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Energy and nuclear power planning study for Romania
(covering the period 1989–2010)

Report prepared by a team of experts from Romania with the guidance of the International Atomic Energy Agency

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FOREWORD

The introduction of nuclear power into the electricity generation grid of a country poses specific requirements on the national infrastructures that largely surpass those experienced in general industrial and energy development planning. The relatively high expenditures associated with the construction of a nuclear power plant, and the implications for the country and the power utility involved, require that the decision for introduction of this technology be a sound one. The problem is further complicated in the case of developing countries, primarily due to scarcity of financial resources and the fact that investments in the energy and electricity sectors are competing with those needed for general development and public welfare.

Consequently, careful planning of the future energy and electricity facilities of the country must be carried out by the appropriate authorities in order to make timely decisions. At the start of this planning, it is required to identify the expected levels of energy/electricity demand and the options that are available to meet these demands, taking special note of the national energy resources and potential imported sources. Further analyses would be needed for the optimization of the supply facilities to meet the demand in the most efficient and economic manner, with due consideration of the environmental impacts and resource requirements imposed by the resulting energy/electricity system derived through the optimization process. This type of analysis should also consider other alternatives to expanding the system, such as measures at the demand side that would reduce the level of expected demands.

If nuclear power is one of the options to be considered for expanding the electricity generation system, the economic comparison of this technology against other options becomes of tantamount importance. After the decision of "going nuclear" is made, a co-ordinated programme is required to be implemented in order to guarantee that adequate financing and project management is in place throughout the construction of the plant, and the safe and efficient operation of the plant, once it is completed.

In accordance with its mandate of promoting the use of nuclear energy for peaceful uses worldwide, the IAEA has developed a systematic approach for the assessment and development of national infrastructures encompassed in the assistance programme to developing Member States. The overall objective of this programme is to help strengthen national capabilities for conducting energy, electricity and nuclear power planning studies that would serve as a basis for the decision whether to undertake a nuclear power programme, and in case a positive decision is made, for planning the timely steps that need to be taken by the country for successful implementation of the programme, including: assessment of the available infrastructure and the need, constraints and possibilities for their development; development of master schedules, programmes and recommendations for action.

One particular type of activity consists in providing technical assistance to developing countries in the conduct of energy, electricity and nuclear power planning studies, considered to be the first task to be performed by a country interested in launching a nuclear power programme. The scope, objectives, organization and duration of this type of study are described in Appendix A of IAEA-TECDOC-470, Energy and Electricity Demand Forecasting for Nuclear Power Planning in Developing Countries, A Reference Guidebook (1988).

The present report describes the study conducted in co-operation with several organizations from Romania and covers the energy and electricity requirements for this

country up to the year 2010. It also outlines optimal expansion plans for the power generating system of the country over the same period.

The Energy and Nuclear Power Planning (ENPP) study for Romania is not a typical one for several reasons. Firstly, similar to other east European countries, Romania is going through a process of reorganization as a result of the transition from a centrally planned economy to a market oriented one. Secondly, a nuclear power plant (Cernavoda) is currently under construction in the country and the study provided the opportunity to verify its economic competitiveness with other options.

In view of the above and, in particular, because many of the assumptions made for the study are the result of expert consensus but have not been validated or endorsed by the Government, the present study should not be considered as the Energy and Electricity Master Plan for Romania, but rather as an attempt to evaluate the possible evolution of the energy and electricity consumption under certain scenarios of socioeconomic and technical development. Likewise, the expansion plans of the electricity supply system delineated by the study should not be taken as the Government plan in this area. The findings of the study do, however, provide more insight as to the possible strategies for developing the power generating system and the necessary work to be undertaken to supplement the results of the study or to update it, if deviations are experienced in the principal hypotheses made for the study.

National organizations that participated in the study include: the Romanian Electricity Authority (RENEL) and its specialized research organization: the Institute of Power Studies and Design (ISPE); the Institute of Economic Research (INCE); the National Commission for Statistics (CNS); Ministry of Economy and Finance (MEF); Ministry of Industry (MI); and the Polytechnic Institute of Bucharest (IPB). Support at some stages of the study was also provided by the Romanian Energy Conservation Agency (ARCE) and the Academy of Economic Sciences (ASE).

ISPE was fully responsible for all phases of the study, including the preparation of the present report. The IAEA's role was to provide overall co-ordination and guidance throughout the conduct of the study, and to guarantee that adequate training in the use of the IAEA planning models was provided to the members of the national team, both through their attendance to regular training courses on the subject matter and during the several meetings organized within the scope of the project.

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SUMMARY

1. Objectives and Scope of the Study

The Energy and Nuclear Power Planning (ENPP) study for Romania has been conducted under the technical cooperation programme of the International Atomic Energy Agency (IAEA). The objective of the study was to analyze the electricity demand as part of the total final energy demand, in various scenarios of Romania's socioeconomic and technological development, and to develop economically optimized electric generating system expansion plans for meeting the electric power demand, and to assess the role that nuclear energy could play within these optimal programmes.

The ENPP study for Romania had the following major objectives:

- to implement systematic planning procedures in Romania;
- to verify the MAED (Model for Analysis of the Energy Demand) and WASP (Wien Automatic System Planning package) methodologies under the concrete conditions of Romania and the possibility to introduce them in the national energy planning procedure;
- to train a group of Romanian experts in the use of the MAED and WASP models.

Within the project, Romania has received three complete microcomputer configurations (personal computers and peripherals) which have been thoroughly dedicated to the energy and electricity planning studies and analyses, and assistance in term of training of local experts in the above mentioned models, both at formal training courses organized by the IAEA and on-the-job training throughout the conduct of the study.

By the end of the study the energy planners in Romania who participated in the study have gained sufficient expertise in the methodologies and computer programs provided by the IAEA and could utilize them to carry out future planning studies without external support.

2. Organization of the Study and Division of Responsibilities

The study was achieved with the participation of experts from organizations involved in the economic and energy forecasting activity, namely: Romanian Electricity Authority - RENEL together with its specialized institute, Institute of Power Studies and Design - ISPE; Institute of Economic Research - INCE; National Commission for Statistics - CNS; Ministry of Industry - MI; Ministry of Economy and Finance - MEF; and Polytechnic Institute of Bucharest - IPB.

A working team was set up to conduct the study working under IAEA coordination and a Romanian coordinating team, the latter being responsible of providing guidance and directives for the study. ISPE acted as overall coordinator of the national effort and carried out the calculations with the MAED and WASP models and produced the technical report. ISPE also provided the liaison with IAEA.

Similar to other IAEA technical cooperation projects, the ENPP study was conceived as a joint effort of Romania and the IAEA where each side had its own, clear, well established responsibilities:

- Romanian experts had full responsibility for the conduct of the study, including data collection and preparation, execution of the computer runs, interpretation and improvement of results, etc., up to the production of the draft report of the study;

- The IAEA experts provided guidance and coordination throughout the conduct of the study, on-the-job training of the national team and transfer of know-how and the necessary methodologies and computerized planning tools to Romania.

The IAEA trained the Romanian team in the use of the MAED and WASP models in Romania and at IAEA's headquarters in Vienna, Austria, for 9 man-month during 1991 and 1992. In addition, three complete microcomputer configurations (personal computer and peripherals) were provided to Romania to be totally dedicated to energy and electricity planning studies and analyses.

3. Summary of the Approach

3.1. Planning Methodologies

The analyses were carried out in sequence, first to determine the total final energy requirements, including electricity, by using the MAED Module 1 for various development scenarios for Romania. The resulting electricity demand projections so obtained were used as input to the WASP model in order to optimize the expansion of the power generation system over the study period and the role that nuclear power could play in the generation mix. The versions of the MAED and WASP models used in the study are part of a microcomputer-based package called ENPEP (Energy and Power Evaluation Program).

The MAED analysis involves:

- breakdown of the final energy consumption of the country for a base year into various consuming sectors and categories of end-use, in a consistent manner; and the identification of the economic, social, technological factors influencing each category of final consumption;

- specification (in mathematical terms) of the relationships between each category of energy consumption and the factors governing this consumption;

- reconstruction, by means of the MAED model, of the final energy consumption based on the statistical data available for the base year of the study;

- construction of consistent development scenarios having in view the future evolution of demographic, macroeconomic, social and technological factors influencing the energy demand;

- evaluation, by means of MAED model, of the final energy demand corresponding to each scenario.

The MAED model allows to take into account the influence on the energy demand of:

- structural changes of the economy: the share of various economic sectors in the gross domestic product (GDP) and the evolution of their energy intensities;

- changes in population's living style: housing conditions, mobility, social needs, etc.

- trends regarding the penetration into the market of each final energy form: electricity, coal, gas, oil, etc.

A special treatment is given to the demand for electricity which is not only calculated on an yearly basis as other forms of energy, but also on an hourly basis in order to determine information that can be readily used as input for the analysis of the expansion of the generating system by means of the WASP model.

The subsequent analyses with WASP was carried out using the electricity generation demand and load characteristics previously determined by MAED, together with some assumptions for the type of generating plants that could be used as expansion candidates (new power plants and rehabilitated thermal plants), their operational characteristics and data related to economic parameters (fuel price, investment cost, discount rate) and optimization criteria.

The WASP model analyses have in view the following components:

- the electricity demand and load duration curves determined with the MAED model;
- the technical and economic features of the existing and firmly committed thermal and hydro power plants units at the beginning of the study period;
- the units retirements program;
- the available domestic resources of primary energy for generating electricity;
- the types of new candidate plants that can be used to expand the generating system during the study period and their technical and economic characteristics;
- reliability constraints for the electric power system that should be met by the system developing optimal solution;
- specific investments and the prices of fuels.

The WASP model allows to carry out some sensitivity analyses on the optimal solutions under variations of different parameters: fuel prices, the discount rate, specific investments.

3.2. Study Period

It was decided to select the year 1989 as the base year for the MAED analysis because it was the last year with a certain economic stability and representative of the economic and energy background of the country. Energy and economic statistics for 1990 and 1991 were considered not to be representative for future energy forecasting due to the interactions between the old and the new structures and relations.

It was considered as very important for the ENPP study to start from a quite stable base year, taking into account that the changes induced by the transition period should be modelled within the development scenarios.

Under the present conditions in the country, as far as the study period is concerned, a range of about 20 years 1989-2010 has been considered sufficient for determining the energy demand and the electricity supply strategy.

3.3. Major Policies and Assumptions

During the time the present study was executed there was no macroeconomic and technological medium and long forecasting available from the government. For this reason in the establishment of the Romania's development proper consideration was paid to the major national objectives and to the conclusions drawn from the comparison of the past background of Romania's main macroeconomic and energy parameters and those of other countries.

The major policies and assumptions that were considered in the ENPP study for the determination of the future energy demand are shown in the Table S.1.

Table S.1 Major Policies and Principal Assumptions

Description	Policy	Assumptions
1. Economic growth	- The speed and the manner the country will move through the period leading to the market economy; - Increase of the national production of goods to satisfy the domestic demand and possible exports markets; - Investments stimulation; - Romania's integration in the European and world economy; - Incorporation of environmental issues in energy and electricity planning with the view to reducing the burden to the environment.	- Stop economic decline through 1993-1994 followed by a real growth with an average annual rate of 3-5%; - Gradual change of the GDP structure by reducing the share of Industry and increasing the share of Agriculture, Service and Transport; - Gradual elimination of subsidies both for raw materials and fuels and for a range of services and products; - Foreign resources utilization, especially, for investment leading to upgrading of the economy; - Increase of labour productivity.
2. Population	- Providing decent living to the population; - Improvement of the social system.	- Stopping the decreasing trend the next 1-2 years followed by a moderate increase similar to that in West European countries; - Small and medium-sized towns development by developing small industry, services and tourism; - Rural settlements development due to the land law (in force) and reduction of migration rate from villages to towns; - Due to recession and economy adjustment one can expect an increase of the unemployment until 1992-1993 followed by a gradual reduction up to 2010.

Table S.1 Major Policies and Principal Assumptions (cont.)

3. Energy	- Increase of primary energy production by improving the extraction technologies; - Aligning energy prices to international level.	- Limited available domestic energy resources; - Fuel price increase between 1992-2010 with an average annual rate of 2.5% for heavy oil 3.5% S; 2.2% for heavy oil 1% S; 0.5% for coal, 2.5% for natural gas and 2.3% for liquefied natural gas.
4. Industry	- Re-adjustment of the production rough processing industry; - Development of the industries with high value added; - Reduction of the energy and materials intensities; - Technological upgrading by combining rehabilitation of existing equipment and introducing new technologies.	- Reduction of the share of some energy intensive and polluting industries in the Basic Materials sub-sector, while increasing the share of the Non-durable goods & Miscellaneous sub-sectors; - Finally, preservation of the share of Machinery and Equipment sector to such a rate that would allow, together with some imports, an adequate supply of equipments for the rest of economy; - Improvement of the efficiency of energy and raw materials resources use both by selecting systems and by fiscal supporting measures that might stimulate the technological gap bridging; - Increase of electricity penetration within the industry energy consumption.
5. Transportation	- Reduction of subsidies and stimulation of the use of efficient transportation system both for passenger and freight transportation; - Upgrading transportation by rehabilitation of existing infrastructure and extension of this infrastructure (road, railway and sea transport).	- Road network development by building up new highways - Extension of electric freight and passenger transportation; - Urban transportation restructuring for increasing traffic fluency; - Increase of population mobility especially increasing the share of private motor cars; - Increase of Constanţa harbour capacity and of the traffic on the Danube-Black Sea Canal by upgrading harbour installations.

Table S.1 Major Policies and Principal Assumptions (cont.)

Description	Policy	Assumptions
6. Household/Service	- Providing decent energy comfort level for both urban and rural areas; - Reduction of pollution urban areas; - Significant increase of electrical appliance ownership; - Development of the services by extending the existing ones and meeting the request of new services.	- Covering all energy demand; - Increase of centralized thermal energy share for space and water heating; - Slight decrease of the number of persons living together in one dwelling; - Increase of electricity demand due to more intensive use of electrical appliances; - Improvement of the thermal insulating rate both of the existing dwellings and of the new constructions; - Slight penetration of the electricity utilization for both heating and air-conditioning purposes.

In order to select some outstanding scenarios that should indicate the evolution trends of the energy demand a sensitivity study was conducted. The test consisted on determining the influence on the final energy demand of the GDP structure and the energy intensities.

The influence of GDP structure upon the final energy demand was studied taking into consideration the variation of either the share in total GDP of the economic branches (Manufacturing, Agriculture, Transportation, Service, etc.) or the share in manufacturing value added of the various sub-sectors: Basic Materials, Machinery and Equipment, Non-durable goods, Miscellaneous industries.

As a conclusion of these tests, the most important parameters affecting the evolution of the final energy demand are the share of Manufacturing within the total GDP and the share of Basic Materials industries in the manufacturing value added, as well as the variation of their energy intensities.

After performing these sensitivity tests, three scenarios have been set up, namely:

- Low scenario (with slightly improved technologies);
- Basic scenario (with moderately improved technologies);
- High scenario (with high technologies).

The Romanian economy was assumed to expand at an average annual growth rate of 3.4%, 4.2% and 5.0% for the Low, Basic and High scenarios, respectively, over the period 1992-2010. By the year 2010, the total GDP would be about $57.2*10^9$ US$, $66.1*10^9$ US$ and $75.0*10^9$ US$ (1989 Exchange rate) for the Low, Basic and High scenarios, respectively; and the resulting GDP per capita would reach 2343, 2708 and 3073 US$ per capita.

4. Principal Findings

4.1. Energy Demand Projections (Module 1 of MAED)

The evolution of the final energy demand (including non-commercial energy) through the 1989-2010 period, obtained from the analysis performed by means of Module 1 of the MAED model is estimated to be 77.017 Mtce in the Low scenario, 82.225 Mtce in the Basic scenario and 86.672 Mtce in the High scenario against 78.170 Mtce in the base year (1989). (Figure S.1).

These results imply that in 2010 the energy demand in the Basic scenario is 7.0% higher than the value of the Low scenario and 5.6% less than that of the High scenario.

A comparison between the evolution of the average growth rate of the GDP and final energy demand shows that in all three scenarios the final energy demand has the same trend as that of the GDP, but at a lower level.

The sectoral final energy demand (commercial energy) is summarized in Figure S.2 and Table S.2.

The results show that, as in the past, the Industry sector (including Manufacturing, Construction, Mining and Agriculture) would remain the biggest final energy consumer of Romania in all scenarios.

As for the distribution of the total energy demand by energy form, fossil and district heat would still have the largest contribution, of about 50% to the total demand in 2010 as listed in Table S.3 and illustrated in Figure S.3.

