AS A PERCENT OF NATIONAL INCOME, 1981-1983, SELECTED COUNTRIES

Hungary	-2.5
Poland	0.9
Czechoslovakia	-0.6
EC	-2.7
US	-3.1
Japan	-4.7

Source: *Magyarorzag*, 7 July 1985, cited in Kramer, 123.

Certainly, with the advent of world market pricing for Soviet energy supplies, some increases in marginal efficiency will be forced upon the country. Hungarian policy makers face two major questions. The first is to what extent the economic growth that Hungary requires can become de-linked from a parallel growth in energy use. The second is to what extent policy can lead improvements in efficiency. Further progress in efficiency, however, will depend on structural changes of the industrial sector and modernization of the economy. To further this end, the World Bank gave Hungary $400 million in structural adjustment loans

---

[6]Ibid, 114.
[7]Ibid, 120.
[8]Ibid.

with the condition that Hungary reduce the percentage of heavy industries, encourage light industries and close unprofitable coal mines.

3.1.1 Industrial and Manufacturing

The Hungarian government has articulated a policy that emphasizes two basic strategies. One involves expanding the capacity of existing manufacturing and service industries as opposed to entering new areas of extractive raw material production or energy intensive sectors. Two, the government is emphasizing the introduction of high technology applications to the reconstruction of old manufacturing plants. The objective is to increase productivity and product quality while keeping energy consumption stable.

Construction and metallurgy account for nearly 10 percent of total primary energy consumption, offering the most potential for energy savings. Price incentives combined with restructuring, will increase the cost of energy while at the same time, encourage introduction of energy efficient technologies through capital investment. Upgrading equipment in the major industries, such as iron smelting, could save as much as 11.2 GJ/ton, when efficiency of Hungary's technology is compared to the best technology available. Another critical element in the government's industrial restructuring program is the shift in emphasis from energy and capital intensive industries to light industries. The relative electricity intensity of heavy industry versus manufacturing, for example, is 0.559 kWh/forint and 0.059 kWh/forint, respectively.[9] Although Hungary's economic situation is still quite fluid, conditions are favorable for permanently reducing energy demand.

3.1.2 Utilities

The biggest limitation Hungary faces in its push to modernize its equipment and retrofit existing plants is the huge foreign debt. At the end of 1989 external debt totaled $14 billion which amounts to almost $1,400 per capita. Twenty-five percent of the country's hard currency exports are used to service the foreign debt.[10]

Although energy efficiency increased by 30 percent between 1971 and 1987, Hungary is still two or three times more energy intensive than most developed market economies. Not only are the production technologies high in energy consumption but the value-added of the output produced is low. Since both factors contribute to high energy use per unit of GDP, gains in energy efficiency must be coupled with structural change in Hungary's industries in order to have a significant impact on energy intensity.

Direct energy efficiency improvement opportunities remain important, nevertheless. The average expenditure for energy efficiency efforts in Hungary between 1985 and 1990 was just under 100 Hungarian forints per gigajoule (GJ). This average amounted to approximately half the cost of imported oil, calculated using a world market oil price of $18 per barrel. While several efficiency investments requiring small up-front costs and yielding quick results have already been realized, there are opportunities for efficiency gains.

The transmission and distribution of electricity is a prime candidate for energy savings. A two percent increase in efficiency, which would bring Hungary in line with average network losses exhibited in other

---

[9]Tamas Jászay, *Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030*, Report prepared for the U.S. Environmental Protection Agency by Pacific Northwest Laboratory, May 1990, 6.

[10]Jászay, 2.

European countries, represents a savings of 728 GWh. Further information is needed in order to determine the most cost effective investment projects for reducing losses. Possible explanations for the high level of network losses include: the high proportion of low voltage lines, low quality materials leading to a significant amount of energy loss through the generation of heat and inefficient step-down transformers.

Combined heat and power generation, or cogeneration, offers considerable development opportunities because of the extensive use of district heating in Hungary. The prospect is particularly good for applying flue gas heat recovery to industrial furnaces, a process which can be realized with a gas turbine topping cycle.[11]

3.1.3 Agriculture

There are opportunities within the agricultural community to enhance fuel alternatives through the utilization of by-products, primarily biomass. If the turbines could be adapted to use biomass, the savings would be 250 percent greater. Considerable research and development of gasification or liquefaction technology will be necessary before biomass can be widely used in combustion turbines, particularly if it is to be cost effective. As a long-term electric energy source, however, biomass could be quite attractive in Hungary because cogeneration potential is expected to grow to 15 terawatt hours per year by 2030. Hungary is well suited for biomass production.[12]

3.1.4 Residential

The three major uses for power in the residential sector are heating, hot water, and electricity for appliances. There is room for improvement in the end-use as well as the distribution of all three.

Space heating and hot water are less than optimally consumed in Hungary. Without thermostats in apartments, over-heated apartments are cooled by opened windows. Distribution networks for both heat and hot water are rarely insulated, resulting in considerable waste from leaks and general heat loss. Experts believe that if such inefficiencies were corrected in the residential sector in Hungary, the effect would be a 30 percent cost saving.[13] In addition, an estimated 8 percent of the current carbon emissions, 1.1 million tons year, could be eliminated.[14]

Living space per occupant is expected to grow and the number of home appliances per household will multiply. A number of factors may balance this picture of increasing residential energy demand. Housing construction is slowing. Also, improved technology and Western imports should provide households with more efficient home appliances available. In particular, lower energy consuming refrigerators, televisions, and lighting should enter the Hungarian appliance market in the future.

In addition to the potential improvements at the building sites, newer technology is likely to be employed at the point of generation. Hungarian energy specialists are increasingly aware of the savings available from combined cycle gas turbine systems serving district heating systems, for example. The criteria for such systems will be high efficiency, short construction lead-times, and low capital costs. In the unpredictable climate of Hungarian transformation, these three factors are necessary to address the changing demand conditions as well as to avoid over-investment and/or over-capacity. It is expected that

---

[11]Ibid, 8.
[12]Ibid.
[13]Ibid, 8.
[14]Ibid.

as much as 800 megawatts of combined cycle gas turbine capacity will be installed by the year 2000.[15] These will predominantly use natural gas. In addition to new systems being built, existing oil and lignite-fired systems will be retrofitted.

3.1.5 Transportation

Gas mileage is very low in the cars available on the Hungarian market. Also, truck sizes and power often do not correspond effectively to loads transported. Energy efficiency in road transportation could increase in Eastern Europe by 50 percent over 1985 levels if improvements were made.[16]

The new Hungarian government is placing a high level of importance on improving the efficiency of private transportation. Automobile ownership has increased in the past few years and is expected to double in the next 15 years. With the current poor fuel efficiency of most automobiles in Hungary, this rapid increase in traffic may mean an unmanageable fuel bill for the transportation sector. Current rates of fuel use per kilometer could be reduced 25 percent.[17]

Budapest may be the most air polluted city in Europe. Air pollution in the capital is primarily from the automobile exhaust of older cars running off Eastern European-made two-stroke engines. The problem is so bad that some estimate that one in ten Hungarians die of pollution-related diseases.[18] In Budapest, citizens go to clinics to receive fifteen minutes of pure oxygen treatment to clear their lungs.

"The pollution in Budapest is best battled by replacing the automobiles," said a leader of the Democratic Forum's energy policy board. "We intend to put into practice a customs policy which encourages the import of new cars with good emission control - opposite the policy of the old regime, which put high duties on new, imported Western cars."[19]

3.2 Opportunities for Alternative Energy Sources

The market-oriented economies of Western Europe have access to alternative energy technology as well as energy efficient technology through the supply and demand imposed on the market. Yet in Hungary, if the manufacturing and management of these technologies are not accounted for in Hungary's central planning process, there is no mechanism for procurement.[20]

Recognizing the lack of resources committed to research and development of alternative energy sources, the Hungarian government is currently seeking opportunities for innovations, developments and adaptations of alternatives.[21] Natural resources favor the development of the bioenergic and geothermic sectors.[22]

---

[15]Ibid, 5.

[16]William U. Chandler, Alexei A. Makarov, and Zhou Dadi, "Energy for the Soviet Union, Eastern Europe and China," *Scientific American*, September 1990, 24.

[17]Jászay, 8.

[18]William Bassow, "Making the Brown Danube Blue Again," *Environmental Protection*, October 1990, 10-11.

[19]Gellert Tamas, "Hungary's Power Plight," *Independent Energy*, September 1990, 69.

[20]Michelle LaSalle Keene, "The European Community and Environmental Policy: Opportunities and Tasks for Hungary," unpublished paper, Kennedy School of Government, Harvard University, May 1990.

[21]*Hungarian Environment and Water Review: Special Edition*, Ministry for Environment and Water Management, Vol.3, ISSN 0864-764X, Budapest, 1989,

[22]Ibid, 18.

The Ministry for Environment and Water Management however, points out that the current pricing and subsidies of fuels do not make private investors interested in utilization of renewable energy sources.

Hungary does not have a sustainable energy supply based on fossil fuel reserves, emphasizing the need and opportunities for alternative energy sources. According the Hungarian Ministry for Environment and Water Management, the significance of coal as a primary energy resource has been and is expected to continue to decline. The past 10 years have seen an increased reliance on the contributions of nuclear energy. Since environmental concerns have halted the expansion of hydroelectric power and Hungary's weather patterns are not conducive to the use of solar-based energy, the most promising prospects for alternative energy sources are geothermal and biomass, both of which have been supported by the government.[23]

Free-market forces will also encourage growth in the alternative energy sector. As most of Europe has harnessed the environmental strategies of "polluter pays" through deposits and effluent excursion fees, there is potential for Hungary to maximize on these strategies to promote the use of energy alternatives.

Alternative energy use, however, remains in infant stages all over the world. Even the United States, a leader in the development of alternative energy resources, non-carbon resources accounts for only 9 percent of domestic energy supply.[24]

3.2.1 Utilities

Nearly 50 percent of the energy used in Hungary is produced and distributed through state-owned utilities. The MDF [Democratic Forum] has written its party program to encourage development of alternative sources of energy, particularly geothermal. The government intends to subsidize the expansion of alternative energy sources to act as a complement to traditional energy forms.[25] In particular, the MDF energy policy board has actively encouraged the development of geothermal sources. The government welcomes private initiative in areas that may not be economical from the government's standpoint.[26]

3.2.2 Residential

Currently, households demand the largest share of non-production based energy. In the future, less homes will be state-owned communal residences (such as apartment buildings). Instead of the state-owned apartment buildings, new construction in Hungary is predominantly privately-owned single-family homes. Consumers, however, have had little incentive to conserve on electricity because of residential subsidies. With the removal of energy price subsidies, the trend toward more privately-owned residences should translate into a greater awareness of the wastefulness of current energy consumption. Hopefully, this will mean that newer technology will be employed and with that cleaner, cheaper, more efficient sources of energy to heat and electrify Hungarian homes. To encourage energy management in the home, the government has proposed a program including grants and loans for energy-efficient home improvements.

It is difficult to weigh the total effects of the factors that will contribute to or reduce energy demand in the future in Hungary. However, Jászay estimates that the annual rate of increase of electricity demand

---

[23]"Sustainable Development: An Hungarian Approach," *Hungarian Environment and Water Review*, The Ministry for Environment and Waste Management, Vol. 3 No.1, Budapest, 1989, 16.

[24]Energy Information Administration, (USDOE 1990).

[25]Tamas, "Hungary's Power Plight," 69.

[26]Ibid.

in buildings will decrease from 6 percent per year to between 2.5 and 3 percent per year by the year 2000.[27] In the residential sector, oil and coal consumption is expected to be replaced with natural gas and, to a lesser extent, with electricity.

3.2.3 Transportation

To help alleviate some of the environmental problems, engines in automobiles might be retrofitted to use liquified natural gas. Besides being a cleaner fossil fuel for burning than oil, natural gas is less expensive. The Ikarus Bus Company is currently involved in a joint venture with the US firm Union City to build liquified natural gas engines. Electrification of the rail lines and inter-city bus routes could also contribute in the areas of cost-cutting and pollution-reduction.

3.3 Opportunities for Foreign Investment

Hungary is particularly attractive to Western investors since it has the one of the most liberal financial and commercial systems in Eastern Europe. Over 100 US companies, taking advantage of liberal joint-venture laws and generous tax incentives, have established offices in Hungary. One of the biggest challenges for Western investors is educating managers of state-owned enterprises in the principles of free-market economics. Workers, as well as managers, must be taught the basic concepts of free enterprise such as, profit, cash flow and market-value of assets. Despite the strains that low wages and rising inflation are placing on Hungarian workers, the government remains committed to its economic reform program.

3.3.1 Economic Status

The economic situation in Hungary is currently experiencing great flux and figures and key indicators become obsolete rapidly. It is imperative for any party looking to invest in the Hungarian marketplace to constantly update statistical information and, thus, information presented below provides a broad overview as of September 1990.*

During 1988 and 1989, Hungary's GDP stagnated at $28.0 billion, while real GDP growth declined by 1.5 percent over the period.[28] GDP per capita increased negligibly from $2,643 in 1988 to $2,645 in 1989.[29] The components of GDP in percent are given in Table 3.3.a.

TABLE 3.3.a. COMPONENTS OF 1988 GROSS DOMESTIC PRODUCT
(percent)

Private Consumption	61.0
Government Consumption	11.3
Gross Fixed Capital Formation	21.0
Change in Stocks	3.8
Net Exports	2.8

---

[27]Jaszay, 4.
[28]"Survey on Hungary," *London Financial Times*, 17 September 1990, 2.
[29]Ibid.

Manufacturing and construction accounted for 43 percent of GDP in 1988. Services contributed the next largest share, 37 percent, with the remaining 20 percent attributable to agriculture.[30]

The current account deficit grew from $0.59 billion in 1988 to $1.44 billion in 1989.[31] Exports increased from $5.79 billion to $6.45 billion but imports increased as well, from $5.12 billion to $5.91 billion, resulting in a decline in the balance of trade from the $0.67 billion 1988 level to $0.54 billion in 1989.[32] The Soviet Union and European countries are Hungary's main trading partners; their share in total exports and imports is summarized in Table 3.3.b.

TABLE 3.3.b. MAJOR TRADING PARTNERS

	Percent Total Exports		Percent Total Imports	
	1988	1989	1988	1989
USSR	27.6	25.1	25.0	22.1
West Germany	11.0	12.0	13.9	16.1
Austria	5.7	6.5	7.2	8.6
EC	22.7	24.8	25.4	29.0

Source: "Survey on Hungary," *London Financial Times*, 17 September 1990.

Gross external debt increased from $19.6 billion in 1988 to 20.6 billion in 1989. Total reserves, convertible currencies minus gold, dropped slightly from $1.9 billion in 1988 to $1.7 billion in 1989.[33]

Inflation is officially at approximately 16 percent, but unofficial figures range closer to 30 percent.[34] In 1989 real wages fell by eight percent and consumption declined by three percent.[35] It is estimated that one-fifth of the population lived below the poverty line as of 1989 and an unemployment potential of 100,000 is estimated.[36]

3.3.2 Investment Climate

The general investment climate seems to be favorable for foreign investors. There are no restrictions on foreign investments as long as they only constitute a minority share. The secretary of the Ownership and Privatization Committee released a list of companies that are to remain either 100 percent state owned or with the state maintaining a controlling interest of 51 percent. The names of these 31 companies are provided in Appendix B.[37]

---

[30]Ibid.
[31]Ibid.
[32]Ibid
[33]"Business Outlook Abroad: Hungary," *Business America*, Vol. 110, Issue 22, 6 November 1989, 18.
[34]Ibid, 18.
[35]Ibid.
[36]Ibid
[37]"Hungary Lists Firms to Remain State-Owned," *Eastern Europe Report*, 24 June 1991.

Production structures are largely obsolete and the economy is highly sensitive to changes in the world market.[38] Industry is cumbersome because past labor policy means that ambitions to expand are bolstered by the fact that the more physical assets and labor the company already uses, the better its bargaining position is to secure additional government appropriations.[39] Current means of managing property result in a recurrence of labor shortages and a tendency to hoard labor.[40]

Company debts in 1989 stood at $1.2 billion.[41] Overall industrial production rates declined 10 percent during 1990 leading to a sharp recession in the large State sector.[42] These figures, however, do not reflect the increasingly important gray market and smaller firms not included in the State sector.[43] An added problem is that Hungary is limited in terms of natural resources, with the exception of agricultural land, bauxite deposits, brown coal (heavily polluting, low energy btu) deposits and relatively smaller oil and natural gas deposits.[44]

On the other hand, Hungary offers a strategic central European location with a dynamic, well-educated population and a recent history of government policies favoring exports.[45] In addition, exports in convertible currency to the West rose 15 percent from 1989 and tourism was up 80 percent.[46] While the general economic indicators point to an economy on the edge of crisis, the dynamic small entrepreneurial and services sectors offer the potential for the generation of valuable hard currency.