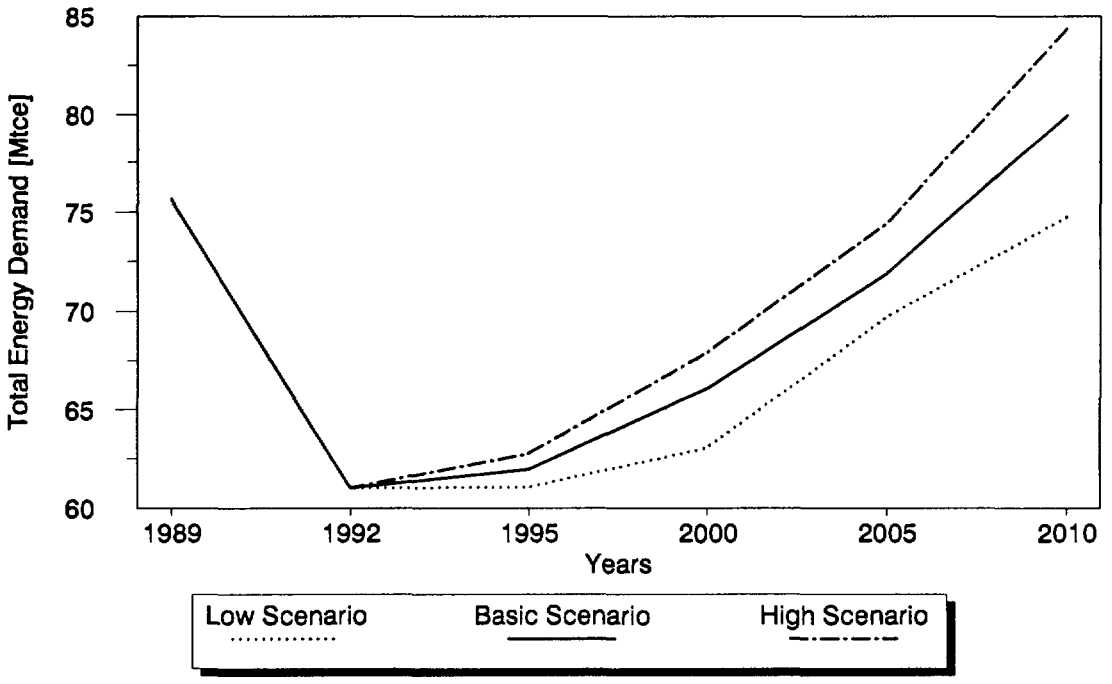

Figure S.1 Evolution of the Final Energy Demand According to the Scenarios

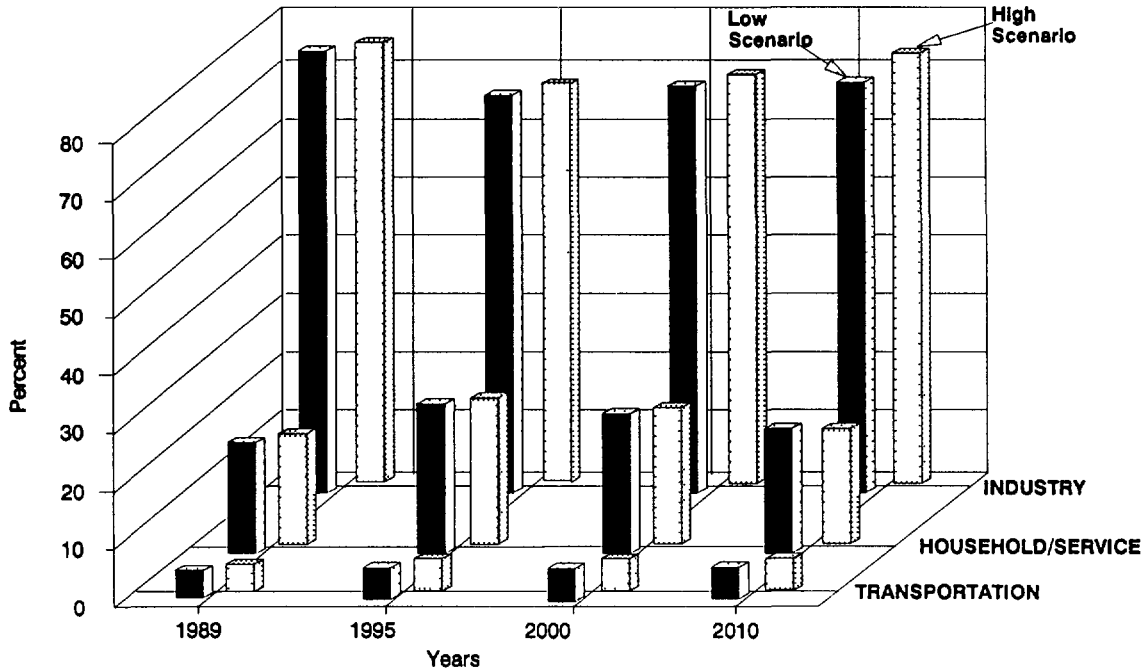

Figure S.2 Final Energy Demand by Sector

Table S.2 Final Energy Demand by Sector (1989-2010)

Sector	Growth rate [% per year]	Energy demand [Mtce]		Share [%]	
	1989-2010	1989	2010	1989	2010
Low Scenario					
1. Industry	-0.27	57.4	54.2	75 9	72 5
-Agr/Cons/Min	1 73	6 7	9.6	8 9	12 9
-Manufacturing	-0 61	50 7	44.6	67.0	59.7
2. Transportation	0 96	3.6	4.4	4 8	5.9
3. Household/Service	0 47	14.6	16.1	19 3	21.6
Total	-0 06	75.6	74.7	100 0	100.0
Basic Scenario					
1. Industry	0 11	57 4	58 8	75 9	73.5
-Agr/Cons/Min	2 4	6 7	11 0	8 9	13 8
-Manufacturing	-0 3	50.7	47 8	67 0	59.7
2 Transportation	1 07	3 6	4 5	4 8	5 7
3 Household/Service	0 61	14 6	16 6	19 3	20 8
Total	0 26	75 6	79 9	100 0	100 0
High Scenario					
1. Industry	0 43	57 4	62 8	75 9	74 4
-Agr/Cons/Min	3 00	6 7	12 5	8 9	19 9
-Manufacturing	-0 04	50 7	50 3	67 0	54 5
2 Transportation	1 28	3 6	4 7	4 8	5 6
3 Household/Service	0 70	14 6	16 9	19 3	20 0
Total	0 53	75 6	84 4	100 0	100 0

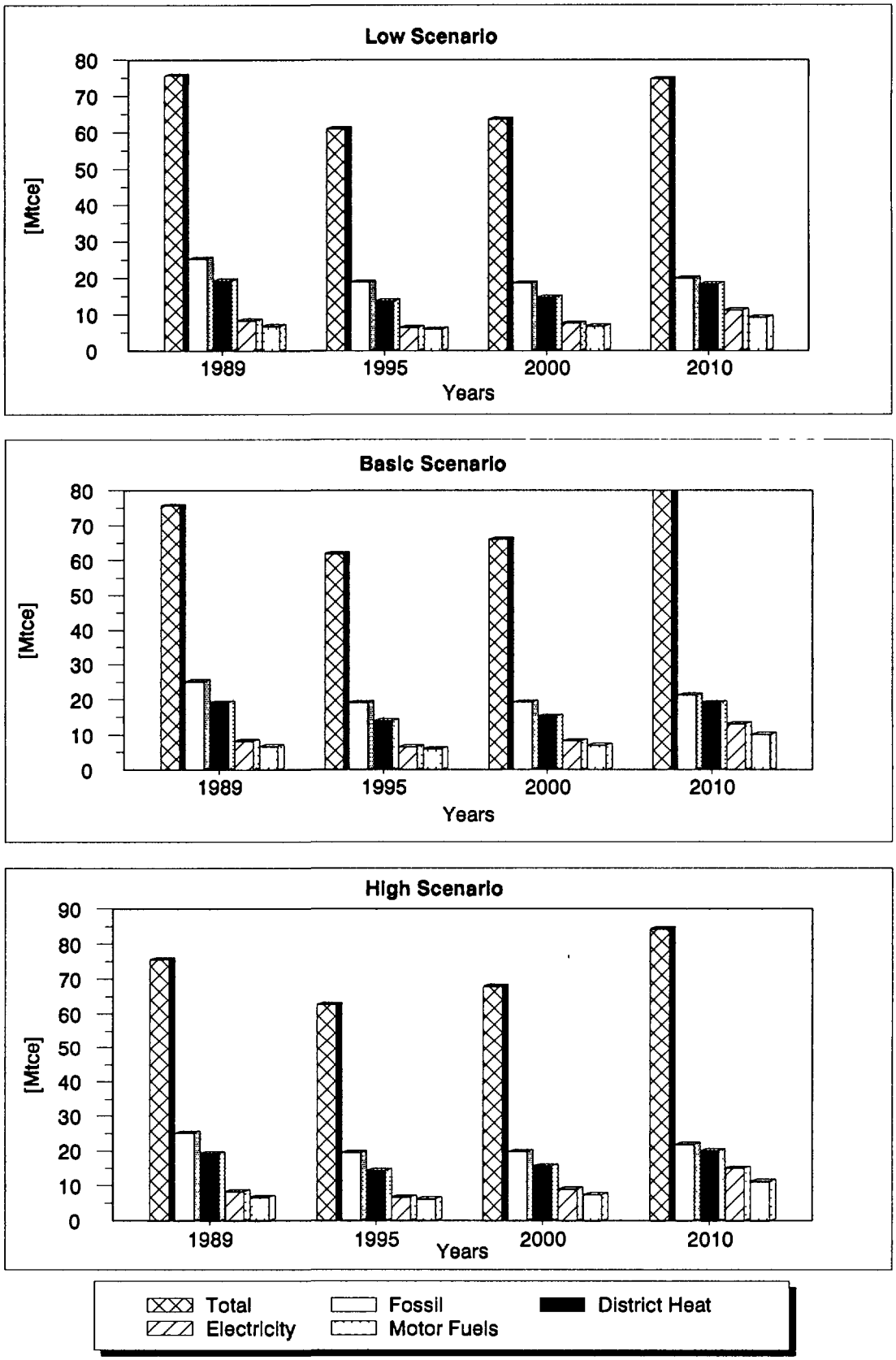

Figure S.3 Distribution of Final Energy Demand by Energy Form

On the other hand, electricity would have an increasing share in the total energy consumption during the study period, growing from about 11% in 1989 to about 15%, 16,5% and 18% in 2010 for the Low, Basic and High scenarios, respectively.

Table S.3 Summary of Energy Demand by Energy Form

Energy Form	Growth rate 1989 - 2010 [% per year]	Demand [Mtce]		Share [%]	
		1989	2010	1989	2010
Low Scenario					
Total commercial	-0.057	75.6	74.7	100.0	100.0
of which :					
Fossil	-1.099	25.2	20.0	33.3	26.7
District heat supply	-0.228	19.3	18.3	25.5	24.6
Electricity	1.403	8.3	11.1	11.0	14.9
Motor fuels	1.468	6.8	9.2	8.9	12.3
Basic Scenario					
Total commercial	0.264	75.6	79.9	100.0	100.0
of which :					
Fossil	-0.813	25.2	21.2	33.3	26.6
District heat supply	0	19.3	19.2	25.5	24.1
Electricity	2.227	8.3	13.2	11.0	16.5
Motor fuels	1.969	6.8	10.2	8.9	12.7
High Scenario					
Total commercial	0.523	75.6	84.4	100.0	100.0
of which :					
Fossil	-0.679	25.2	21.9	33.3	25.9
District heat supply	0.218	19.3	20.2	25.5	23.9
Electricity	2.878	8.3	15.1	11.0	17.8
Motor fuels	2.446	6.8	11.2	8.9	13.3

4.2 Electricity Demand Projection and Generation Requirements

In order to determine the amount of electricity that should be supplied by power plants the losses in transmission and distribution were added to the total demand of electricity. In addition, the consumption of refineries and coke was forecasted outside the MAED model and was added directly to the electricity demand of industry.

In view of the importance of the manufacturing sector, it was necessary to consider a breakdown of the electricity consumer sectors different than in Module 2 of the MAED. The assumptions made for this breakdown consider the following sectors and types of clients (or sub-sectors):

Sector 1: Industry/Transportation: includes the following subsectors: Basic materials, Machinery & Equipment, Non-durable goods, Miscellaneous and Transportation

Sector 2: Household/Service: with Agriculture (including irrigation), Construction, Mining, Household as sub-sectors.

It should be noted that, in the first major sector the Basic Materials sub-sector has a very large share. Although this share has been decreasing slightly in time, it will remain at the level of 67% of the respective sector until the year 2010 in all three scenarios.

The Machinery & Equipment sub-sector practically keeps the same share in all three scenarios (13-15%), with a slight reduction in the years 1992 and 1995.

The share of the three other sub-sectors: Non-durable goods, Miscellaneous and Transportation are quite small and have almost the same trend in all three scenarios.

Within the second major sector, Agriculture keeps a quite identical share in the three scenarios, with a slight increasing trend in the second part of the study period from 18% in 1995 up to about 22-23% in 2010.

The Construction sub-sector has the same share in all three scenarios with a decreasing trend from 8% in 1989 to 3% in 2010.

The Mining sub-sector maintains the same share in all three scenarios and over the study period (18-21%), excepting the base year (30%).

Finally, the Household and Service sub-sector has an increasing share over time, towards 54-56% of the total sector in 2010. In addition, its share is slightly higher in the Low and Basic scenario, against the High scenario. This is basically due to the assumption of higher economic growth rate in the High scenario which in turn leads to increased energy and electricity demand in the other sub-sectors of the Sector 2.

Based on the electricity requirements of each sector and sub-sector and the load modulating coefficients of each sub-sector, the values of the peak load for the power system were established for the reference years (Table S.4).

In the Low scenario, the decrease of the electricity consumption during the 1989-1992 period, is followed by a slow growth of the system peak requirements of about 0.65% per year during 1993-1995 and a more emphasized growth of about 3.55% between 1995-2000 and about 4.20% within 2000-2010 period.

In the Basic and High scenario, the growth rates of the system peak load are higher: 1.76% and 2.61% respectively, until 1995 and about 5.0% and 5.5% respectively, during 1995-2010 period.

Under these conditions in 2010, the peak load is estimated to about 16,000 MW in the Low scenario, 19,000 MW in the Basic scenario and 21,600 MW in the High scenario. According to this forecast the growth of the peak load is estimated between 5500 MW in the Low scenario and about 11,000 MW in the High scenario through the 1989-2010 period.

4.3 Expansion of the Electricity Generation System - The Role of Nuclear Power

The future expansion of the generating system was carried out by means of the WASP model for covering the three levels of electricity demand after having executed modules 1, 2, 3 of MAED.

Other factors taken into consideration refer to the characteristics of the existing plants and of those used as expansion candidates, the reliability level to be met by the system and other expected developments such as decreasing pollution by power plants, reduction of domestic reserves in oil and natural gas, etc.

Table S.4 System Peak Load Requirements

Year	Low scenario		Basic scenario		High scenario	
	MW	% Increase	MW	% Increase	MW	% Increase
1989	10563	-	10563	-	10563	-
1990	9923	-6.06	9923	-6.06	9923	-6.06
1991	9321	-6.06	9321	-6.06	9321	-6.06
1992	8756	-6.06	8756	-6.06	8756	-6.06
1993	8814	0.65	8910	1.76	8985	2.61
1994	8872	0.65	9067	1.76	9219	2.61
1995	8930	0.65	9227	1.76	9460	2.61
1996	9247	3.55	9671	4.81	10010	5.81
1997	9575	3.55	10136	4.81	10592	5.81
1998	9914	3.55	10623	4.81	11208	5.81
1999	10266	3.55	11134	4.81	11860	5.81
2000	10630	3.55	11670	4.81	12550	5.81
2001	11077	4.20	12244	4.92	13224	5.37
2002	11542	4.20	12847	4.92	13933	5.37
2003	12028	4.20	13480	4.92	14681	5.37
2004	12533	4.20	14144	4.92	15470	5.37
2005	13060	4.20	14840	4.92	16300	5.37
2006	13609	4.21	15587	5.03	17249	5.82
2007	14183	4.21	16371	5.03	18254	5.82
2008	14780	4.21	17195	5.03	19317	5.82
2009	15402	4.21	18061	5.03	20442	5.82
2010	16050	4.21	18970	5.03	21633	5.82

Since the coal reserves are at great depths and hard to operate and the lignite reserves do not allow the development of new power plants, the new thermal power plants will be based on imported fuel, only.