Hungary's new government, under the leadership of the conservative Hungarian Democratic Forum, is increasingly establishing international contacts in order to encourage aid, credit, foreign trade and joint-ventures. The business climate has changed somewhat from the reform Communist leadership to the Forum government. While, the reform Communist government enacted legislation (see below) to attract foreign firms and investment, the Forum is pursuing a more cautious approach to opening Hungarian markets to Western firms.[47]

The State Investment Center has been established in Budapest with representatives in Hungary's major embassies to work with foreign investors.[48] Hungary was admitted in November 1990 to the Council of Europe[49] while the European Community has indicated that it will not consider Hungarian membership in the EC in the near future,[50] Council of Europe membership should lend legitimacy to the democratization process and encourage Hungarian business and industry to adopt Western European standards and regulations (e.g., environmental, energy efficiency).

---

[38]Casaba Lalmos, "Political and Economic Reform and Labour Policy in Hungary" in *International Labor Review*, Vol. 129, 1990, 42

[39]Ibid, 44.

[40]Ibid.

[41]Business Outlook Abroad: Hungary," *Business America*, 18.

[42]Nicholas Denton, "On the Brink of Transformation" *London Financial Times*, Survey on Hungary, 17 September 1990, 2.

[43]Ibid.

[44]"Business Outlook Abroad: Hungary," *Business America*, 18.

[45]Ibid.

[46]Denton, "On the Brink of Transformation", 2.

[47]Personal communications with Jennifer Wayne, May-July 1989 and June-August 1990.

[48]"Business Outlook Abroad: Hungary," *Business America*, 20.

[49]"Hungary is a Member of Council of Europe," *The Boston Globe*, 7 November 1990, 23.

[50]Richard C. Longworth, "E.C. Fosters Change in Eastern Europe," *Europe*, Issue 291, November 1989, 25.

In addition to the Council for Mutual Economic Assistance (CMEA), Hungary belongs to the International Monetary Fund, the International Finance Corporation, the General Agreement on Tariffs and Trade, the International Wheat Council and the World Bank's International Bank for Reconstruction and Development.[51] Hungary's foreign trade, divided evenly between the CMEA and hard currency markets, accounts for over half its GNP.[52]

On October 26, 1989, the United States granted Hungary Most Favored Nation status.[53] The overall decline of the dollar during the late 1980s against the yen, Deutschmark and related Common Market currencies gives US products a competitive edge in Hungary.[54]

While Hungary's investment climate for Western firms is improving, a chronic problem cited by foreign investors has been a lack of clear information on the structure of Hungarian business.[55] This is, in part, due to the dichotomous structure of the economy. There is a vigorous sector of joint ventures, private limited companies and the steadily graying black market activities which coexist with the official sector of large state-owned enterprises.[56] American investors, due perhaps to the lack of local contacts, have been encumbered by the government bureaucracy which primarily handles the State sector.[57] Local reporters note, as well, that foreign investors regularly complain of the sluggishness of privatization and the bureaucratic morass.[58]

3.3.3 Legislation

Beginning in 1989, reduced import regulations, continued development of a modern banking sector and announced cuts in some government and production subsidies[59] contributed to the opening of the Hungarian economy. In 1988, new bankruptcy and liquidation laws empowered credits to begin reconstruction or closure of inveterate loss-makers, even if such actions were to result in job losses.[60] The Act on the Right of Association authorizes the establishment of any association or organization that conforms with the Constitution thus guaranteeing the necessary conditions for the creation and functioning of employers' and workers' organizations in accordance with provisions of international labor conventions regarding the freedom of association.[61]

The 1988 Law on Corporate Association allows up to 500 employees in private firms. This number was previously limited to 150.[62] In addition, foreign firms may own up to 50 percent of Hungarian joint ventures without formalities.[63] However, foreign investors must request permission from the government

---

[51]"Business Outlook Abroad: Hungary," *Business America*, 18.
[52]Ibid.
[53]Ibid, 19.
[54]Ibid.
[55]Nigel Ash, "The Privatization Dilemma" *Euromoney*, September 1990, 148.
[56]Denton, "On the Brink of Transformation", 2.
[57]Personal communication with Jennifer Wayne, August 1990.
[58]Nicholas Denton, "Privatization Programme Under Pressure," *London Financial Times*, Survey on Hungary, 17 September 1990, 5.
[59]"Business Outlook Abroad: Hungary," *Business America*, 18.
[60]Colin Jones,"Two-Way Quickstep by the Danube" *Banker*, Vol. 138, Issue 744, February 1988, 13.
[61]Lalmos, "Political and Economic Reform and Labor Policy in Hungary," 41.
[62]"Business Outlook Abroad: Hungary," 20.
[63]Ibid.

for 100 percent ownership which, on paper, is granted or denied within 90 days.[64] The corporate association law provides legislation for the establishment of limited liability companies, personal and value-added taxes and the only stocks and bonds markets within the CMEA.[65] The Act on Foreign Investment guarantees to any foreign partner repatriation of investment capital and dividends in convertible currency.[66]

Two additional pieces of legislation were enacted in 1989: a law giving firms the right to determine the type of ownership framework such as corporation, shareholder, non-profit organization, etc. and a law stating that any entity with more than 30 percent foreign capital is considered private.

The State Privatization Agency is responsible for overseeing the privatization process. Up until late 1990, privatizations had been mainly spontaneous in nature. The government is reluctant to institutionalize the process due to large potential dislocations similar to those experienced in Poland.[67] Despite a lack of overarching legislation, the government has decreed that foreigners are excluded from privatization of small retail firms.[68] Unlike this sector, unlimited right of establishment in services exists.[69]

Tax reforms included a reduction, from 90 percent to 70 percent in 1988, in taxes paid by profitable businesses.[70] If a foreign share equals at least 20 percent of total assets, a tax holiday for up to five years is possible in certain sectors including telecommunications, tourism, agriculture and related food processing, pharmaceutical, electronics, vehicle component production, machinery and machine tools.[71] In other sectors, 20 percent plus ownership results in an eight-point discount on the official tax rate.[72] In addition, joint ventures are released from certain wage and price regulations.[73]

As of June 1991, 90 percent of Hungary's productive assets were still state-owned. The lack of foreign capital and the low level of domestic savings have been cited as the reasons for such a small percent of private ownership. The Hungarian government is currently examining the privatization of land and the transformation of cooperatives into private companies.

3.3.4 Financial Markets

In 1988, the National Bank of Hungary (Magyar Nemzeti Bank) handed its credit intermediating role to three new commercial banks, two older socialized banks with enhanced powers and several other banks in which Citibank, the International Finance Corporation, Western and Japanese banks have holdings.[74] The largest bank, the Hungarian Credit Bank, has initial capital of a little less than $196 million and opening balance-sheet footings of $4 billion.[75] It is handling bank accounts of 3,000 plants through 23

---

[64]Ibid.
[65]Ibid, 18.
[66]Ibid, 20.
[67]Denton, "Privatization Programme Under Pressure," 5.
[68]Ibid.
[69]Denton, "Shortage of Stocks" *London Financial Times*, Survey of Hungary, 17 September 1990, 6.
[70]Jones, "Two-Way Quickstep by the Danube," *Banker*, 13.
[71]"Business Outlook Abroad: Hungary," *Business America*, 20.
[72]Andrea Gabor, "Investment: Unhappy Hunting Ground," *International Management* (Europe Edition), Vol. 45, Issue 8, September 1990, 61.
[73]"Business Outlook Abroad: Hungary," *Business America*, 20.
[74]Jones, "Two-Way Quickstep by the Danube," *Banker*, 13.
[75]Ibid, 14.

provincial offices and five Budapest offices.[76] Its clients produce almost half of the GDP: 60 percent of industrial output, 30 percent agriculture, 50 percent internal and foreign trade and 40 percent transport and services.[77]

The second commercial bank is the Commercial and Credit Bank with initial capital of $104.7 million and balance-sheet footings of $2.2 billion.[78] Through 46 local branches, the bank handles the accounts of 2,400 companies: 900 large agricultural concerns, over 800 industrial firms, 290 trading companies, most hotels and travel agencies.[79] This bank has the largest number of shareholders.[80]

Other relevant banks are the Budapest Bank, State Development Bank, the Hungarian Foreign Trade Bank, the General Banking and Trust Company, the Citibank Budapest and the Unicbank, a World Bank subsidiary. The foreign-owned East European Investment Bank is an offshore dollar-based bank restricted to hard currency business and exempted from central bank requirements.[81]

Despite the recent developments in banking, a credit famine has hit emerging private entrepreneurs who do not have access to foreign capital or are not connected with Hungarian companies or cooperatives that have shares in banks.[82] Already profitable companies, on the other hand, have access to new opportunities providing hard currency to purchase imports.[83]

In January 1989, Hungary released 40 percent of its hard currency imports from licensing requirements, up from 10 to 15 percent. Hard currency imports consist mainly of manufactured goods, some agricultural products and fodder grains.[84] An importing firm must have the forint equivalent to the convertible currency price or a bank guarantee, but they must no longer earn hard currency in order to purchase hard currency imports.[85]

Much aid and credit is being extended to Hungary for multiple uses some of which includes financing. The World Bank is providing $1.6 billion over a five-year period.[86] An Economic Community Action Plan for applying $654 million to Poland and Hungary has been developed. The Action Plan intends to:

1. Provide easier access to Western markets by lowering tariffs, especially for farm exports;
2. Provide direct gifts of farm machinery and pesticides;
3. Create more foreign investment, encouraged by $1.1 billion in loans from the European Investment Bank over the next three years;
4. Provide professional and management training, particularly in banking; and
5. Encourage environmental protection and help in the clean-up of poisoned areas.[87] In July 1989, the United States Trade and Development Program and Hungary signed an

---

[76]Ibid, 17.
[77]Ibid.
[78]Ibid.
[79]Ibid.
[80]Ibid.
[81]Ibid, 18.
[82]Ash, "The Privatization Dilemma," *Euromoney*, 138.
[83]"Business Outlook Abroad: Hungary," *Business America*, 18.
[84]Ibid, 19.
[85]Ibid.
[86]Ibid, 18.
[87]Longworth, "EC Fosters Change in Eastern Europe," *Europe*, 26.

agreement to provide funding for studies on the redevelopment of an economically depressed area in an eastern region of the country.[88]

Over 1,100 joint ventures have been formed with West German and Austrian companies leading the way followed by the Swiss, Japanese and Americans.[89] This figure is growing exponentially with no likely slow-down in the near future.

Investment in Hungary is not without its complications, though. Problems in valuing Hungarian firms add to the element of risk for the buyer which requires a price discount as compensation.[90] Western business people complain that valuation of Hungarian firms is arbitrary.[91] Most of the problems usually arise with the involvement of managers suspected of profiting at the expense of state-run companies in their care.[92] In addition, as was discovered in the case of attempts to purchase the Budapest property which houses the famous Gerbeaud Café, valuing of leases is almost impossible because property and rental leases are not included on corporate balance sheets and there exists no property to speak of.[93]

While financial analysis of markets in Hungary has been very limited, studies indicate that inventories play a major role in the economy. Abel, of the Department of Business Economics, Budapest University of Economics, and Szekely, of the Department of Economic Planning and Modelling, Budapest University of Economics, state that inventories are important because they bear the greatest part of the burden of adjustment to changes in demand.[94]

Csilla Hunyadi, Budapest University of Economics, also discusses the relevance of inventories in money supply and financing. According to Hunyadi, inventories were financed from net working capital instead of current liabilities.[95] That required amount of net working capital depended on annual increases in inventories.[96] The lack of properly functioning capital and money markets constrained firms' investment alternatives. In addition, since liquidity problems did not lead to serious consequences, businesses have not been concerned about keeping cash to ensure liquidity.[97]

After January 1987, the rules of short-term financing were modified with enterprises having to finance permanent current assets with long-term financial sources.[98] The level of permanent current assets was then determined by the firm itself.[99] Under the new financial system, administrative control of the firms' financial policy was replaced by a tightened monetary policy.[100] The interest of profit-oriented

---

[88]"Business Outlook Abroad: Hungary," *Business America*, 20.

[89]Gabor, "Investment: Unhappy Hunting Ground," 61.

[90]Denton, "Privatization Programme Under Pressure", 5.

[91]Gabor, "Investment: Unhappy Hunting Ground," 61.

[92]Ibid.

[93]Ibid, 63.

[94]I. Abel, and I. Szekely, "Credit, Imports and Inventories in CPEs: Causality Test for the Hungarian Economy," *Engineering Costs and Production Economics* (Netherlands), Vol. 19, Issue 1-3, May 1990, 11.

[95]Csilla Hunyadi, "Short-term Finance and Inventories," *Engineering Costs and Production Economics* (Netherlands), Vol. 19, Issue 1-3, May 1990, 32.

[96]Ibid.

[97]Ibid.

[98]Ibid. 33.

[99]Ibid.

[100]Ibid, 33-34.

commercial banks is (at least in theory) financing profitable businesses and refusing credit to loss-making firms.[101] Hunyadi concludes that inventories cannot be controlled easily with monetary policy, first of all because the Hungarian economy is still far from being a market economy and the government is far from being consistent and highly responsible.[102]

Currently, as in the past, inconsistent behavior on the part of the government often leads to situations in which fiscal policy finances what monetary policy refuses to.[103] When banks do not give credits to inefficient, loss-making companies, they ask for state subsidies, tax regulations or favorable regulations.[104]

Thus, it can be concluded that in terms of financing, the Hungarian economy has a way to go before becoming truly open. Government subsidies may continue to undermine foreign investment, the implementation of a market economy and the application of Western technology.

3.3.5 Marketable Technologies

Given the "newness" of Hungary's economy, almost any technology is marketable, particularly any technology applicable in the sectors of telecommunications, tourism, specialized agricultural equipment and related food processing and packaging, agricultural chemicals, pharmaceutical, electronics production equipment, vehicle component production, machinery and machine tools, computers, petrochemical production and equipment, nuclear safety products, medical equipment and energy saving equipment.[105] Recent liberalization of CMEA multilateral export controls have moderately broadened potential sales of non-strategic high-technology equipment.[106] Béla Kadar, Minister of International Economic Relations, stated in September 1990 that research and development-intensive companies offer good growth potential since " what is really cheap [in Hungary] is highly-qualified labor".[107]

With the eventual privatization of Hungary's State-owned "blue chips" come opportunities in engineering. The largest of the blue chips produce buses and electronics (Ikarus, Csepel Auto and Videoton).[108] Foreign investors will be given a freer rein with these companies due to the need for new technology and overhauled management.[109]

Business America cites managerial and production consulting opportunities in meat processing, mining, energy safety and conservation, environmental systems, metallurgy, construction, packaging and marketing[110]; this need for consultants in these sectors suggests that opportunities for the application of technology may exist as well.

---

[101]Ibid.

[102]Ibid, 34.

[103]Ibid.

[104]Ibid.

[105]Kate Bertrand, "Marketers Rush to Be the First on the Bloc," *Business Marketing*, Vol. 75, Issue 10, October 1990, 22.

[106]"Business Outlook Abroad: Hungary," *Business America*, 20.

[107]Nicholas Denton, "Comecon Collapse Spurs Export Drive to the West," *London Financial Times*, Survey on Hungary, 7.

[108]Denton, "Privatization Programme Under Pressure," 5.

[109]Ibid.

[110]"Business Outlook Abroad: Hungary," *Business America*, 20.

Given that the government is preoccupied with unrealistically rapid economic development, applications of energy or environmental technologies may be more difficult. End-of-pipe, command-and-control "techno-fixes" such as scrubbers are likely to be more attractive than pollution prevention and energy efficiency technologies applicable to the production processes, but it may be possible for Western firms to take the lead, hoping for a bandwagon effect, with the use of technologies in joint venture or wholly foreign operations. Because approximately 50 percent of Hungary's electricity is generated by the Paks nuclear power plant, nuclear technology, provided that it is affordable, may be marketable. In addition, since Hungary intends to continue its exploitation of indigenous brown coal resources, especially in light of cuts in Soviet exports of petroleum, clean coal technology has a good chance of marketability. Alternative energy technologies, including biomass generation, cogeneration and geothermal energy, are likely possibilities as long as they are made affordable and as long as Hungary's local experts in such technologies are encouraged to help move the government toward alternative energy use.

3.3.6 Labor Market Assessment

Very little work has been released in terms of quantified technical expertise in Hungary. It is likely that private firms interested in investing have completed some research on this subject, but they have refused to turn this information over to individuals.

Most conclusions regarding technical expertise must be deduced from meetings with government officials and industrial management people in Hungary.[111] The Budapest University of Economics (formerly Karl Marx University) and the Technical University are highly regarded through Europe, both East and West, and the Soviet Union. The Soviets, the East and West Germans, the Yugoslavs and developing countries, particularly African, often send their fast-track technical people to universities in Budapest. The University of Law and the numerous medical schools are also well respected and boast quite an international student body. Efforts at establishing business programs have been less successful due to the inappropriateness of American educational techniques in the Hungarian context, but students and businessmen alike are increasingly attending Western schools and international or regional business, economics, trade and finance conferences and seminars.