In consequence, the power plants considered as alternatives for expanding the power generating system include power plants operating on gas, fuel oil and coal, nuclear power plants, hydro power plants, and the rehabilitation of thermal condensation units over 200 MW.

The reliability criterion used in WASP is the so called Loss-of Load Probability (LOLP) which is established as a limit that should be met by each alternating expansion program. This limit was set to 1 day per year for the present study.

The economic optimization of alternative expansion plans was carried out assuming an annual discount rate of 10%. All costs are expressed in US$ constant money of 1992.

Table S.5 presents the optimal expansion plans resulting from the analyses performed by means of the WASP model to cover the three levels of electricity demand forecast. It is noticed that all optimal expansion plans include the rehabilitated thermal power units, the units 1 and 2 of Cernavodă NPP (already in advanced stage of completion), combined cycle units

Table S.5 Comparative Optimal Sequence of Projects (DR 10%)[1]

	Low Scenario	Basic Scenario	High Scenario
1992 - 1996	committed additions[2]	committed additions[2]	committed additions[2]
1997	-	-	NUC1#1
1998	-	NUC1#1	NUC1#2
1999	NUC1#1	CC6#1 NUC1#2	CC6#1-2
2000	I315#1 NUC1#2	I315#1	I315#1 CC6#3
2001	I315#2 CC6#1	I315#2 CC6#2	DE20#1 CC6#4
2002	DE20#1-2	BO20#1 DE20#1 CC6#3	BO20#1-2 DE20#2 I315#2 CC6#5
2003	DE20#3-4 A3TR#3 CC6#2	BO20#2 DE20#2 CC6#4-5	DE20#3-4 A3TR#3 CC6#6
2004	A3TR#4 CC6#3-4	A3TR#3 BZ20#1 DE20#3 VH01	A3TR#4 BZ20#1-2 CC6#7
2005	BL20#1 BZ20#1	A3TR#4 BL20#1 CC#6 DE20#4	BL20#1 CC6#8-9
2006	BL20#2-3 BZ20#2 BO20#1	BL20#2 BZ20#2 CC6#7 VH02	BL20#2-3 CC6#10 VH01
2007	BO20#2 CC6#5	CC6#8-9	CC6#11-12
2008	CC6#6	BL20#3 CC6#10	CC6#13-14
2009	CC6#7	CC6#11-12	CC6#15-16 VH02
2010	CC6#8 VH01	CC6#13	CC6#17,18,19

(1) Code names of the plants are listed in Tables 6.1, 6.3 and 6.4. The symbol # is followed by the unit number of the same plant.

(2) Committed additions are listed in Table 7.2.

running on natural gas, and hydro power plants for the peak and intermediate zones of the load curve.

These expansion plans request the supply of some important amounts of natural gas. Hence, by the year 2010, for generating electricity it would be necessary about 8800 millions m^3 natural gas in the Low scenario, about 14000 millions m^3 natural gas in the Basic scenario and 19000 millions m^3 natural gas in the High scenario. For this reason some sensitivity analyses were conducted on the optimal solutions with the objective of evaluating the impact on the solutions of changes on the hypotheses used to conduct the optimization.

A first sensitivity analysis consisted in assuming escalation of the fuel prices in the world market, in general, and of that of natural gas, in particular.

Assuming a growth of the price of natural gas of 5% within the period 1992-1993, 23% (1996-2000) and 45% (2001-2010) leads to new expansion plans with higher contribution by nuclear power plants.

The consideration of the growth of all fuel prices by 20% along the period of study also made the nuclear option more favourable.

Other sensitivity analyses had in view to determine the influence on the optimal expansion plans of changes in the annual discount rate. When the annual discount rate is increased to 15% the nuclear power option is less attractive than the combined cycle units based on natural gas.

Considering an increase of the price of natural gas (by 5% within the 1992-1995 period, by 23% within 1996-2000 and by 45% within 2001-2010 period), and a 15% discount rate, the expansion plan with combined cycle plants is still preferable.

If the annual discount rate is decreased to 8%, nuclear power plants become more attractive for expansion than combined cycle units.

The following conclusion may be drawn out of the analyses performed, namely that until the year 2000, the rehabilitation of the condensation thermal power plants and the completion of some plants already in construction will play an important role in covering the future electricity demand. This conclusion is in correlation with the scarcity of capital that is characteristic for this period.

5. Conclusions and Recommendations

The ENPP study has allowed the Romanian team to gain valuable experience in the use of the MAED model to determine the possible evolutions of the energy and electricity demand under different socioeconomic and technical development scenarios for the country and of the WASP model to estimate economically optimal expansion plans to satisfy the demand for electricity with the required reliability.

It is recommended that this expertise should be further utilized and that both planning models should be used for the conduct of similar studies in the future. Such studies should be updated in a recurrent basis and particularly when there are important changes in the economic, social, and technical situation that deviate from the original assumptions made in the scenarios considered.

During the conduct of ENPP study, the working team faced several problems, such as the lack of some statistical data required by the MAED model and some other data which are not the object of the statistic reports. It is recommended to adapt the national system for gathering statistical data leading to an increase of the amount of data and the change in the manner the data are aggregated.

Regarding the outcomes of the present study, they should not be interpreted as the official forecast levels for the electricity and energy demand and the long term expansion

programme of the power generating system in Romania. In this context, it should be emphasized that several variants exceeding the transition towards the market economy were analyzed but none was approved by the government as a viable strategy of economic re-launching and of the energy sector development.

Nevertheless, even under these conditions, the results obtained have shown that there is a strict dependence of the energy and electricity demand on to economic structure and on the technologies implemented in all sectors.

The main goal of the ENPP study was to determine both the final energy demand in its structure (electric, thermal, fuels) for some technological, socioeconomic developing scenarios and the analysis of the way to cover only the electricity demand. For these reasons, expansion strategies of the generation system have been established on the basis of least cost, stating the capital cost necessary either for constructing new power plants or for rehabilitating the existing ones, the fuel amounts that must be supplied either from domestic resources or from import, annual costs for operation and maintenance.

Similar analyses are also recommended for the supply of other forms of energy. In this way it can be guaranteed that the capital costs required for expanding all facilities in the energy sector are consistent with the economic growth rates that have been taken into consideration in the development scenarios. These analyses must be completed with appraisals of the primary energy demand, requirements of energy resources imports and financial resources, as well as the impact on the environment.

As to the outcomes of the study regarding electricity generating capacities, the units 1 and 2 of Cernavodă nuclear power plant represent a common path of all expansion plans. The further development of nuclear power would depend on the evolution of the price of natural gas.

It is recommended that the decision on the future programme of addition of new generating capacity should rely on other analyses, in order to supplement the results of the ENPP study. The most important studies recommended to complement the ENPP study are:

- standard acceptable reliability criteria, LOLP and minimum reserve margin;
- cost of unserved energy;
- electricity transmission and distribution system losses;
- fuels prices forecast on the world market and fuel supply capabilities;
- rehabilitation solutions for the existing plants;
- environmental impact of different expansion programmes;
- financial analysis of the suggested programmes;
- the national participation in different power plants programmes;
- manpower requirement and development.

Chapter 1

INTRODUCTION

1.1 Background

The socioeconomic development of a nation cannot be achieved without consumption of energy, in order to meet the requirements for satisfaction of services (transport, cooking, etc.) and the production of goods needed by the society (equipment, basic materials, etc.). This energy is consumed under different forms: electricity, motor fuels, thermal energy, etc.

Energy systems have a specific feature, namely the implementation cycle of the energy generating facilities is, as a rule, longer than those of the energy consuming facilities. As a consequence, the decision for installing new energy supply facilities or expanding the existing ones should precede the decision of implementing new consumers by several years. This imposes the need to estimate several years ahead, what would be the level of consumption by current and new consumers. Moreover, taking into account that both capital costs and fuel prices are continuously increasing, it is obviously necessary to perform a systematic energy planning activity, as an attempt to estimate the energy demand in different variants (scenarios) of the country's socioeconomic and technological development in order to optimize the energy supply.

Having in view the inherent uncertainty in estimating the future development both in countries with stable economy and, especially in countries with the economy in transition, such as Romania, a sound solution might be the elaboration of some coherent socioeconomic and technological development scenarios that might include a large range of probable evolutions of the country and the forecasting of the total energy and the electricity demand corresponding to each of those scenarios.

The Energy and Nuclear Power Planning (ENPP) study for Romania, conducted under the technical cooperation programme of the IAEA had in view the forecasting of the electricity demand, as a part of the overall energy demand, in various scenarios of Romania's socioeconomic and technological development, and the economic optimization of the electric generating system expansion in order to meet the electric power demand. An assessment of the role that nuclear energy could play within this optimal programme was also part of the study objectives.

1.2 Purpose and Scope of the Study

Similar to other IAEA technical cooperation projects, the ENPP study was conceived as a joint effort of Romania and the IAEA where each side had its own, clear, well established responsibilities:

- Romanian experts had full responsibility for the conduct of the study, including data collection and preparation, execution of the computer runs, interpretation and improvement of results, etc., up to the production of the draft report of the study;
- The IAEA experts provided guidance and coordination throughout the conduct of the study, on-the-job training of the national team and transfer of know-how, and the necessary methodologies and computerized planning tools to Romania.

This distribution of tasks was thus conceived so that by the end of the study the energy planners in Romania will have gained sufficient experience in the use of the methodologies and computer programs provided by the IAEA and could utilize them independently for carrying out future planning studies.

Because of the data needs imposed by the computer models used, specially by the MAED model, a duration of two years (1991-1992) was envisaged for the conduct of the study.

1.2.1 Objectives

The ENPP study for Romania had the following major objectives:

- to implement systematic planning procedures in Romania that will allow:
  - to integrate electricity demand forecasting in the framework of overall energy demand forecasting;
  - to improve long run generating system planning, based on the electricity forecast above mentioned;
  - to establish the role that nuclear power could play within national development plans;
- to verify the MAED (Model for Analysis of the Energy Demand) and WASP (Wien Automatic System Planning package) methodologies under the concrete conditions of Romania and the possibility to introduce them in the national energy planning procedure.
- to train a group of Romanian experts in the use of the MAED and WASP models.

Within the project, Romania has received three complete microcomputer configurations (personal computers and peripherals) which have been thoroughly dedicated to the energy and electricity planning studies and analyses, and assistance in term of training of local experts in the above mentioned models, both at formal training courses organised by the IAEA and on-the-job training throughout the conduct of the ENPP study.

1.2.2 Activities

The ENPP study included the following main activities:

- forecasting of the overall demand of energy, including electricity, for various socioeconomic and technological development scenarios for Romania up to the year 2010, by means of the MAED model;
- determining optimal development programmes of the electric generating system that would meet, under given reliability constraints, the above mentioned forecast of electricity demand.

With these objectives in mind, the study was intended to provide to the Romanian decision makers information about the future energy and electricity demand, the electric generating system expansion programmes and the role that nuclear power could play within various development scenarios for Romania.

1.3 Brief Description of the Methodologies Used

The MAED and WASP methodologies have been initially released by IAEA to the Member States, including Romania, in versions for mainframe computers. Lately, they have been integrated into the microcomputer based package ENPEP (Energy and Power Evaluation Program) which was developed by Argonne National Laboratory, USA, and made available to the IAEA for distribution to its Member States. Within the present study, the last versions of MAED and WASP models have been utilised (the ENPEP version of WASP-III model is called ELECTRIC).

1.3.1 MAED Model

MAED (Model for Analysis of the Energy Demand) is a simulation model designed to evaluate the medium and long-term demand of energy in a country or a region according to the evolution of the economic activity and the living style of the population, taking into account governmental policies and technological evolution of the country or region [Ref. 1.1]. It belongs to the family of MEDEE models (Modèle d'Evolution de la Demande d'Energie) developed by Mrs. B. Chateau et B. Lapillone from the Institut Economique et Juridique de l' Energie (IEJE) of the University of Grenoble in France [Ref. 1.2].

The MAED methodology includes the following sequence of steps:

- breakdown of the final energy consumption of the country for a base year into various consuming sectors and categories of end-use, in a consistent manner;
- identification of the economic, social, technological factors influencing each category of final consumption;
- specification (in mathematical terms) of the relationships between the energy consumption and the factors governing this consumption;
- reconstruction, by means of the MAED model, of the final energy consumption based on the statistical data available for the base year of the study;
- construction of consistent development scenarios having in view the future evolution of demographic, macroeconomic, social and technological factors influencing the energy demand; three scenarios are usually retained: a minimum and a maximum one covering most of the possible future evolutions and a basic (medium) scenario;
- evaluation, by means of MAED model, of the final energy demand corresponding to each scenario.

The MAED model allows to take into account the influence on the energy demand of:

- structural changes of the economy: the share of various economic sectors in the gross domestic product (GDP) and the evolution of their energy intensities;
- changes in population's living style: housing conditions, mobility, social needs, etc.

- trends regarding the penetration into the market of each final energy form: electricity, coal, gas, oil, etc.

Special attention is paid to the demand of electricity which is not only calculated on an annual basis, as for all other energy forms, but is also converted into hourly consumption and finally, into load duration curves in the form required as input information for the WASP model.

The general structure of the MAED model, shown in Figure 1.1, indicates that the model is integrated by several modules.

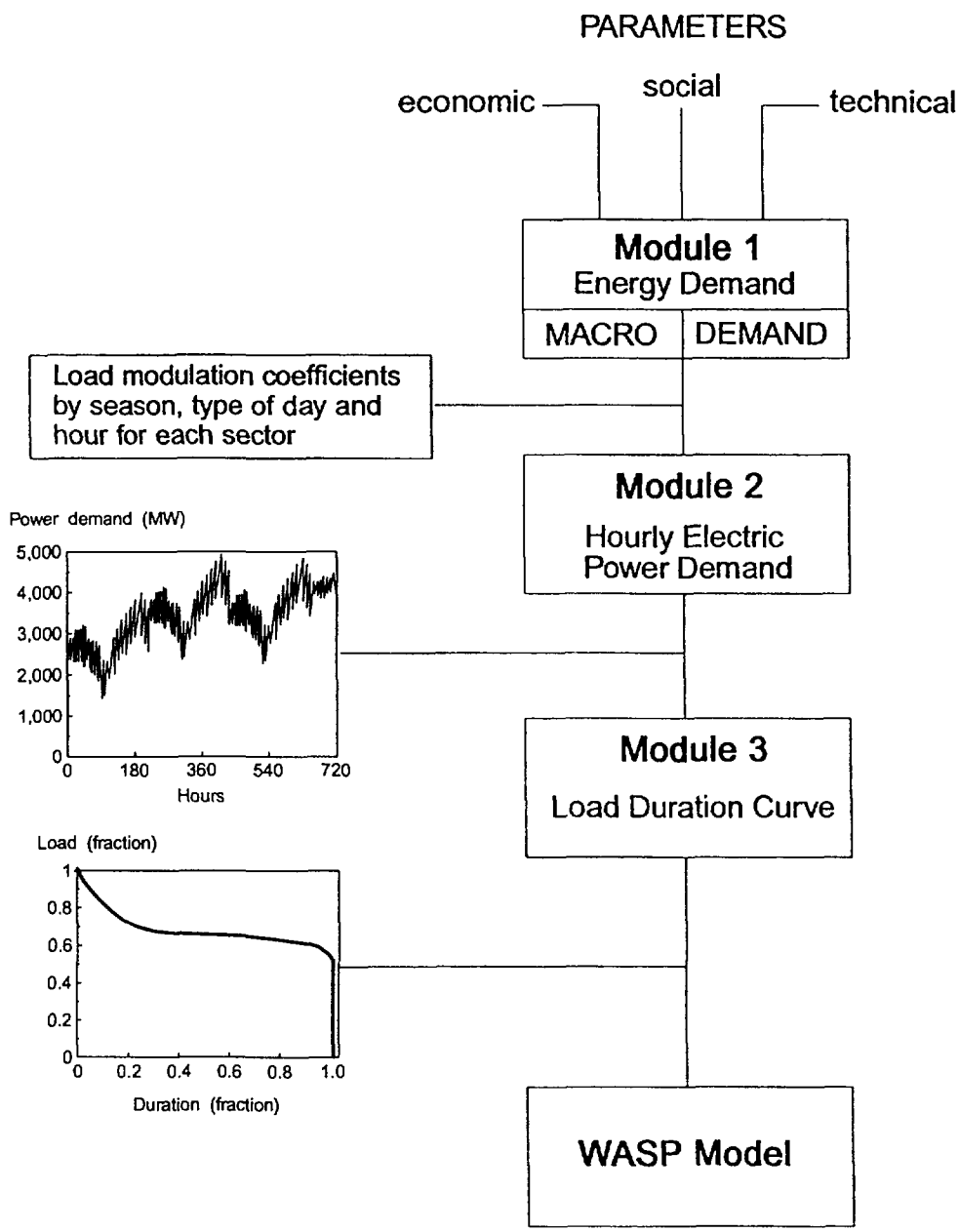

Figure 1.1 MAED Model Organization

Module 1 receives as input data, the economic, social and technological parameters for a scenario and processes them by means of two main subroutines:

- The MACRO subroutine determines the level of activity of each economic sector considered;
- The DEMAND subroutine calculates the energy demand for each category of end-use, aggregating the consuming sectors into three sectors: Industry (Agriculture, Construction and Mining included), Transportation and Household/Services.

The result of this module is the total demand for final energy and its breakdown by consuming sectors and by forms of energy.

Module 2 receives from Module 1 the demand for electricity, aggregated into two major sectors: Industry/ Transportation and Household/Services. In addition, it requires the specification by the user of the load modulation coefficients by types of days and types of consumers for each sector. This module determines the hourly electric power demand, for each of the two major sectors and for the country as a whole.

Module 3 converts the hourly electric power curve for the whole country into normalized load duration curves (loads are expressed relative to the peak load and durations to the total time), for as many periods per year as specified by the planner. These load duration curves can be used as direct input data to the WASP model.

1.3.2 WASP Model

WASP Model (Wien Automatic System Planning package) is designed to determine the economically optimal expansion programme of an electric generating system over a period of up to thirty years, within user-specified constraints [Ref. 1.3]. It utilizes probabilistic simulation for estimating the system production costs, unserved energy and reliability, as well as the dynamic programming technique for optimization of system expansion policies.

The WASP-III computer code is organized in a modular form as shown in Figure 1.2.

Module 1, LOADSY (Load System Description), processes information referring to the annual and period peak loads and the load duration curves for each period of the year, over the study period. These data may be directly imported from the MAED model.

Module 2, FIXSYS (Fixed System Description), processes information describing the existing power plants and also to the firmly committed additions or retirements.

Module 3, VARSYS (Variable System Description), processes information related to the various candidate plants taken into account for expanding the electric generating system.

Module 4, CONGEN (Configuration Generator), calculates all possible year-to-year combinations of candidate units additions which, together with the FIXSYS plants, meet the demand of electricity with the imposed reliability level.

Module 5, MERSIM (Merge and Simulate), uses the probabilistic simulation of the system operation for estimating associated production costs, the amount of unserved energy and reliability level of each configuration retained by CONGEN.

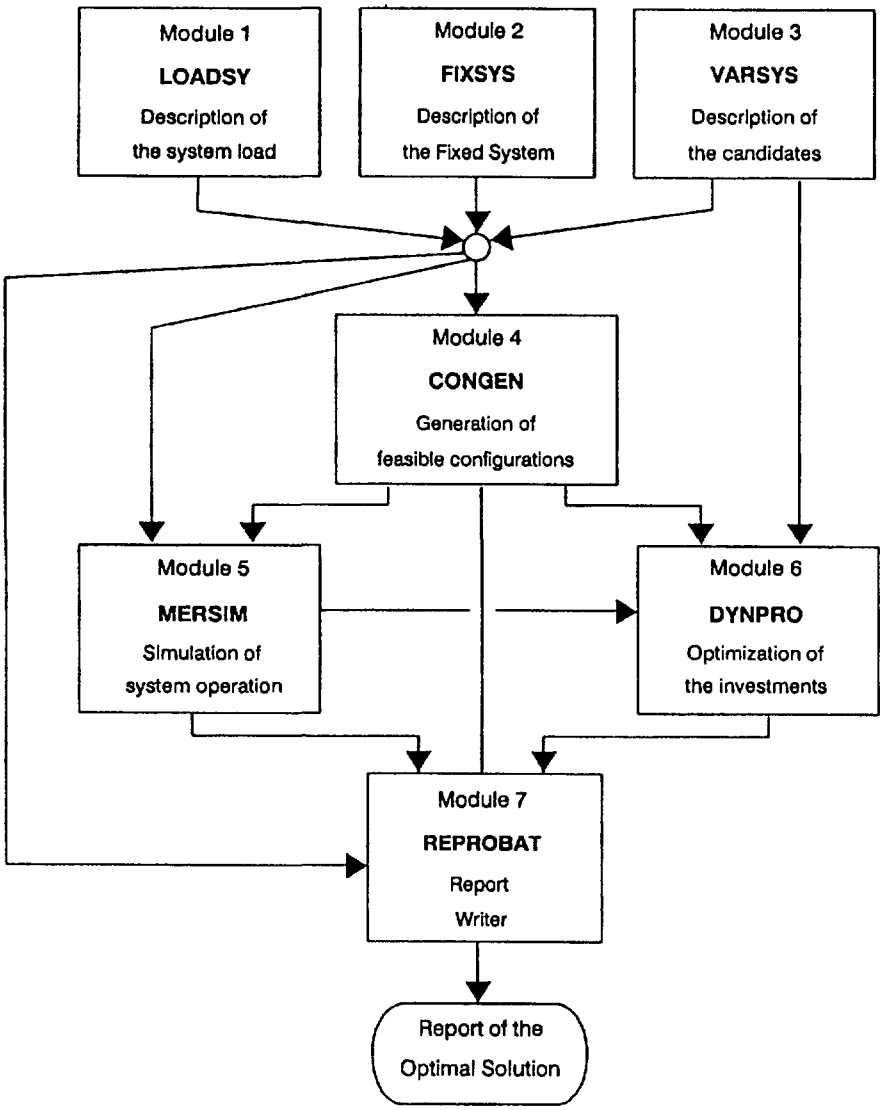

Figure 1.2 WASP Model Structure

Module 6, DYNPRO (Dynamic Programming Optimization), determines the optimum expansion strategy of plant additions over the study period by means of a dynamic programming algorithm.

Module 7, REPROBAT (Report Writer of WASP in a Batched Environment), writes up a partial or total report for the optimum or near optimum power system expansion plans.

The optimal solution is evaluated in terms of minimum discounted total cost (including investment, operation and unserved energy costs) and consists in the optimal schedule of candidate units additions to the existing system over the study period.

Additionally, the WASP Model allows conducting sensitivity analyses of the optimal solution subject to the variation of various parameters, such as: capital costs, fuel prices, interest and escalation rates, new plants construction time, unserved energy cost, etc.

The WASP model may also be utilized in a simplified way, for estimating the costs associated to a predetermined expansion schedule of the electric power generating system. It

can be also used together with other models of the IAEA, such as VALORAGUA, for optimizing the expansion of power system with big hydro-power potentials or ICARUS in order to calculate long run marginal cost for the design of electricity tariffs.

1.4 Institutional Framework for Energy and ElectricityPlanning

Before 1989, decisions on economic and energy development of Romania were made in a centralized manner at the level of the former Planning State Committee and especially, at the level of the former dictatorial leadership of the country.

At the beginning of 1990, with the rejection of the centralized economy rules and principles, the Planning State Committee was cancelled. Furthermore, even the concept of "planning" was questioned due to misunderstanding of what planning involves. Fortunately,

Table 1.1 National Agencies Involved in Economic and Energy Planning in Romania

Ministry	Agency	Responsibility
Office of the Prime Minister	Forecasting and Planning Commission	- Socioeconomic development guidance - Institutional and legal framework for fulfilling the economic and energy policy
Economy and Finance (MEF)	Energy Policy and Planning Division	- Macroeconomic planning - Prices and fees policy
Industry (MI)	Planning Department	- Sectorial development planning
	Energy Division	- Energy policy and planning - Regulation of energy sources exploration and production - Energy supply policy - Energy import and export policy
	Romanian Electricity Authority (RENEL)	- Electric power system development planning - Forecasting studies on energy demand (fuels, electricity and thermal energy) and supply scenarios - Research on new sources of energy - Research and studies on energy conservation
	Romanian Energy Conservation Agency (ARCE)	- Programmes on energy conservation according to the energy policy
Academy of Science	Institute of Economic Research (INCE)	- Macroeconomic and sectorial forecast
Education and Science	Polytechnic Institute of Bucharest (IPB)	- Research on improving equipment for electric and thermal power generation and consumption
	Academy of Economic Sciences (ASE)	- Economic research and forecasting
	National Commission for Statistics (CNS)	- Statistical data on socioeconomic and energy situation

after a certain time, the responsible people from all levels began understanding the necessity and the importance of forecasting and planning activities.

At the same time, due to the fast changes of the Romanian society, the institutional framework of energy and economic planning has been facing an ever changing process. Table 1.1 shows the national agencies involved in energy and economic planning in Romania at beginning of 1992. Some of them did not exist under this form when the ENPP study began, while others changed several times during the conduct of the study.

The Romanian Electricity Authority (RENEL) which continues the activity of the former Ministry of Electricity, has enjoyed more stability. As part of its responsibilities, and as a consequence of the big share of fuel consumption for electricity and thermal energy generation in the primary energy balance of Romania, RENEL is interested not only in generation and rational consumption of both electricity and thermal energy but, also, in their interaction with other forms of energy.

For these purposes, RENEL's energy planning activity is carried out within the Institute of Power Studies and Designs (ISPE) which, since its foundation in 1949, has undertaken planning studies for the overall energy at the country's level and the design of all Romania's power facilities. In addition, ISPE is the national institution designated as recipient of all models and computer programs received from IAEA by Romania.

RENEL and ISPE cooperate, within their energy planning activity, with all the other agencies mentioned in Table 1.1, and elaborate planning studies for the Ministry of Economy and Finances and for the Ministry of Industry.

1.5 Organization of the ENPP Study

1.5.1 National Institutions Involved and Team Responsible for Execution of the Study

Three Romanian institutions were involved in the execution of the study, namely: RENEL through ISPE, INCE and CNS. Among these, CNS provided the necessary statistic information for conducting the study.

During the time the ENPP study was carried out, INCE conducted a study concerning the future equilibrium of the main macroeconomic parameters of Romania on which the development scenarios for the ENPP study are based.

ISPE provided overall coordination of the national effort and acted as the liaison with IAEA and also for being responsible for the conduct of the studies with the MAED and WASP models and of the production of the technical report.

A sub-committee was set up composed of representatives from the various organizations involved in the ENPP study. Within the sub-committee, there were two levels of responsibilities, namely: the Steering Group and the Working Group (see Table 1.2).

The Steering Group was responsible for providing guidelines and directions for the Working Group in carrying out analytical work and drafting the final report, while the Working Group carried out their tasks in close consultation with the IAEA experts.

Table 1.2 ENPP Sub-committee

Name	Position	Affiliation
A. Steering Group		
1. Mr. Dimitrie Ardelean	Director, Energy Policy and Planning Division	MEF
2. Mr. Virgil Musatescu	Director, Energy Division	MI
3. Mr. Aureliu Leca	President	RENEL
4. Mr. Gabriel Popescu	Director, Development Strategy Division	RENEL
5. Mr. Iosif Bilegan	Director, IAEA Liaison Officer	RENEL
6. Mr. Mircea Breazu	Director	ARCE
7. Mr. Ionel Desmireanu	Director, Institute of Economic Forecasting	INCE
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9. Mr. Vasile Nitu	Professor	IPB
10. Mr. Mircea Tarta-Arsene	General Director	ISPE
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B. Working Group		
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5. Ms. Floarea Breazu	Senior Engineer	ISPE
6. Ms. Constantin Posoiu	Senior Engineer	ISPE
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8. Ms. Anca Diaconu	Senior Engineer	RENEL
9. Ms. Florina Popa	Senior Engineer	INCE
10. Mr. Mihail Istrate	Senior Engineer	CNS
11. Ms. Pauna Olaru	Economist, Service head	CNS

(1) Leader of the Working Team

The IAEA trained the Romanian team in the use of the MAED and WASP models in Romania and at IAEA's headquarters in Vienna, Austria, for 9 man-month during 1991 and 1992. In addition, three complete microcomputer configurations (personal computer and peripherals) were provided to Romania to be totally dedicated to energy and electricity planning studies and analyses.

1.5.2 Major Tasks Accomplished

The major tasks of the Romania team were to master the planning methodologies using the MAED and WASP computer codes based on realistic past and present information and possible future evolutions in terms of different development scenarios. These tasks can be summarized as follows:

1) to install the MAED and WASP and computer codes on local microcomputers;

2) to select a so-called base year for the study, which was to be used to validate the MAED model for the local conditions. For the present study, 1989 was chosen, because it was the most recent year for which the energy and economic statistics were available at the beginning of the study (1991). In addition, 1989 was the latest year with a relative economic and financial stability before the deep changes

associated to the transition period that the country is going through (from centrally planned economy to a market planned one);

3) to reconstruct the energy consumption of the base year, by economic sector and by energy form, using the MAED model;

4) to construct consistent scenarios of socioeconomic and technological development of the country, involving the determination of the future evolution of all parameters affecting the various categories of energy demand;

5) to conduct MAED (Module 1) analyses according to the selected scenarios and to determine the overall demand for final energy and the associated electricity requirements;

6) to conduct MAED (Module 2 and 3) analyses in order to determine electricity forecasts by periods of the year in such a way as to be readily input to the WASP model;

7) to conduct WASP analyses in accordance with the electricity requirements and technical and economic constraints in order to determine economically optimal expansion plans for the electrical generating system;

8) to prepare the final report of the study;

9) to present the results of the ENPP Study to the national decision makers.

1.5.3 Basic Sources of Reference Used in the Study

The basic sources of references used in the study were:

- National Commission for Statistics, which publishes two annual reports, namely:
  - Romanian Statistical Yearbook;
  - Energy Balance and Structure of the Energetic Equipment
- Romanian Electricity Authority, which publishes an annual report (RENEL Information Bulletin) and carries out studies for electric system planning;
- Romanian Institute of Economic Research, which provided macroeconomic and sectorial forecast for the definition of the scenarios;
- IAEA, which provided technical documents and reports of similar ENPP studies.

1.5.4 Main Problems Encountered

The main problems encountered in using the MAED and WASP models are related to the specific conditions Romania was experiencing at the moment of the study execution, i.e. the transition from one type of economy to another accompanied by the decrease of value added in all economic sectors, during the first part of the study period. These problems might be summarized as follows:

a) Problems referring to statistical data:

- before 1989, economic performance was measured by means of macroeconomic parameters specific to centrally planned economies: social product, national income, etc., while the concept of gross domestic product (GDP) started to be used since 1990 only, when the series regarding the 1980-1990 period were issued.
- statistics do not include the GDP breakdown by subsectors of industry according to the degree of detail required by the MAED model; that is why the GDP structure in industry was determined proportional to the production value of the various subsectors.
- the trends resulting from the past development of the economy cannot be extrapolated into the future due to the disruption caused after 1989. As a consequence, in establishing the scenarios of development, a pragmatic approach was used whereby comparisons with other countries' macroeconomic and energy consumption indicators were made.

b) Problems related to the use of the MAED and WASP models under Romania's concrete conditions:

- modelling of some variables through linear relations dependent on GDP evolution does not meet Romania's particular situation during the study period. This is the case for steel production, feedstock consumption and volume of freight and miscellaneous transportation. It is believed that such variables could be treated as scenario parameters specified by the user for each year of study. This would lead to better results, closer to the specific situation that the country is going through;
- the use of unique values of energy intensities by end-use categories for the whole manufacturing industry, does not allow a differentiation for the intermediate years among the four subsectors of industry; in Romania's particular case this is a main issue because these subsectors have very different energy intensities;
- thermal energy generated in cogeneration and thermal plants has an important share in the thermal uses in Romania (47% in 1989) and it is used also in sectors like Agriculture, Construction and Mining, which is not allowed by the current MAED version;

The solution found for every problem encountered in conducting the ENPP study is described in other parts of the report (especially in Appendix A and B).

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1.1 International Atomic Energy Agency, Model for Analysis of the Energy Demand (MAED), Users' Manual for Version MAED-1, IAEA-TECDOC-386, Vienna, 1986.

1.2 Hölzl, A. (1980), A Computer Program for Energy Demand Analysis by the MEDEE Approach; Documentation of the MEDEE-2 Version used in IIASA's Energy Systems Program, IIASA Internal Document, August 1980.

1.3 International Atomic Energy Agency, Wien Automatic System Planning Package (WASP), A Computer Code for Power Generating System Expansion Planning, User's Manual for the WASP-III Version, Vienna, 1980.