Local expertise is extremely high in the sciences, in engineering and in the upper management levels of consulting firms and industrial companies. Officials contacted in the Energetics Ministry, the Environment Ministry, the Nuclear Power Program and the Water Management Institute all possessed a wealth of information on technologies, both within Hungary and throughout the West. Most officials received the latest papers from colleagues around the world as well as having attended scientific colloquia where travel expenses could be covered. Nuclear engineering is particularly well-developed with clear familiarity with Western technologies and standards and regulations. Planners are very interested in the latest advances in computer systems despite the general lack of computers to run even the most basic programs.

Officials in the Energetics Ministry conducted a tour of a recently constructed biomass cogeneration plant in Tatabanya which employs some of the latest technology in the field. Energy planners have expressed interest in biomass as an alternative energy source and have contacted developers of a biomass turbine at Princeton University. Incinerator technology is also being considered.

Hungary's environmental groups are knowledgeable in the issues and technologies in the areas of nuclear power, hazardous waste and the Nagymoros Barrage Project. Members of the Soros Foundation, the

---

[111]All information below is derived from personal communications with Jennifer Wayne while in Hungary during the summers of 1989 and 1990.

Danube Circle and the Blue Line are trained scientists such as geologists, ecologists, hydrogeologists, chemists or engineers. In addition to actively opposing government projects which threaten the environment and/or human health, these organizations have also called attention to the employee safety aspects of using out-dated or faulty engineering techniques.

It is more difficult to assess expertise in the industrial sector since the use of obsolete technology does not necessarily point to a lack of knowledge. Most Hungarian management consultants are aware of such technology as digital electronic control equipment and sophisticated industrial air and water purification systems, but such awareness is not apparently as prevalent on the supervisor or floor manager level. Assessment of the sophistication of the equipment and the skill level of the labor pool requires on-site audits of the firm's operations and processes. Certain government officials have characterized Hungarian labor as skilled, but no further elaboration has been offered.

Hungary has been previously noted for its high level of scientific and technical expertise in government ministries. Yet by July 1990, the new government, under the leadership of the Hungarian Democratic Forum (MDF), systematically replaced the former government's technocracy with its own personnel. Purely political decisions have guided most new appointments with an obvious decrease in skill and knowledge.

Many of the opposition scientists have complained that power struggles and politics had all but paralyzed the Environment Ministry. As a result, some of the best scientists of the Soros Foundation, who were critical of the government's lack of concern for the environment, were left out of the ministry. Scientists, represented by environmental groups, and industrialists, represented by the Alliance of Free Democrats, have accused the MDF of ineptitude. The government subsequently moved many of their more vocal opponents with technical knowledge to menial positions with meager incomes. For example, in the summer of 1990, a well-known and respected hydrogeologist worked three jobs, one of which was as the graveyard shift concierge at a youth hostel in one of the less reputable areas of Pest.

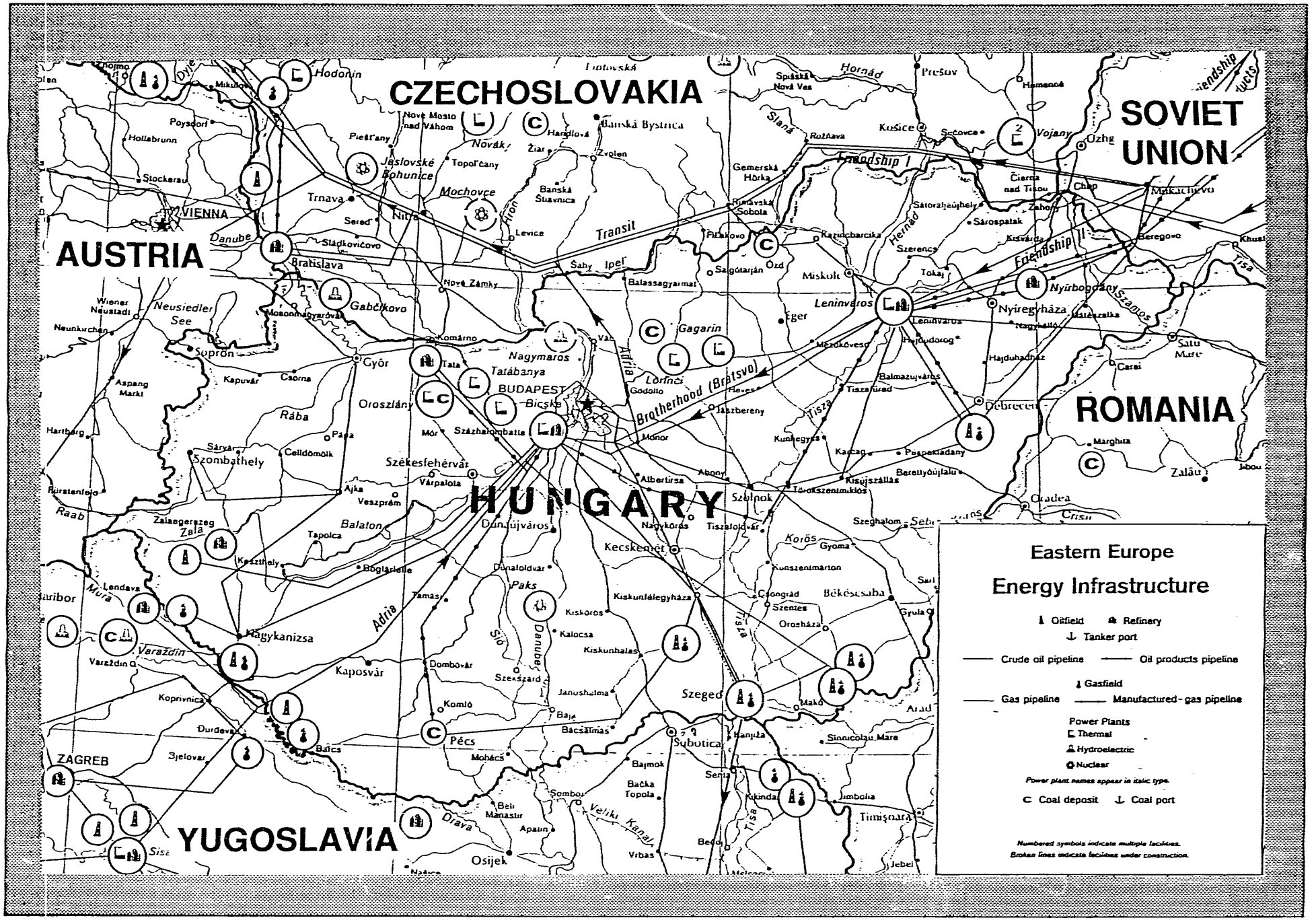
An unfortunate by-product of the government's reorganization of the various ministries, was the loss of a valuable body of professionals. Disappointment in the level of technical expertise exhibited by ministry personnel is likely to deter potential investors unless contacts within the scientific community can be used to identify the more qualified personnel. Investors who do not have established contacts within Hungary can use the international scientific community to obtain names of experts in particular fields.

Continued opening of the Hungarian economy, however, presents numerous opportunities both for foreign capital and expertise. Modernization of Hungary's obsolete technologies and education of its labor force are essential ingredients in Hungary's transition to a free-market economy. The government has demonstrated a committment to industrial restructuring as a way to reduce its energy requirements in conjunction with conservation measures. Although foreign debt stands at nearly 60 percent of its GDP, Hungary has not been forced to reschedule its debt and has already attracted significant foreign investment. As Hungary continues to liberalize regulations governing trade and ownership and as its telecommunications network improves, foreign investment will undoubtably increase.

APPENDIX A

MAP OF HUNGARY'S ENERGY

INFRASTRUCTURE


CZECHOSLOVAKIA
SOVIET UNION
AUSTRIA
HUNGARY
ROMANIA
YUGOSLAVIA
VIENNA
BUDAPEST
Eastern Europe
Energy Infrastructure
Oilfield
Refinery
Tanker port
Crude oil pipeline
Oil products pipeline
Gasfield
Gas pipeline
Manufactured-gas pipeline
Power Plants
Thermal
Hydroelectric
Nuclear
Power plant names appear in italic type.
Coal deposit
Coal port
Numbered symbols indicate multiple facilities.
Broken lines indicate facilities under construction.

APPENDIX B

FIRMS TO REMAIN STATE-OWNED[1]

Secretary of the Ownership and Privatization Committee in May 1991 announced that the following firms will remain under state control:

Companies to remain 100 percent state-owned:

Airport and Air Traffic Directorate
HIT Investcenter-Tradeinform
Technika Foreign Trade Co.

Companies to remain 51 percent state-owned:

Agrimpex PLC
Budapest Bank
Csepel Automotive Works
Danube Iron Works
EROTERV Power Plant Design Co.
Herend Porcelain Factory
Hungarian Aluminum Industry PLC
Hungarian Broadcasting Co.
Hungarian Credit Bank
Hungarian Commercial and Credit Bank
Hungarian Electricity PLC
Hungarian Foreign Trade Bank
Hungarian Post Office
Hungarian Shipping Co. PLC
Hungarian State Mint
Hungarian State Railways
Hungarian Telecommunications Co.
Hungexpo POC
Ikarus Bus Co.
Mechanical Laboratory
National Oil Industry PLC
National Savings Bank
Nitrochemistry Works
Precision Mechanics Co.
Raba Hungarian Railways Carriage and Machine Factory
Tisza Chemical Complex
UVATERV Road and Railway Design Co.
Zsolnay Porcelain Factory

[1]"Hungary Lists Firms to Remain State-Owned," Eastern Europe Report, 24 June 1991.

APPENDIX C

BIBLIOGRAPHY

Abel, I. and I. Szekely, "Credit, Imports and Inventories in CPEs: Causality Test for the Hungarian Economy," *Engineering Costs and Production Economics* (Netherlands), Vol. 19, Issues 1-3, May 1990.

"Ailing Eastern Europe Sails Into an Oil Slick," *Financial Times*, 15 August 1990.

"Antall Introduces New Government," *Budapest MTI*, 24 May 1990, (as found in *Foreign Broadcast Information Service: Eastern Europe*, 25 May 1990).

Ash, Nigel, "The Privatisation Dilemma," *Euromoney*, September 1990.

Bassow, Whitman, "Making the Brown Danube Blue Again," *Environmental Protection*, October 1990

Baumol, William J., "Productivity Growth, Convergence and Welfare: What the Long-Run Data Show," *American Economic Review*, Vol. 76, No. 5, December 1986.

Bertrand, Kate, "Marketers Rush to be the First on the Bloc," *Business Marketing*, Vol. 75, Issue 10, October 1990.

Bienkowski, Wojiech, "External Competitiveness and Reform in Eastern Europe," *Business in the Contemporary World*, Vol. 1, No. 1, October 1988.

Bohi, Douglas and Zimmerman, Mary, "An Update on Econometric Studies of Energy Demand Behavior," *Annual Review of Energy*, 1984.

British Petroleum [BP], *BP Statistical Review of World Energy*, July 1990.

Brookes, Len, "The Greenhouse Effect: The Fallacies in the Energy Efficiency Solution," *Energy Policy Communications*, March 1990.

Burgess, Joanne C., "The Contribution of Efficient Energy Pricing to Reducing Carbon Dioxide Emissions," *Energy Policy*, June 1990.

"Business Outlook Abroad: Hungary," *Business America*, Vol. 110, Issue 22, November 6, 1989.

Caldwell, Lynton Keith, International Environmental Policy: Emergence and Dimensions, Duke University Press, Durham, 1984.

Central Intelligence Agency, *International Energy Statistical Review*, 10 October 1990.

Central Intelligence Agency, *Selected Countries' Trade with the USSR and Eastern Europe*, Washington, DC, July 1990.

Chandler, William U., Alexei A. Makarov, and Zhou Dadi, "Energy for the Soviet Union, Eastern Europe and China," *Scientific American*, September 1990.

Chen, Chia-Yon and Rose, Adam, "A Structural Decomposition Analysis of Changes in Energy Demand in Taiwan: 1971-1984," *The Energy Journal*, Vol. 11 No. 1, January 1990.

"Comecon Collapse Spurs Export Drive to the West," *Financial Times*, 17 September 1990.

"Current Status of Fuel Supplies Analyzed," *Magyar Nemzet* in Hungarian, 30 October 1990 (English translation as found in *Foreign Broadcast Information Service: East Europe*, 6 November 1990).

Davey, W.G., "Energy Issues and Policies in Eastern Europe," *Energy Policy*, February 1987.

De Long, J. Bradford, "Productivity Growth, Convergence and Welfare: Comment," *American Economic Review*, Vol. 78, No. 5, December 1988.

De Long, J. Bradford, "The Protestant Work Ethic Revisited," *The Fletcher Forum of World Affairs*, Vol. 13, No. 2, Summer 1989.

Denison, Edward, *Trends in American Economic Growth, 1929-1982*, Washington, DC, The Brookings Institution, 1985.

"East Europe's Needed Funds Become Harder to Reach," *Financial Times*, 6 August 1990.

"East European Pollution: Clearing Up After Communism," *The Economist*, 17 February 1990.

"Eastern Bloc May Mean New Business for U.S. Pollution-Control Companies," *Wall Street Journal*, 12 February 1990.

Eastern Europe: Environmental Briefing, Environmental Resources Lmtd., London, January 1990.

Energy Information Administration (USDOE 1990).

"Energy Profiles of Czechoslovakia, Hungary and Poland and Their Emerging Free-Market Economies," *United States Senate: Committee on Energy and Natural Resources*, June 1991.

Energy USSR and Eastern Europe 1986/7 Yearbook, The Economist Intelligence Unit, The Economist Publications Ltd, London, 1986.

Environmental Data Report, United Nations Environment Programme, Prepared for UNEP by the GEMS Monitoring and Assessment Research Centre, London, UK, 1990.

European Economy--Economic Transformation in Hungary and Poland, Commission of the European Communities, Directorate-General for Economic and Financial Affairs, No. 43, March 1990.

External Trade Monthly Statistics, Eurostat, Brussels, July 1990.

"For a Gloomy Outlook, Hungarians Top All," *New York Times*, 2 January 1991.

Gabor, Andrea, "Investment: Unhappy Hunting Ground," *International Management*, (Europe Edition), Vol. 45, Issue 8, September 1990.

"Gas Price Protest Cripples Hungary" *New York Times*, 28 October 1990.

"Government Approves New Energy Policy," *Budapest MTI*, 19 June 1991, (as found in *Foreign Broadcast Information Service: East Europe*, 20 June 1991).

"High Price for Energy Freedom," *New York Times*, 30 May 1990.

Hinrichsen, Don and Enyedi, Gyorgy editors, *State of the Hungarian Environment*, Budapest Hungarian Academy of Sciences, the Ministry for Environment and Water Management, and the Hungarian Statistical Office, January 1990.

Hogan, William and Jorgensen, Dale, *Productivity Trends and the Cost of Reducing CO_2 Emissions*, Harvard University Global Environment Policy Project, Cambridge, MA, 1990.

Homer-Dickson, Thomas F., *Taxes, Fuel Consumption, and Carbon Dioxide Emissions*, Harvard University Energy and Environmental Policy Center, Cambridge, MA, 1990.

Hospododarske noviny, No. 40, 1985.

"Hungarian Coalition is Badly Beaten at the Polls," *New York Times*, 16 October 1990.

Hungarian Environment and Water Review, Ministry for Environment and Water Management, Vol. 3, No. 1, Budapest, 1989.

Hungary: Agricultural Sector Strategy for Policy and Structural Change, World Bank, Report No. 7320-HU, August 1989.

"Hungary," Cambridge Energy Associates. Information obtained from the Embassy of the Republic of Hungary, Office of the Commercial Counselor, August 1991.

"Hungary," *Financial Times*, 17 September 1990.

"Hungary," The New Encyclopædia Britannica, Vol. 20, 1990.

"Hungary Exemplifies a New Era in East-West Relations," *Europe*, January/February 1989.

"Hungary Is a Member of Council of Europe," *Europe*, Issue 291, November 1989.

"Hungary Lists Firms To Remain State-Owned," *Eastern Europe Report*, 24 June 1991.

"Hungary's Premier Says Economy Is in 'Extremely Grave' Condition," *New York Times*, 5 December 1990.

Hunyadi, Csilla, "Short-term Finance and Inventories," *Engineering Costs and Production Economics* (Netherlands), Vol. 19, Issue 1-3, May 1990.

"Interior Minister Announces Organizational Changes," *Budapest MTI*, 12 June 1990, (as found in *Foreign Broadcast Information Service: Eastern Europe*, 14 June 1990).

"International Economic Relations Ministry Tasks," *Budapest MTI*, 28 June 1990, (as found in *Foreign Broadcast Information Service: Eastern Europe*, 29 June 1990).

International Financial Statistics 1990, International Monetary Fund, Washington, DC, 1990.

International Petroleum Encyclopedia, PennWell Publishing Co., Tulsa, OK, 1990.

Jászay, Tamas, "Carbon Dioxide Emissions Control in Hungary: Case Study to the Year 2030," Report prepared for the US Environmental Protection Agency by Pacific Northwest Laboratory, May 1990.

Jones, Colin, "Two-Way Quickstep by the Danube," *Banker*, Vol. 138, Issue 744, February 1988.

"Jump in Gasoline Prices is Softened in Hungary," *New York Times*, 28 October 1990.

Kats, Gregory H., "Slowing Global Warming and Sustaining Development--The Promise of Energy Efficiency," *Energy Policy*, January/February 1990.