Chapter 2

PAST AND PRESENT SITUATION OF THE COUNTRY

2.1 General Remarks

Romania, like other East and Middle European countries, has faced, after 1989, a very difficult transition period from the centrally planned economy to the market one.

The decline of the Romanian economy that started since 1988, went on deepening from one year to another, leading to a drop of the GDP in 1990 by 13.7% compared with 1987 [2.1]. While the recession of 1988 (0.5%) and 1989 (5.8%) against the previous year could be explained by the lack of efficiency of the old centrally-planned managing system, the fall of 1990 (7.9%) was due to multiple causes, namely:

- the complex processes accompanying the transition period;
- the impact of foreign economic changes, such as: the disintegration of the COMECON[1] system, the Gulf war, etc.
- the lack of flexibility of the economy to adapt to the changing circumstances,
- the high degree of interdependence between national companies, determining some chain effects of certain local disturbances.

Against the energy background, big difficulties accompanied the transition period, such as the need for the payment in hard currency of energy imports from the ex-COMECOM countries (especially the ex-Soviet Union), as well as the embargo upon Iraq's oil deliveries, from which Romania used to buy oil for covering an older Iraq's debt.

2.1.1 Geography, Location, Climate

Romania is located in the South-Eastern part of Europe, between 43°- 48° Northern latitude and 20°-29° Eastern longitude. Its neighbours are: Ukraine (the North and East), Moldavia Republic (East), Black Sea (South-East), Bulgaria (South), Yugoslavia (South-West) and Hungary (West).

The total area of 237,500 km^2 consist of plains (under 200 m altitude, 33%), hills (between 200-800 m, 36%) and mountains (over 800 m, 31%).

Romania has a continental climate with certain marine influences in the South-Western region due to the Mediterranean Sea and on the Black Sea coast. The monthly average temperature presents large variations between summer and winter, between the plain and mountain regions, imposing the need for all dwellings to have space heating during the cold season.

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[1] Council for Mutual and Economic Assistance

2.1.2 Demography

On July 1st, 1990, Romanias population was about 23 207 million inhabitants Bucharest, the capital of the country, is the most populated city of Romania, with about 2 1 million inhabitants

Table 2 1 lists the historical evolution (1950-1990) of the population in Romania Due to the continuous decrease of the population's natural growth within the 1955-1965 period, a law for stimulating birth rate was adopted in 1966 Although, as a result of this law, the annual growth rate increased during the first 2-3 years to almost 1 3%, after that it began decreasing again, stabilizing itself around 0 3-0 5% within the 1983-1989 period

Table 2.1 Population of Romania (1950-1990)

Unit Million persons

Year	Total[1]	Annual growth rate (%)	Urban[2]	Annual growth rate (%)	Share[3] (%)	Large cities[4]	Share[3] (%)	Rural	Annual growth rate (%)	Share[3] (%)	Number of dwellings[6] (million)	Household size (inh /dw)
1950	16 356	-	4 239	-	25 9			12 117	-	74 1		
1955	17 356	1 19	5 329	4 68	30 7			12 027	-0 15	69 3		
1960	18 183	0 94	6 261	3 28	34 4			11 922	-0 18	65 6		
1965	18 983	0 86	7 170	2 75	37 8	5 340	28 1	11 813	-0 18	62 2		
1970	20 253	1 30	7 465	0 81	36 9			12 788	1 60	63 1		
1975	21 245	0 96	8 339	2 24	39 3	7 799	36 7	12 906	0 18	60 7	6 040	3 52
1980	22 201	0 88	10 171	4 05	45 8	9 690	43 6	12 030	-1 40	54 2	6 999	3 17
1981	22 353	0 68	10 485	3 09	46 9	10 004	44 7	11 868	-1 35	53 1	7 128	3 13
1982	22 487	0 56	10 872	3 69	48 4	10 395	46 2	11 605	-2 22	51 6	7 257[5]	3 10
1983	22 553	0 33	11 054	1 67	49 0	10 581	46 9	11 499	-0 91	51 0	7 386[5]	3 05
1984	22 625	0 32	11 142	0 80	49 2	10 667	47 1	11 483	-0 14	50 8	7 515[5]	3 01
1985	22 725	0 44	11 370	2 05	50 0	10 907	48 0	11 355	-1 11	50 0	7 645	2 97
1986	22 823	0 43	11 540	1 50	50 6			11 283	-0 63	49 4	7 735	2 95
1987	22 940	0 50	11 771	2 00	51 3	11 359	49 5	11 169	-1 01	48 7	7 828	2 93
1988	23 054	0 50	11 962	1 62	51 9			11 092	-0 69	48 1	7 916	2 91
1989	23 152	0 43	12 312	2 93	53 2	11 835	51 1	10 840	-2 27	46 8	7 960	2 91
1990	23 207	0 24	12 609	2 41	54 3	11 872	51 2	10 598	-2 23	45 7	8 006	2 90

Source National Commission for Statistics

Note (1) Values to 1 July
(2) Before 1968 includes the population of towns and suburban communes, after 1968 includes only the population of towns
(3) Relative to Total population
(4) More than 20000 inhabitants
(5) Estimation
(6) At the and of the year

Urbanization rate has continuously increased, with the urban population reaching 54.3% of the total population in 1990. The average household size expressed in terms of persons per dwelling (per./dw.) decreased from 3.5 per./dw. in 1975 to around 2.9 per./dw. in 1990, a value close to those encountered in developed countries.

Table 2.2 shows the structure of the labour force by economic sector during the 1950-1990 period. In the first part of this period (1950-1980), as a result of the industrialization process, the share of labour force working in industry, construction, transportation and services continuously grew to the detriment of population working in agriculture, while after 1980 the distribution of labour force by sector, became more stable. In spite of this evolution the share of the tertiary sector (commerce, transportation, telecommunications and other service branches)

Table 2.2 Labour force in Romania (1950-1990)

Year	Labour force				Labour force by sector (%)				
	Potential[1] (million)	Share[2] (%)	Actual (million)	Share[3] (%)	Ind.	Cons.	Agr.	Transp.	Services
1950	10.458	63.9	8.377	80.1	12.0	2.2	74.3	2.2	9.3
1955	11.560	66.6	8.960	77.5	13.1	4.3	69.7	2.7	10.2
1960	12.270	67.5	9.538	77.7	15.1	4.9	65.6	2.8	11.6
1965	12.510	65.8	9.684	77.4	19.2	6.3	56.7	3.7	14.1
1970	13.493	66.6	9.875	73.2	23.0	7.8	49.3	4.2	15.7
1975	13.845	65.2	10.151	73.3	30.6	8.1	38.1	5.0	18.2
1980	13.999	63.1	10.350	73.9	35.5	8.3	29.8	6.9	19.5
1981	14.054	62.9	10.376	73.8	36.1	7.7	29.3	7.2	19.7
1982	14.171	63.0	10.428	73.6	36.5	7.7	29.0	7.0	19.8
1983	14.583	64.7	10.458	71.7	36.7	7.6	29.3	6.9	19.5
1984	14.824	65.5	10.500	70.8	36.8	7.4	29.2	6.8	19.8
1985	14.969	65.9	10.586	70.7	37.1	7.4	28.9	6.8	19.8
1986	15.165	66.4	10.670	70.4	37.3	7.4	28.7	6.9	19.7
1987	15.325	66.8	10.719	69.9	37.4	7.4	28.6	6.9	19.7
1988	15.120	65.6	10.805	71.5	37.6	7.1	28.4	6.9	20.0
1989	15.275	66.0	10.946	71.7	38.1	7.0	27.9	6.9	20.1
1990	15.324	66.0	10.840	70.7	37.0	6.0	28.6	6.9	21.5

Source: National Commission for Statistics

Note : (1) In age of 15-64 years
(2) Relative to total population
(3) Relative to potential labour force

is still low (under 30%) compared to the developed countries: Austria and Germany-55%, France-64%, Denmark-66%, Sweden-67%, United Kingdom-68%, Belgium and Norway-69% [Ref. 2.1].

2.2 Macroeconomic Background

2.2.1 Historical Evolution and Current Situation

Before 1989, Romania's economic growth was expressed by two macroeconomic indicators: the national income and the social product, which are specific to the centrally planned economy countries.

The concept of Gross Domestic Product (GDP) arose for the first time in the 1990 edition of the Romanian Statistical Yearbook related to the 1989 economic activity. On that occasion, the GDP series for the 1980-1989 period were also published.

The evolution of the GDP in real terms is summarized in Table 2.3. After a period of positive economic growth (1980-1987), beginning with 1988 the fall of economy deepened

Table 2.3 Economic Growth Parameters for Romania (1960-1990)

Year	Social Product		National Income		Gross Domestic Product		
	Year 1989 =100	Real annual growth rate (%)	Year 1989 =100	Real annual growth rate (%)	Year 1989 =100	Real annual growth rate (%)	Per capita 10^3 lei(1)
1960	14.1	-	16.8	-	...	...	...
1965	22.1	9.4	25.9	9.0	...	...	...
1970	33.6	8.7	37.7	7.8	...	...	...
1975	55.4	10.5	64.1	11.2	...	...	...
1980	77.5	6.9	92.3	7.5	88.5	-	31.809
1981	77.5	0.0	91.9	-0.4	88.6	0.1	31.624
1982	79.6	2.7	95.6	4.0	92.1	4.0	32.703
1983	87.3	9.7	101.3	6.0	97.7	6.1	34.567
1984	93.5	7.1	107.9	6.5	103.4	5.9	36.486
1985	95.9	2.6	106.7	-1.1	103.4	0.0	36.295
1986	100.7	5.0	110.1	3.2	105.8	2.4	37.007
1987	101.8	1.1	110.8	0.6	106.7	0.8	37.127
1988	102.5	0.7	108.6	-2.0	106.2	-0.5	36.757
1989	100.0	-2.5	100.0	-7.9	100.0	-5.8	34.468
1990	85.5	-14.5	90.0	-10.0	92.6	-7.9	31.848

Source: National Commission for Statistics

Note : (1) 10^3 lei constant prices 1989 (17.5 lei = 1 US $)

Table 2.4 Gross Domestic Product by Economic Sectors (1980-1990)

Unit: 10^9 lei (current prices)

Sector	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture & Forestry	78.0	91.6	125.7	107.9	110.7	114.3	106.8	103.4	115.6	110.9	152.0
(%)	12.6	14.7	17.3	14.0	13.6	14.0	12.7	12.2	13.5	13.9	18.0
Construction	47.4	44.7	47.2	52.2	53.5	57.9	59.5	60.8	60.4	50.6	47.9
(%)	7.7	7.2	6.5	6.8	6.6	7.1	7.1	7.2	7.0	6.3	5.7
Industry(1)	325.3	311.2	365.4	411.4	445.1	433.0	460.5	461.8	459.9	421.9	407.0
(%)	52.7	49.9	50.2	53.5	54.5	53.0	54.9	54.6	53.7	52.9	48.2
Transportation & Telecomms.	43.6	44.8	48.9	49.9	53.1	55.4	57.0	58.0	60.3	60.0	56.5
(%)	7.1	7.2	6.7	6.5	6.5	6.8	6.8	6.9	7.0	7.5	6.7
Services	122.6	131.4	140.2	147.3	153.7	156.8	154.8	161.1	160.8	154.6	180.6
(%)	19.9	21.0	19.3	19.2	18.8	19.1	18.5	19.1	18.8	19.5	21.4
Total GDP	616.9	623.7	727.4	768.7	816.1	817.4	838.6	845.1	857.0	798.0	844.0

Source: *National Commission for Statistics*

Note : (1) Including Mining and Energy sectors

from one year to another, due to the reasons previously indicated in the introduction of this chapter.

Owing to the fact that up to 1989 Romania still had a planned economy with prices that did not reflect real costs and the national currency exchange rate was fictitious, the comparison between Romania and other countries concerning per capita GDP is quite difficult.

The evolution of GDP by economic sectors between 1980-1990 shown in Table 2.4 indicates a rather large share (50-55%) in the total GDP of industry (Manufacturing+Mining+Energy sectors), and a relatively small share of agriculture (12-18%) and services (18.5-21.5%).

It should also be noticed that the decline in total GDP observed during the period 1988-1990 was accompanied by the first signs of transition to a market economy system. This was reflected by a restructuring of the sectoral share of the total GDP, so that in 1990 the share of industry (Manufacturing + Mining + Energy sectors) decreased to 48.2%, while that of agriculture and services increased to 18.0% and 21.4% respectively. The value added of agriculture has also increased in 1990 due to the higher number of private farms producing at relatively small expenses [Ref. 2.2].

2.2.2 Expected Evolution and its Implications for Planning

Unlike other countries with stable economy, where the analysis of their past development can provide information on the future trends, in the case of Romania the disruption with the past is so important that such an analysis is not so useful for the future

projections. It is unanimously accepted that the Romanian economy will bear important changes regarding its structure, energy intensity, etc., but they will not continue the past tendencies. On the contrary they will represent radical changes imposed by the market economy implementation.

The main questions concerning the future evolution of the Romanian economy refer to:

- how long will the economic decrease continue and with what rate?
- when will the economic recovery start and with what rate?
- how will the GDP share of the different economic sectors evolve in the future?

Naturally, it is almost impossible to accurately answer these questions. For this reason the only logical approach is the construction of some consistent scenarios that should cover most of the possible future evolutions and the evaluation of their implications from the energy demand point of view with the MAED model.

2.3 Energy Outlook

The energy situation of Romania during the period 1980-1990 also reflects the economic difficulties faced by the country during this period, and which still prevail to this date. Table 2.5 and Figure 2.1 show the variation of some macroeconomic and energetic indicators for Romania during the period 1980-1990.

Table 2.5 Macroeconomic and Energetic Indicators of Romania (1980-1990)

Year	Per capita Gross Domestic Product		Per capita primary energy consumption		Per capita electricity consumption		Ratio of electricity to primary energy[2] (%)	Energy intensity			
								Primary energy		Electricity	
	10^3lei[1]	1980=100	kgce	1980=100	kWh	1980=100		kgce /10^3lei[1]	1980=100	kWh /10^3lei[1]	1980=100
1980	27.787	100 0	4161	100 0	3058	100 0	26 9	149 7	100 0	110 1	100 0
1981	27 620	99 4	4203	101 1	3131	102 4	27 3	152 1	101 6	113 3	102 9
1982	28 565	102 8	4109	98 8	3115	101 9	27 7	143 8	96 1	109 0	99 0
1983	30.177	108 6	4083	98 1	3210	105 0	28 8	135 2	90 3	106 3	96 5
1984	31 872	114 7	4301	103 4	3300	107 9	28 1	134 9	90 1	103 5	94 0
1985	31 705	114 1	4325	103 9	3304	108 0	28 0	136 4	91 1	104 2	94 6
1986	32 316	116 3	4416	106 1	3501	114 5	29 0	136 6	91 2	108 3	98 4
1987	32 427	116 7	4522	108 7	3454	112 9	28 0	139 4	93 1	106 5	96 7
1988	32 094	115 5	4519	108 6	3579	117 0	29 0	140 7	94 0	111 5	101 3
1989	30 121	108 4	4526	108 8	3614	118 2	29 2	148 0	98 9	120 0	109 0
1990	27 843	100 2	4017	96 5	3179	104 0	29 0	144 3	96 4	114 2	103 7

Source National Commission for Statistics

Note (1) Constant prices 1980

(2) Conversion factor 10^3 kWh = 0 366 tce

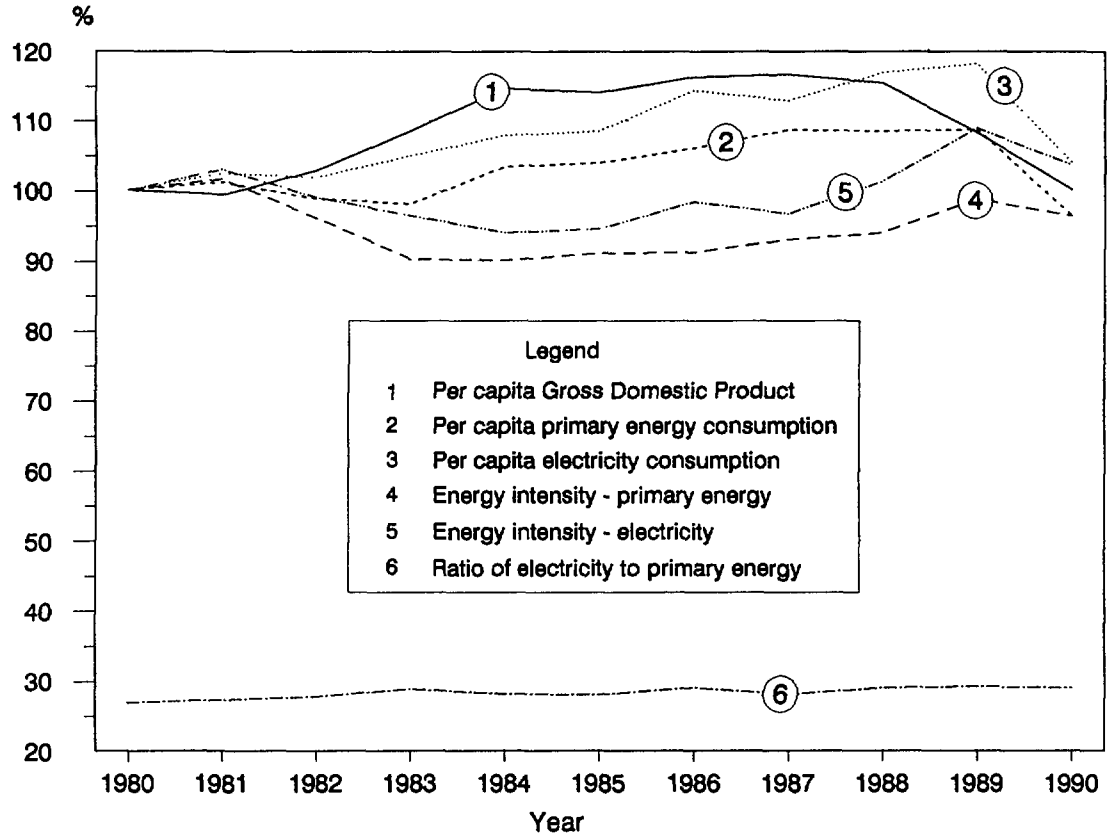


Figure 2.1 Macroeconomic and Energy Indicators of Romania (1980-1990)

The following aspects can be identified from the past evolution of these indicators:

- per capita primary consumption slightly decreased during 1982 and 1983, maybe as a late response to the second oil crisis of 1979/1980. It then increased during the period 1984-1987, was almost constant in 1988 and 1989 and decreased in 1990 below the 1980 level. The most unfavourable years were 1981 and 1985 when the per capita primary energy consumption increased against the background of a negative economic growth.It is noticeable the fact that Romania did not bear a clear disruption between the economic growth and the energy consumption growth, as it was the case in the developed countries after the oil crises.

- the intensity of primary energy decreased between 1982-1984, reflecting an improvement of economic efficiency. It then increased between 1985-1989, and decreased again in 1990.

- per capita electricity consumption increased between 1980-1989, except in years 1982 and 1987, and decreased in 1990 as a result of the general recession in the first year of the transition period toward the market economy.

- the electricity intensity had also a sinuous evolution with increases in 1981, 1985, 1986, 1988 and 1989 and decreases within 1982-1984, 1987 and 1990.

The variation of the two last indexes cannot be considered as fully conclusive due to the electricity insufficiency at that time.

The main conclusion from the above-mentioned aspects would be that the past evolution of both the economic and energy situation of Romania do not provide clear trends to be taken into consideration for future projections.

In order to overcome this problem, specific to Romania and the ex-socialist East-European countries, a comparative analysis of the above-mentioned indicators with similar indexes for other countries has been made for the year 1988. This comparison are shown in Table 2.6 and Figure 2.2-2.8.

The following conclusions can be made from this analysis:

1) Per capita primary energy consumption of Romania (3.163 tons of oil equivalent) was higher than that of Turkey (0.935 toe), Portugal (1.526 toe), Yugoslavia (2.030 toe), Greece (2.045 toe), Spain (2.169 toe), Italy (2.643 toe), Ireland (2.775 toe), Hungary (2.796 toe) and lower than that of Poland (3.381 toe), United Kingdom (3.722 toe) and the rest of OECD countries (see Figure 2.3);

2) Primary energy intensity of Romania (1,486 kilograms of oil equivalent per 1000 US $ of GDP) is one of the highest in Europe (see Figure 2.5). For 1000 US $ of GDP, Romania consumed in 1988 more primary energy than Hungary (1.3 times), Yugoslavia (1.8 times), Turkey (2.0 times), Canada (2.6 times), Greece (3.5 times), Portugal (3.6 times), U.S.A. (3.8 times), Sweden (4.3 times), Norway (4.4 times), Belgium (4.6 times), Finland (4.7 times), Netherlands (5.0 times), U.K. (5.2 times), Spain (5.3 times), Austria (6.1 times), France (6.4 times), Denmark (7.4 times), Italy (7.5 times) or Switzerland (9.6 times).

   The excessively high intensity of primary energy consumption of Romania, compared with most European countries (except Poland), can be explained by the relatively high level of the primary energy consumption per capita and especially, by the low level of GDP per capita.

   The very low efficiency of Romania's economy is due to a complex of factors, such as: the structure of the economy, relying on the development of some energy intensive industries, prices that did not reflect true costs, inefficient external trade operations in real terms, etc.

   It is obvious that Romania has large possibilities of reducing the primary energy intensity and, therefore of increasing the economic efficiency. These could be achieved in the future as long as the country advance towards market economy and the following connected measures are implemented:

   - aligning prices to the international ones;
   - enforcing national currency convertibility;
   - changing the structure of economy;
   - improving the present technologies.

3) Per capita final electricity consumption of Romania (2,681 kWh) was in 1988 higher than that of Turkey (700 kWh) and Portugal (2,017 kWh), comparable with that of Greece (2,690 kWh) and lower than that of Poland (2,846 kWh), Yugoslavia (2,864 kWh), Spain (2,963 kWh), Hungary (2,996 kWh), Italy (3,450 kWh) and of the rest of OECD countries (Figure 2.6).

Table 2.6 Macroeconomic Indicators for Some Selected Countries (1988)

Country	Population mid-1988 (Million)	GNP per capita ($ 1988)	Energy consumption per capita (toe)		Electricity consumption per capita (kWh)		Ratio of electricity to final energy (%)	Energy intensity (kg.o.e./1000$)		Final electricity intensity (kWh/ 1000$)
			Primary	Final[3]	Gross	Final		Primary	Final[3]	
Austria	7.6	15,470	3.794	2.508	5,765	5,283	18.1	245	162	341
Belgium	9.9	14,490	4.634	3.100	5,920	5,463	15.2	320	214	377
Canada	26.0	16,960	9.596	5.560	17,885	16,021	24.8	566	328	945
Denmark	5.1	18,450	3.734	2.830	5,923	5,506	16.7	202	153	298
Finland	5.0	18,590	5.910	4.143	11,855	11,030	22.9	318	227	593
France	55.9	16,090	3.737	2.265	5,997	5,040	19.1	232	141	313
Germany, F.R.	61.3	18,480	4.472	2.950	6,539	6,021	17.6	242	160	326
Greece	10.0	4,800	2.045	1.353	3,057	2,690	17.1	426	282	560
Hungary	10.6	2,460	2.796	1.909	3,579	2,996	13.5	1,137	776	1,218
Ireland	3.5	7,750	2.775	1.889	3,188	3,063	13.9	358	244	395
Italy	57.4	13,330	2.643	1.810	3,841	3,450	16.4	198	136	259
Netherlands	14.8	14,520	4.360	2.882	4,876	4,616	13.8	300	199	318
Norway	4.2	19,920	6.675	3.841	24,367	22,000	49.3	334	193	1,100
Poland	37.9	1,860	3.381	2.125	3,579	2,846	11.5	1,818	977	1,530
Portugal	10.3	3,650	1.526	0.943	2,303	2,017	18.4	418	258	553
Romania	23.1	2,129[1]	3.163[2]	2.196	3,342	2,681	10.5	1,486	1,031	1,259
Spain	39.0	7,740	2.169	1.334	3,318	2,923	18.8	280	172	378
Sweden	8.4	19,300	6.691	3.873	16,443	14,887	33.1	347	201	771
Switzerland	6.6	27,500	4.265	2.861	7,358	6,716	20.2	155	384	244
Turkey	53.8	1,280	0.935	0.667	878	700	9.0	730	521	547
U.K.	57.1	12,810	3.722	2.430	5,228	4,645	16.4	285	190	363
U.S.A.	246.3	19,840	7.829	5.226	11,097	10,112	16.6	395	263	510
Yugoslavia	23.6	2,520	2.030	0.978	3,225	2,864	25.2	806	388	1,137

Source: World Bank for Population and GNP per capita
United Nations Economic Commission for Europe for Energy and Electricity Consumption

Note : (1) Exchange rate: 1 US$ = 17.5 lei (1988)
(2) Based on Romanian Statistical Data
(3) Excluding non-energy uses

Figure 2.2 Per Capita Gross National Product for Some Selected Countries (1988)

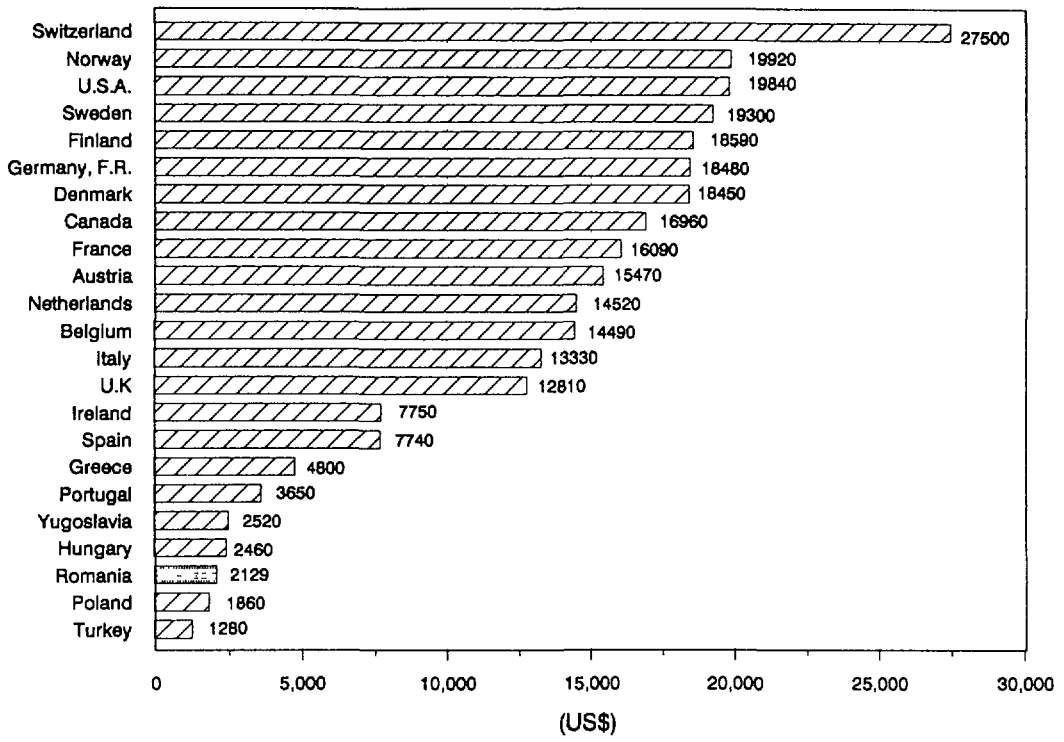
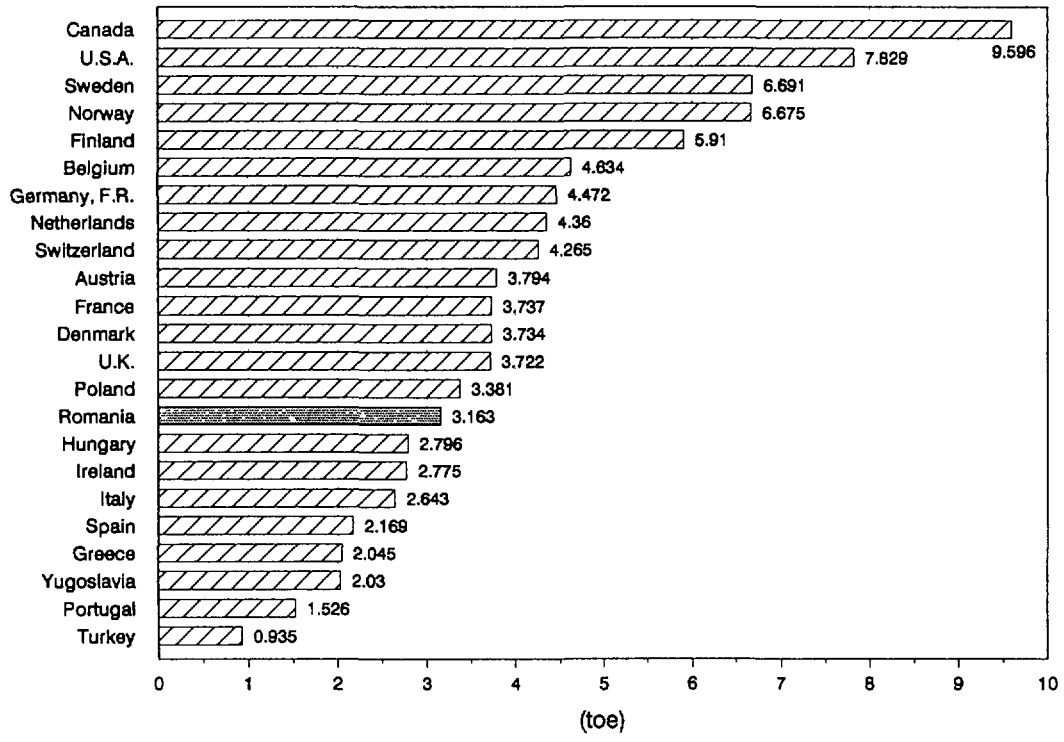


Figure 2.3 Per Capita Primary Energy Consumption for Some Selected Countries (1988)



Source: World Bank for population and GDP per capita
U.N. Economic Commission for Europe for energy and electricity consumption

Figure 2.4 Per Capita Gross Electricity Consumption for Some Selected Countries (1988)