Keene, Michelle LaSalle, "The European Community and Environmental Policy: Opportunities and Tasks for Hungary," Unpublished paper, Kennedy School of Government, Harvard University, May 1990.

Kozlov, Victor, Socialism and Energy Resources, Progress Publishers, Moscow, 1985.

Kramer, John M., The Energy Gap in Eastern Europe, Lexington Books, Lexington, MA, 1990.

Lalmos, Csaba, "Political and Economic Reform and Labor Policy in Hungary," *International Labor Review*, Vol. 129, 1990.

Lang, Istvan, "Environmental Future in Hungary," Hungarian Academy of Sciences, a paper presented at the 11th World Conference of the WFSF, Budapest, May 27-31, 1990.

"Lights Going Dim in Eastern Europe," *Financial Times*, 17 September 1990.

Longworth, Richard C., "EC Fosters Change in Eastern Europe," *Europe*, Issue 291, November 1989.

Magyar Villamos Müvek Tröszt, *Statistical Data Featuring the Power Industry*, 1987.

Magyar Villamos Müvek Tröszt, *Technical Data 1990*, Vol. 28, 1990.

Magyarorzag, 7 July 1985.

Merkin, Victor, *Petroleum Conservation in Eastern Europe*, Delphic Associates, Falls Church, VA, 1987.

Miller, Mark S., "A Green Wind Hits the East," *Technology Review*, October 1990.

"Modernization in Hungary in the Long and Short Run Measured by Social Indicators," Social Indicators Research, Edited by Alex C. Michalow, Vol. 23, Nos. 1-2, August/September 1990.

Mohnfeld, Jochen H., "Energy and Oil in Eastern Europe -- Status and Prospects," *Intereconomics*, July/August 1990.

Mountain, Dean C., "The Contribution of Changing Energy and Import Prices to Changing Average Labor Productivity: A Profit Formulation for Canada," *The Quarterly Journal of Economics*, August 1985.

Nagy, Andras, "Why Doesn't the Hungarian Economy Work?" *Business in the Contemporary World* Winter 1989.

National Foreign Assessment Center (CIA), Energy Supplies in Eastern Europe: A Statistical Compilation, ER79-10624, December 1979.

"New Labor Minister on Tasks, Unemployment," *Budapest Nepszabadsag*, 11 February 1991, (as found in *Foreign Broadcast Information Service: Eastern Europe*, 20 February 1991).

"OECD: Partners in Transition," *US Department State: European Affairs*, (unclassified cable), July 1991.

Overview of the Ministry of Industry and Trade: Republic of Hungary, DOE memorandum on meeting with the Hungarian Minister of Industry and Trade, 13 May 1991.

Oil and Energy Trends, Annual Statistical Review 1987, Energy Economics Research Ltd., Reading, England, EERL, May 1988.

Okolicsanyi, Karoly, "Privatization in the Steel Industry and the State Property Agency," *Radio Free Europe Report on Eastern Europe* Vol. 1, No. 34, 24 August 24 1990.

Okolicsanyi, Karoly, "The Effect of German Currency on Hungary," *Radio Free Europe Report on Eastern Europe*, Vol. 1, No. 34, 24 August 1990.

"On the Brink of Transformation," *Financial Times*, in Survey on Hungary, 17 September 1990.

"On the Danube, Unbuilt Dams but Pent-Up Anger," *New York Times*, 5 December 1990.

Poland: Reform, Adjustment and Growth, The World Bank, 17 August 1987.

"Privatisation Programme Under Pressure," *Financial Times*, 17 September 1990.

Proceedings from the World Energy Conference (WEC), 1980 and 1984.

Radio Free Europe, *Situation Report* (Hungary), 3 January 1986.

Regional Energy Listener, Energy Information Ltd., 15 August 1990.

Salay, Juergen, "Hungary -- Restructuring the Energy System," *Radio Free Europe Report on Eastern Europe*, 31 August 1990.

Samorodov, Aleksandr, "Coping with the Employment Effects of Restructuring in Eastern Europe," *International Labour Review*, Vol. 128, No. 3, 1989.

Schipper, Lee, Howarth, Richard B. and Geller, Howard, *United States Energy Use from 1973 to 1987: The Impacts of Improved Efficiency*, Lawrence Berkeley Laboratory, draft 16 May 16 1990.
"Shortage of Stocks," *Financial Times*, in Survey on Hungary, 17 September 1990.

Solow, Robert, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics*, August 1957.

Statisticheskii ezhegodnik stran-chlengy Soveta Ekonomicheskoi Vzaimopomoshchi.

Sterner, Thomas, "Energy Efficiency and Capital Embodied Technical Change--The Case of Mexican Cement Manufacturing," *The Energy Journal*, Vol. 11, No. 2, April 1990.

Summa, John, "Coming out of the Solar Eclipse--Alternative Energy's First Brush with Success," *E Magazine*, March/April 1990.

Survey of Business Journal, Vol. 25, Fall, 1989.

Tamas, Gellert, "Hungary's Power Plight," *Independent Energy*, September 1990.

The European Community and the Environment, Luxembourg: Office for Official Publication of the European Communities, 1987..

The PlanEcon Report, PlanEcon, Inc., Washington, DC, 12 October 1990.

The PlanEcon Report, PlanEcon, Inc., Washington, DC, 18 August 1989.

The PlanEcon Report, PlanEcon, Inc., Washington, DC, 8 June 1990.

Thomas, Steve, "Comecon Nuclear Power Plant Performance: A Comparison with the USA and Japan," *Energy Policy*, July/August 1990.

Trade in Services: Economic Determinants and Development-Related Issues, World Bank Staff Working Paper, No. 480, August 1981.

Tye, Larry, "US Heads Effort for Nuclear Safety in old East Bloc," *The Boston Globe*, 30 October 1990.

Tzeng, Gwo-Hshiung, "Modeling Energy Demand and Socioeconomic Development of Taiwan," *The Energy Journal*, Vol. 10, No. 2, April 1990.

United Nations, Energy Statistics Yearbook, 1982 and 1985 and 1989 editions.

United Nations, *United Nations National Accounts Statistics*, 1987.

US Congress, Office of Technology Assessment (USC/OTA, 1990), *Energy Use and the U.S. Economy*, OTA-BP-E-57, US Government Printing Office, Washington, DC, June 1990.

US Congress, Office of Technology Assessment (USC/OTA), *Energy Use and the US Economy*, OTA-BP-E-57, US Government Printing Office, Washington, DC, June 1990.

US Department of Energy, *Energy for Today--Renewable Energy*, USDOE Office of Conservation and Renewable Energy, Washington, DC, March 1990.

US Department of Energy, *Programs in Renewable Energy Fiscal Year 1990*, USDOE Office of Energy Storage and Distribution, Washington, DC, 1989.

Voloshin, Vladimir, "Electric Power in the Comecon European countries," *Energy Policy*, October 1990.

"Waiting Lists Grow," *Financial Times*, 17 September 1990.

"Welfare Minister Laszlo Surjan on Tasks," *Budapest Nepszabadsag*, 31 May 1990 (as found in *Foreign Broadcast Information Service: Eastern Europe*, 5 June 1990).

Wenzel, G.B. of EGI Contracting and Engineering, A Division of Energotechnology, Budapest, Hungary (Personal Communications).

World Development Report 1990, The World Bank, Oxford University Press, Oxford, 1990.

World Nuclear Industry Handbook, Reed Business Publishing, Sutton, Surrey, UK, 1989.

APPENDIX D

CONVERSION FACTORS[1]

A variety of units are used in reporting information about energy supply, demand, or usage. It is difficult to arrive at consistent conversions since energy can, and usually is, expressed in different measuring units. The conversion is further complicated by the fact that the quality of a specific energy source can vary or there may be a variety of products, especially from petroleum, that are brought together under one source. For instance, in the United States natural gas has a nominal heating value of 1032 Btu (British thermal units) per SCF (standard cubic foot). However, low and intermediate Btu gas may have heating values in the 150 to 500 Btu/SCF range. It is also necessary to determine whether the natural gas is being reported as natural gas (dry) or natural gas (wet) since the heating values differ by approximately ten percent (1032 Btu/SCF and 1103 Btu/SCF respectively). A common practice is to use 1000 Btu/SCF in conversions unless otherwise specified.

Similar problems arise with regard to petroleum and petroleum products. Crude petroleum has a nominal heating value of about 5,600,000 Btu/bbl [Btu per barrel (42 US gallons)] although other nominal values may be used (5,800,000 Btu/bbl). Residual fuel oil, a heavy fraction from the distillation of crude and often used as a fuel for power plants, however, has a nominal heating value of 6,300,000 Btu/bbl.