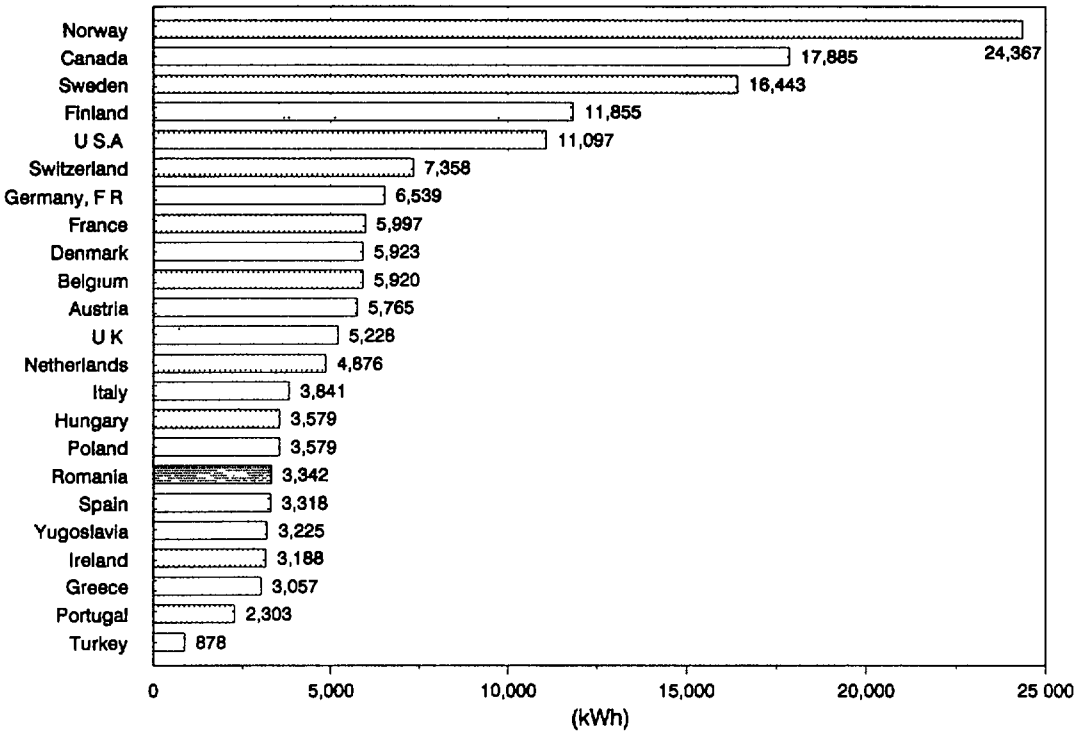
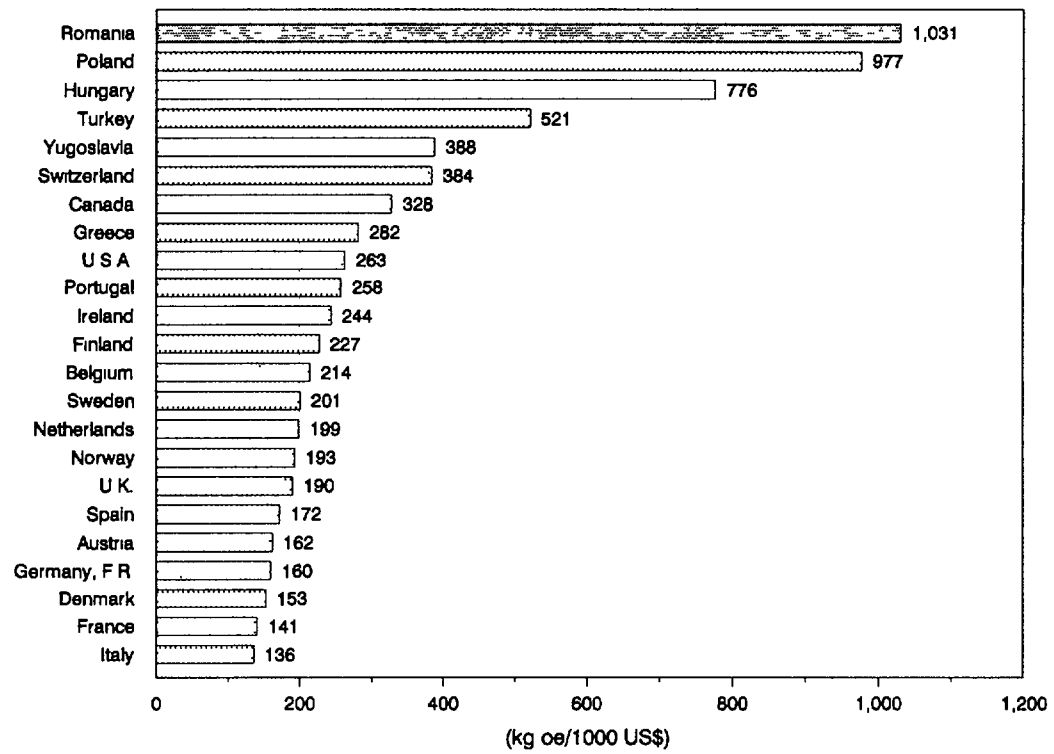
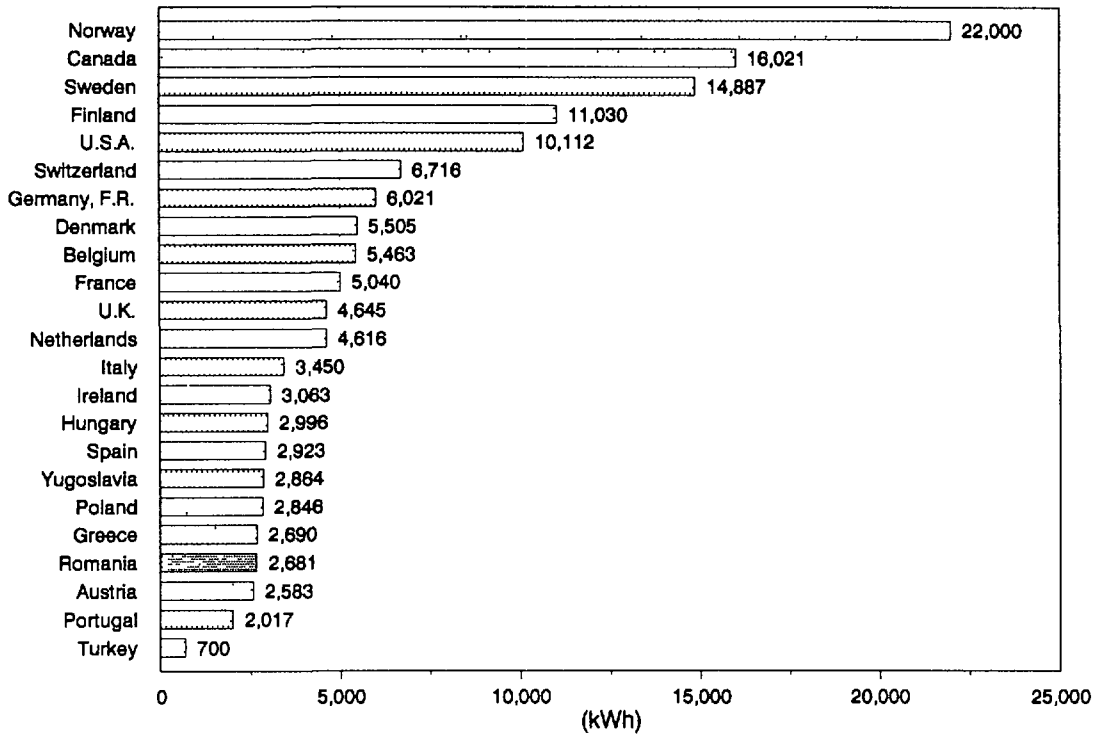


Figure 2.5 Final Energy Intensity for Some Selected Countries (1988)



Source World Bank for population and GDP per capita
U N Economic Commission for Europe for energy and electricity consumption

Figure 2.6 Per Capita Final Electricity Consumption for Some Selected Countries (1988)



Source World Bank for population and GDP per capita
U N. Economic Commission for Europe for energy and electricity consumption

4) The ratio of electricity to final energy consumption (10.5%) places Romania before Turkey (9 0%) but behind Poland (11.5%), Hungary (13.5%) and all OECD countries (Figure 2.7).

   Both per capita electricity consumption and the ratio of electricity to final energy consumption reflects the low level of electricity penetration into the socioeconomic activities. In the future, by changing the structure of the economy, it can be expected a decrease of primary energy intensity and a higher penetration of electricity into the total final consumption.

5) The intensity of electricity consumption of Romania (1,259 kWh/1000 U.S $) was smaller than that of Poland (1,530) and higher than that of Hungary (1,218), Yugoslavia (1,137), Norway (1,100) and the rest of OECD countries (Figure 2.8).

   In the future it is expected that the value of this index should decrease as a result of the increase of the per capita GDP to a rate higher than that of the per capita electricity consumption.

2.3.1 Consumption of Primary Energy

Romania's consumption of primary energy increased by 12 8% through the 1980-1988 period from 92.37 Mtce to 104.18 Mtce and returned within two years (1989-1990) to the level of 1980 (see Table 2 7 and Figure 2.9). As can be seen in this table and figure, the largest

Figure 2.7 Ratio of Electricity to Final Energy Consumption for Some Selected Countries (1988)

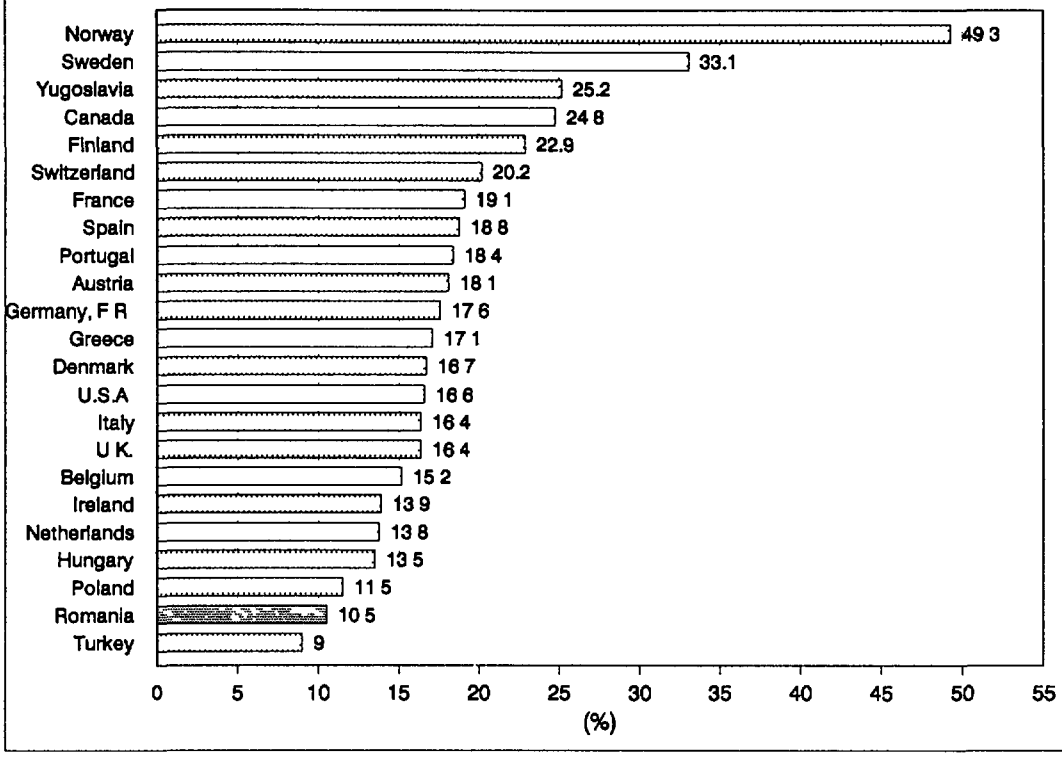
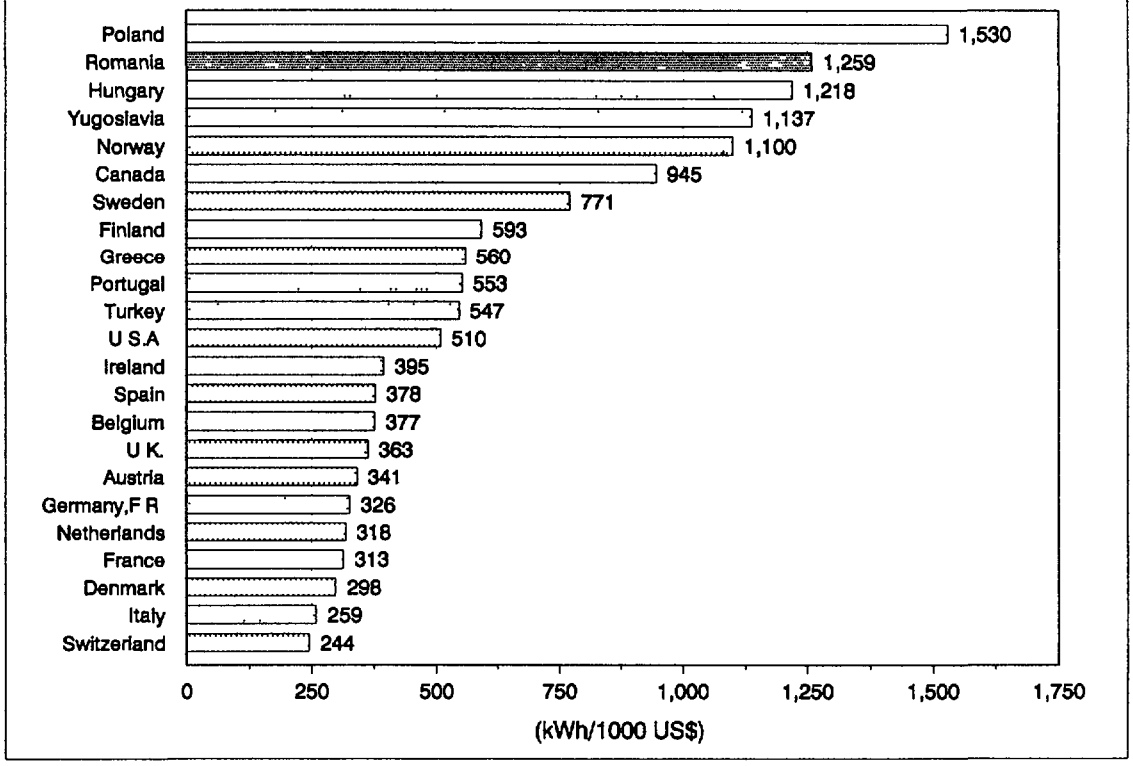


Figure 2.8 Intensity of Electricity Consumption for Some Selected Countries (1988)



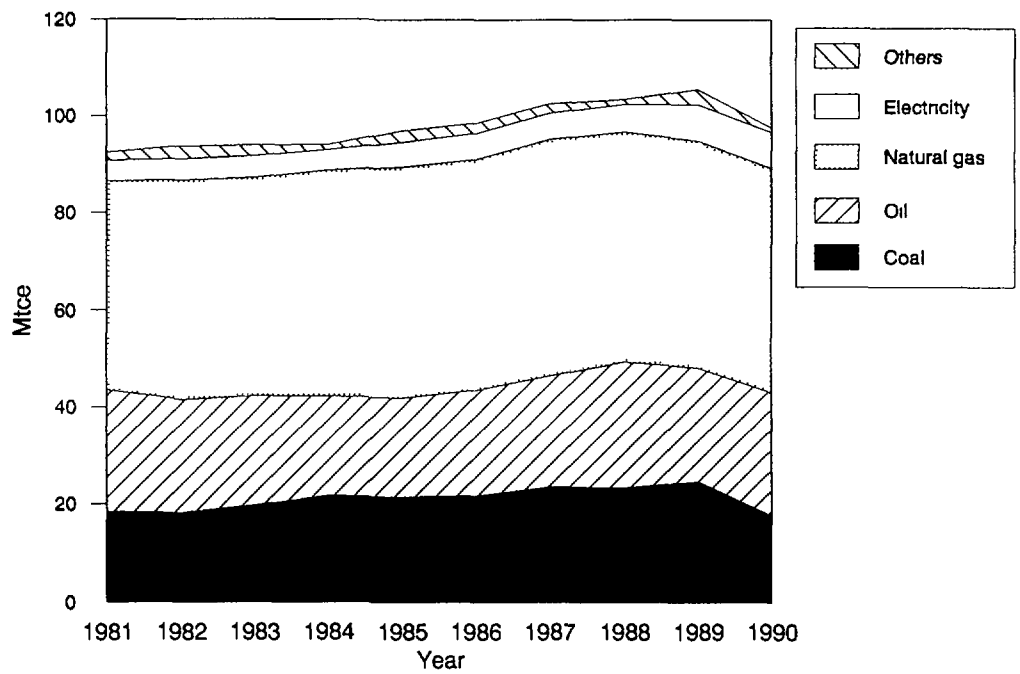
Source World Bank for population and GDP per capita
U N Economic Commission for Europe for energy and electricity consumption

Table 2.7 Structure of Primary Energy Consumption by energy forms (1980-1990)

Year	Coal		Oil		Natural gas		Electricity		Other		TOTAL
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce
1980	18 26	19 8	25 15	27 2	42 98	46 5	4 31	4 7	1 67	1 8	92 37
1981	18 39	19 6	23 32	24 8	45 16	48 1	4 45	4 7	2 62	2 8	93 94
1982	18 15	19 7	22 44	24 3	45 09	48 8	4 41	4 8	2 27	2 4	92 36
1983	19 73	21 4	20 65	22 4	46 55	50 6	4 20	4 6	0 95	1 0	92 08
1984	21 64	22 2	20 45	21 0	47 68	49 0	5 07	5 2	2 46	2 6	97 30
1985	21 34	21 7	21 86	22 2	47 54	48 4	5 35	5 4	2 20	2 3	98 29
1986	21 66	21 5	23 01	22 8	48 78	48 4	5 44	5 4	1 90	1 9	100 79
1987	23 51	22 7	26 16	25 2	47 28	45 6	5 74	5 5	1 04	1 0	103 73
1988	23 37	22 4	23 57	22 6	46 69	44 8	7 50	7 2	3 05	3 0	104 18
1989	24 75	23 6	25 55	24 4	46 19	44 1	7 30	7 0	0 99	0 9	104 78
1990	17 60	18 9	26 73	28 7	40 96	43 9	7 49	8 0	0 45	0 5	93 23

Source National Commission for Statistics

Figure 2.9 Structure of Primary Energy Consumption



share in the total consumption of primary energy was that of the natural gas (43 9-50 6%), followed by oil (21 0-28 7%) and coal (18 9-23 6%)

Table 2 8 summarizes the primary energy supply in the 1980-1990 period The domestic production had the most important share in the primary energy supply in this period It increased very slowly during 1980-1984 from about 75 0 Mtce to 81 13 Mtce, with an

Table 2.8 Primary Energy Supply in Romania (1980-1990)

Unit: Mtce

Year	Production	Import	Export	Net import[1]	Stock change	Total supply
1980	74.99	30.56	12.94	19.1	-0.24	92.37
1981	77.63	26.26	10.77	16.5	0.82	93.94
1982	77.77	23.70	9.43	15.5	0.32	92.36
1983	79.45	26.81	13.02	15.0	-1.16	92.08
1984	81.13	30.79	14.85	16.4	0.23	97.30
1985	80.80	31.44	13.79	18.0	-0.16	98.29
1986	79.93	36.08	15.10	20.8	-0.12	100.79
1987	77.28	43.58	17.04	25.6	-0.09	103.73
1988	78.46	44.04	19.03	24.0	0.71	104.18
1989	73.78	48.96	19.56	28.5	1.60	104.78
1990	59.43	41.79	7.39	36.9	-0.60	93.23

Source: National Commission for Statistics

Note : (1) (Import-Export)/Total Supply (%)

average annual rate of 2.0%, after which it decreased reaching 59.43 Mtce in 1990, i.e. about 80% of the 1980 production.