Another problem that arises with regard to petroleum and petroleum products is in the conversion of barrels to tons (or vice versa) (see below). This conversion depends on the density (or specific gravity) of the petroleum and the density varies depending on the source. The value may vary from 6.65 to 8.09 (arbitrary units) depending on its source in the world. On the same scale the values for US, Hungary and Soviet crude are 7.42, 7.63, 7.35 respectively.

Lastly, the heating values for coal vary by source. In the US, western coal may have a heating value as low as 13,000,000 Btu per short ton (see below) while eastern coal may have a heating value as high as 26,000,000 Btu per short ton. When converting from tons to Btu (or vice versa), the value to be used depends on the source and the percentage mix. In previous US studies of coal supply and demand (as expressed in energy units) the value of 21,600,000 Btu per short ton have been used.

---

[1]The reference list used in compiling the conversion tables is provided at the end of Appendix D.

The following conversion tables are provided to assist the reader in moving from one energy source or unit to another. The tables may be used to put all the information into a common energy unit.

Table 1. Weights, Volume, Energy

1 short ton (ton)	=	2,000 pounds
1 metric ton (tonne)	=	1.102 short tons = 2,204 lb = 1,000 kg
1 long ton	=	1.120 short tons = 2,240 lb
1 barrel (as referred to petroleum)	=	42 US gallons
1 cubic meter (m^3)	=	35.31 cubic feet (ft^3)
1 British thermal unit (Btu)	=	1,055 joules

Table 2. Metric Prefixes

kilo (abbreviated k)	=	thousand	= 10^3
mega (abbreviated M)	=	million	= 10^6
giga (abbreviated G)	=	billion	= 10^9
tera (abbreviated T)	=	trillion	= 10^{12}
peta (abbreviated P)	=		= 10^{15}
exa (abbreviated E)	=		= 10^{18}

Table 3. Approximate Conversion Factors for Crude Oil*

From \ Into	Tonnes (Metric Tons)	Long Tons	Short Tons	Barrels	Kilolitres (cub. metres)	1000 Gallons (Imp.)	1000 Gallons (U.S.)
	MULTIPLY BY						
Tonnes (Metric Tons)	1	0.984	1.102	7.33	1.16	0.256	0.308
Long Tons	1.016	1	1.120	7.45	1.18	0.261	0.313
Short Tons	0.907	0.893	1	6.65	1.05	0.233	0.279
Barrels	0.136	0.134	0.150	1	0.159	0.035	0.042
Kilolitres (cub. metres)	0.863	0.849	0.951	6.29	1	0.220	0.264
1000 Gallons (Imp.)	3.91	3.83	4.29	28.6	4.55	1	1.201
1000 Gallons (U.S.)	3.25	3.19	3.58	23.8	3.79	0.833	1

* Based on world average density (specific gravity)

Table 4. Btu Equivalents of Common Fuels[1]		
Short List+		
Fuel	**Common Measure**	**Btus**
Crude oil	barrel (bbl.)—42 gallons	5,800,000
Natural gas	1000 cubic feet	1,035,000
Natural gas	therm	100,000
Coal (bituminous)	ton (short ton -907.2 kg)	26,000,000
Coal (lignite)	ton	14,000,000
Gasoline	gallon	124,000
Electricity	kilowatt-hour (kWh)	3,412[2]

[1] A Btu is the amount of heat required to raise the temperature of 1 lb of water 1°F.

[2] Because of conversion losses in the generation of electric power from heat, about 10,000 Btu are required to produce one kilowatt-hour.

+ See also Table 7.

TABLE 5. Energy Unit Conversion Chart *				
Cubic Feet Natural Gas ** (CF)	**Barrels Oil (bbl)**	**Short Tons Bituminois Coal (T)**	**British Thermal Units (Btu)**	**Kilowatt Hours Electricity (kWh)**
-	-	-	1	0.000293
1	0.00018	0.00004	1000	0.293
3.41	0.00061	0.00014	3413	1
1000 (1 MCF) +	0.18	0.04	1 Million	293
3413	0.61	0.14	3.41 Million	1000 (1 MWh)
5600	1	0.22	5.6 Million	1640
25,000	4.46	1	25 Million	7325
1 Million (1 MMCF)+	180	40	1 Billion	293,000
3.41 Million	610	140	3.41 Billion	1 Million (1 GWh)
1 Billion (1BCF)+	180,000	40,000	1 Trillion	293 Million

* Based on the following nominal fuel heating values:
1 Cubic Foot Natural Gas = 1000 Btu
1 Barrel Crude Oil = 5.6 Million Btu
1 Pound Bituminous Coal = 12,500 Btu

** Substitute Natural Gas (SNG) and Liquefied Natural Gas (LNG) will have approximately the same heating value.

+ Note that when using prefixes for natural gas, 1000 cubic feet is labeled as 1 MCF not 1kCF (see Table 2). With this notation 1 million cubic feet becomes 1 MMCF not 1 MCF (see Table 2). Lastly a billion cubic feet is BCF not GCF (see Table 2) and a trillion cubic feet is TCF which is also the designation for tera.

TABLE 6. ELECTRICAL UNITS

Power. The basic unit of power is the watt. For an electrical appliance the power rating is found by multiplying the voltage by the current (in amperes). Thus, a 125 volt appliance drawing 10 amperes has a power rating of 1250 watts. The kilowatt is simply 1000 watts and a megawatt is a million watts (10^6 watts).

We can summarize these facts as follows:

number of watts = voltage X current
1 kilowatt = 1000 watts = 10^3 watts
1 megawatt = 1,000,000 watts = 10^6 watts

Energy. The basic unit for energy is the kilowatt-hour (kWh), which is the energy used when a device rated at 1000 watts operates for an hour (or a 100 watt appliance operates for 10 hours). The table below gives various equivalents.

Unit or Process	Number of kWh
Btu	2.9×10^{-4}
One hour manual labor	0.06
Combustion of 1 gallon of gasoline	38.3
Heat one gallon of water 1°F	0.0024
0.59 barrels of crude oil *	1000
0.15 short tons of coal *	1000
3,300 cubic feet of dry natural gas *	1000

* Because of energy losses associated with generation of electricity, it takes 1.8 barrels of crude oil, 0.47 short tons of coal, or 10,000 cubic feet of natural gas to generate 1,000 kilowatt hours of electricity.

TABLE 7. Heat Content of Fuels in Btus

	Btu	Per Unit
Coal:		
Anthracite (Pa.)	25,400,000	ton
Bituminous	26,200,000	ton
Blast furnace gas	100	ft^3
Briquettes and package fuels	28,000,000	ton
Coke	24,800,000	ton
Coke-breeze	20,000,000	ton
Coke-oven gas	550	ft^3
Coal tar	150,000	gal.
Coke-oven and manufactured gas products, light oils	5,460,000	bbl.
Natural gas:		
Natural gas (dry)	1,035	ft^3
Natural gas liquids (average)	4,011,000	bbl.
Butane	4,284,000	bbl.
Propane	3,843,000	bbl.
Petroleum:		
Asphalt	6,640,000	bbl.
Coke	6,024,000	bbl.
Crude oil	5,800,000	bbl.
Diesel	5,806,000	bbl.
Distillate fuel oil	5,835,000	bbl.
Gasoline, aviation	5,048,000	bbl.
Gasoline, motor fuel	5,253,000	bbl.
Jet fuel:		
Commercial	5,670,000	bbl.
Military	5,355,000	bbl.
Kerosene	5,670,000	bbl.
Lubricants	6,060,000	bbl.
Miscellaneous oils	5,588,000	bbl.
Refinery still gas	5,600,000	bbl.
Heavy fuel oil	6,287,000	bbl.
Road oils	6,640,000	bbl.
Wax	5,570,000	bbl.
Shale oil	5,800,000	bbl.

TABLE 8. Barrels of Oil in One Metric Ton
(tonne)

United States	7.42
Hungary	7.63
Soviet Union	7.35
World Average	7.33

The following have extensive conversion tables and glossaries and are the primary sources for this appendix.

Energy Technology Handbook, Ed. Douglas M. Considine, McGraw-Hill Book Company, New York, NY 10020, 1977.

Energy Handbook, Robert L. Loftness, Van Nostrand Reinhold Company, New York, NY 10020, 1978.

The World Energy Book, David Crabbe and Richard McBride, Nichols Publishing Company, New York, NY 10024, 1978.

Handbook of Chemistry and Physics, 69th Edition, CRC Press, Boca Raton, FL 33431, 1988.

Energy Facts 1989, Energy Information Administration, U.S. Department of Energy, Washington, DC 20585, DOE/EIA-0469 (89)

END DATE
3-6-92