The import of primary energy continuously increased during the 1982-1989 period, from 23.7 Mtce to 48.96 Mtce and then decreased in 1990 as a result of the economic recession.

The export of primary energy consists mainly in oil products. In order to make operate its quite important refining capacities, built through 1960-1970 period, Romania has imported crude oil and exported its excess of oil products. As a result, the net import expressed as a fraction [(import-export)/total supply] increased during 1983-1990 from 15.0% to 36.9%, reflecting the increase of the dependence of Romania's economy on the energy import.

Table 2.9 lists the domestic production of various form of primary energy. It mainly consisted of natural gas (51.2-57.5%), crude oil (17.1-21.3%) and coal (15.4-24.1%). Coal production continuously rose during 1980-1989 from 11.747 Mtce to 17.746 Mtce, especially from increase of the production of lignite, but it decreased in 1990 to a lower level than in 1980, namely 10.741 Mtce.

The crude oil production continuously decreased within the 1982-1990 period, from 16.286 Mtce to 10.997 Mtce as a consequence of ore exhausting. Natural gas production varied from one year to another with an increasing general trend during 1980-1986 from 41.194 Mtce to 45.943 Mtce, then decreasing up to 32.634 Mtce in 1990.

Estimates of the future production indicate that the decline in hydro-carbons production (crude oil and natural gas) could be slowed down by utilizing new technologies that might allow the increase of the recovering rate of the oil and gas fields. Reactivation of the domestic production of hydro-carbons could be achieved by discovering new fields inside the country

Table 2.9 Domestic Primary Energy Production (1980-1990)

Unit Mtce

Year	Coal		Crude oil		Natural gas[1]		Hydro energy		Other		Total
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce
1980	11 75	15 7	15 97	21 3	41 19	54 9	4 15	5 5	1 93	2 6	74 99
1981	11 97	15 4	16 15	20 8	43 45	56 0	4 26	5 5	1 81	2 3	77 63
1982	12 12	15 6	16 29	20 9	43 38	55 8	4 04	5 2	1 95	2 5	77 77
1983	13 30	16 7	16 08	20 2	44 50	56 0	3 46	4 4	2 11	2 7	79 45
1984	13 51	16 7	15 89	19 6	45 52	56 1	3 99	4 9	2 23	2 7	81 13
1985	13 91	17 2	14 86	18 4	45 47	56 3	4 20	5 2	2 35	2 9	80 80
1986	14 07	17 6	14 04	17 6	45 94	57 5	3 86	4 8	2 02	2 5	79 93
1987	15 54	20 1	13 18	17 1	43 59	56 4	3 93	5 1	1 04	1 3	77 28
81988	17 40	22 2	13 02	16 6	42 17	53 8	4 90	6 2	0 95	1 2	78 46
1989	17 74	24 1	12 72	17 2	37 81	51 2	4 51	6 1	1 00	1 4	73 78
1990	10 74	18 1	11 00	18 5	32 63	54 9	4 02	6 8	1 04	1 7	59 43

Source National Commission for Statistics
Note (1) Including drilling gas

or on the continental platform of the Black Sea Since oil and gas in these fields are estimated to exist at big depths and to be in limited quantities, special drilling technologies would be required

Table 2 10 shows the energy import of Romania by energy form The biggest part of the import consisted in crude oil and some special oil products (55 8-72 4%) The import of solid fuels (15 6-26 4%) mainly consists in coke and pit coal Natural gas import continuously increased within 1983-1990, from 7 6% to 19 9%, exceeding the import of solid fuels at the end of the period

2.4 Energy Resources

Romania is endowed with a variety of energy resources coal, oil, natural gas, hydraulic energy, but within limited amounts

2.4.1 Pit Coal Resources

The proven pit coal resources of 925 million tons, as well as the probable resources estimated at 390 million tons (see Table 2 11) are concentrated on two mining fields the Jiu Valley and the Southern Banat region, out of which 908 million tons proven resources and 367 million tons of probable resources, are located in the Jiu Valley

In 1990 the production of raw pit coal was of 5 365 million tons, much less than of the previous years 8-9 million tons Estimates of the future production indicate that by improving

Table 2.10 Energy Import of Romania (1980-1990)

Year	Coal & coke		Crude & oil products		Natural gas		Electricity		Total
	Mtce	%	Mtce	%	Mtce	%	Mtce	%	Mtce
1980	6.504	21.3	22.115	72.4	1.786	5.8	0.155	0.5	30.56
1981	6.424	24.5	17.943	68.3	1.708	6.5	0.185	0.7	26.26
1982	6.042	25.5	15.579	65.7	1.705	7.2	0.370	1.6	23.70
1983	6.435	24.0	17.588	65.6	2.048	7.6	0.737	2.8	26.81
1984	8.132	26.4	19.405	63.0	2.165	7.0	1.082	3.5	30.79
1985	7.428	23.6	20.787	66.1	2.073	6.6	1.151	3.7	31.44
1986	7.591	21.0	24.061	66.7	2.838	7.9	1.581	4.4	36.08
1987	8.062	18.5	30.018	68.9	3.690	8.5	1.806	4.1	43.58
1988	7.379	16.8	29.574	67.1	4.516	10.2	2.592	5.9	44.04
1989	7.008	14.3	30.776	62.9	8.384	17.1	2.792	5.7	48.96
1990	6.508	15.6	23.327	55.8	8.326	19.9	3.468	8.3	41.79

Source: National Commission for Statistics

Table 2.11 Coal Resources of Romania

Unit : million tons

Energy carrier	Coal field	Resources	
		Proven	Probable
Pit coal(1)	Jiu Valley	908	367
	Southern Banat	17	23
	Total	925	390
Lignite(2)	Oltenia	2,800	1,423
Brown coal(3)	Oltenia	20	

Note: (1) average calorific contents=6,000 kcal/kg in the ore; ashes=25-30; initial humidity=2-3%
(2) average calorific contents=2,100-2,160 kcal/kg in the ore; initial humidity=37-42%
(3) average calorific contents=3,100-3,400 kcal/kg in the ore; initial humidity=18-20%

the extractive technologies it would be possible to reach a production of raw pit coal of 10 million tons a year, for which the pit coal known resources would be enough for a 90-100 years period.

2.4.2 Lignite and Brown Coal Resources

The main part (88 %) of the proven reserves of lignite (2,800 million tons) and brown coal (20 million tons) are located in the coal fields of Oltenia. The total probable resources are estimated at 1,423 million tons, out of which 66% belong to the Oltenia coal fields.

The lignite ores exist in reduced coal stratum (1-5 m) between smooth rocks beds such as sandy clays and water sands, making difficult the underground extraction. The brown coal ores also appear in the form of reduced thickness beds, with big angles and tectonics in many cases.

Lignite is today dug out in 30% ratio from underground and 70% from the quarries. Both lignite and brown coal production reached a total value of 53.1 million tons in 1989. For an estimated future lignite production of 50-55 million tons a year the proven resources would be enough for about 50-55 years.

2.4.3 Hydro-carbon Resources

At present certain data regarding the existing hydro-carbon resources on Romania are not available. The last data of probable and proven recoverable reserves of crude oil is about 90 million tons, which would be depleted by the year 2005. The reserve estimate and production forecast will be further investigated by Romanian Authority of Oil (PETROM) and its consultants.

Current projections foresee a continuous fall of the crude oil output, reaching 5.0 million tons in 2000. This is due to both the advanced exhaustion stage of oil fields and to the growing cost of the extraction in the secondary and tertiary oil fields.

During the last 10 years, the volume of discoveries of new gas reserves decreased continuously from 29.7 billion m^3 in 1980 to 7.4 billion m^3 in 1990.

Natural gas reserves estimated by the Romanian Authority of Natural Gas (ROMGAS) for Transylvania Basin is 36.5 billion m^3 proven, 83 billion m^3 possible and 28 billion m^3 probable, assuming that the reserve estimate is not biased to either optimistic or pessimistic reserve values. Then a weighted expected total reserve value can be obtained by assigning the following confidence coefficients:

			Coefficient	
Proven	365 billion m^3	x	1.00	= 365 billion m^3
Probable	28 billion m^3	x	0.75	= 21 billion m^3
Possible	83 billion m^3	x	0.25	= 21 billion m^3
Weighted total				407 billion m^3

ROMGAS foresees a continuous fall of the gas output from about 19 billion m^3 in 1990 to 9 billion m^3 in 2000.

2.4.4 Hydroelectric Potential

Romania's technically exploitable hydroelectric potential (see Table 2.12) is estimated at 40.0 TWh. Considering that 70% of the technically exploitable hydro-potential would be economically developed, an average annual hydro generation of about 28.0 TWh can be estimated. Of this total the existing hydro power plants have an annual generation of about 17.0 TWh, while new hydro plants would have an annual generation of about 11.0 TWh.

Table 2.12 Romania's Hydroelectric Potential

Region	Technically exploitable potential TWh	Exploited potential	
		Twh	%
Danube	11.5	6.55	56.6
Other rivers	28.5	10.05	35.3
Total	40.0	16.60	41.5

2.5 Final Energy Consumption by Sector

The forecast of Romania's energy demand in the far future required a detailed analysis of the energy consumptions by economic sectors in the past. The original statistic data used for this report [Ref. 2.3] have been restructured by consuming sectors and final energy forms according to the MAED model requirements. The evolution of the final energy consumption through 1981-1990 by economic sectors and energy forms, thus obtained, is presented in Table 2.13.

In the following chapters the term "energy" will basically refer to final energy, unless specified otherwise. The energy consumption of various sectors will be discussed in the following sections.

2.5.1 Agriculture

The energy consumption of this sector decreased from 3.641 Mtce to 2.864 Mtce with an average annual rate of 2.7% during the 1981-1990 period. This decrease was not due to the improvement of equipment and energy consuming processes efficiency, but to the constrains in allocating energy to the economic sectors owing to the energy scarcity background of that period.

The form of energy with the highest share in the consumption of this sector was represented by motor fuels (gasoline and, especially diesel) utilized for the agricultural equipment. Electricity was mainly consumed by irrigating systems and both the fossil fuels and the thermal energy were consumed for heating: space, water, greenhouses, etc.

2.5.2 Construction

The energy consumption of this sector decreased between 1981-1990 from 1.919 Mtce to 1.166 Mtce with an average annual rate of 5.4%. The form of energy with the biggest share in the consumption of the sector was represented by the motor fuels utilized for carrying materials and buildings equipment. Electricity was used for lighting and building equipment operation (cranes, compressors etc.), while fossil fuels and thermal energy were used for space and water heating, and for other thermal uses at the construction sites.

2.5.3 Mining

During the 1981-1990 period the energy consumption of this sector decreased from 3.394 Mtce to 2.504 Mtce with an average annual rate of 6.0%. The biggest share of this consumption was represented by direct use of fossil fuels.

Table 2.13 Commercial Final Energy Consumption According to the MAED Requirements (1981-1990)

Unit Mtce

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture										
- Motor fuels	1 833	1 606	1 553	1 589	1 623	1 593	1 532	1 725	1 694	1 647
- Electricity	0 391	0 425	0 512	0 435	0 486	0 509	0 480	0 451	0 513	0 391
- Fossil fuels(1)	1 417	1 177	1 037	0 843	1 057	0 955	0 991	1 020	0 903	0 826
Subtotal	3 641	3 208	3 102	2 867	3 166	3 057	3 003	3 196	3 110	2 864
Construction										
- Motor fuels	1 168	1 123	1 028	0 944	0 831	0 832	1 362	0 894	0 813	0 669
- Electricity	0 185	0 142	0 137	0 169	0 161	0 166	0 186	0 193	0 186	0 165
- Fossil fuels(1)	0 566	0 520	0 715	0 305	0 289	0 303	0 306	0 355	0 352	0 332
Subtotal	1 919	1 785	1 880	1 418	1 281	1 301	1 854	1 442	1 351	1 166
Mining										
- Motor fuels	0 111	0 168	0 173	0 182	0 264	0 284	0 304	0 277	0 187	0 204
- Electricity	0 459	0 493	0 525	0 373	0 407	0 431	0 443	0 467	0 678	0 623
- Fossil fuels(1)	2 824	2 536	2 765	1 559	1 565	1 995	1 700	1 636	1 367	1 677
Subtotal	3 394	3 197	3 463	2 114	2 236	2 710	2 447	2 380	2 232	2 504
Manufacturing										
- Motor fuels	0 939	0 965	0 904	0 934	0 903	0 809	0 899	0 897	0 917	0 756
- Electricity	4 845	4 939	4 926	5 312	5 331	5 731	5 646	5 837	5 842	4 695
- Fossil fuels	11 097	14 382	11 453	11 879	12 039	12 393	10 500	11 120	12 492	13 110
- Centralized heat	12 580	12 675	12 408	13 312	13 540	14 101	14 018	14 590	14 782	14 237
- Coke	4 095	4 039	3 612	4 405	4 826	4 683	4 587	4 480	6 340	3 093
- Feedstock	9 925	8 680	9 308	9 011	8 625	10 591	8 547	9 302	10 377	10 285
Subtotal	43 481	45 680	42 611	44 853	45 264	48 308	44 197	46 226	50 750	46 176
Transportation										
- Motor fuels	3 879	4 127	3 617	3 422	3 223	3 142	2 893	3 514	3 223	4 254
- Electricity	0 246	0 240	0 364	0 285	0 299	0 317	0 318	0 347	0 359	0 321
- Fossil fuels(2)	0 050	0 045	0 040	0 045	0 050	0 055	0 045	0 040	0 040	0 028
Subtotal	4 175	4 412	4 021	3 752	3 572	3 514	3 256	3 901	3 622	4 603
Service										
- Electricity	0 344	0 327	0 364	0 607	0 316	0 324	0 201	0 352	0 361	0 393
- Fossil fuels	1 813	1 212	1 046	1 204	1 676	1 039	1 028	1 147	1 217	1 064
- District heat	1 347	1 321	1 299	0 950	1 210	1 176	1 221	1 257	1 217	1 480
Subtotal	3 504	2 860	2 709	2 761	3 202	2 539	2 450	2 756	2 795	2 937
Household										
- Electricity	0 631	0 621	0 614	0 588	0 592	0 614	0 591	0 551	0 528	0 658
- Fossil fuels	4 409	4 398	3 910	3 998	4 212	4 105	3 650	3 242	3 505	3 916
- District heat	2 981	3 151	2 881	2 998	2 666	2 924	2 964	3 099	3 300	3 746
Subtotal	8 021	8 170	7 405	7 584	7 470	7 643	7 205	6 892	7 333	8 320
TOTAL	68 135	69 312	65 191	65 349	66 191	69 072	64 412	66 793	71 193	68 570

Source National Commission for Statistics

Note (1) Including Centralized heat
(2) Coal, specific uses

2.5.4 Manufacturing

Between 1981-1988 the energy consumption of this sector remained quite constant around 45.0 Mtce, while in 1989 it increased to 50.750 Mtce, and in 1990 it decreased to 46.176 Mtce. The biggest shares were represented by the direct use of fossil fuels, the thermal energy centrally generated (in cogeneration and thermal plants) and the feedstock.

2.5.5 Transportation

The energy consumption of this sector varied from 4.175 in 1981, to 3.256 Mtce in 1987 and finally reaching 4.603 Mtce in 1990, the biggest share being represented by motor fuels (gasoline and diesel).

2.5.6 Services

During the period 1981-1990 this sector had a consumption varying from 3.504 Mtce in 1981 to 2.450 Mtce in 1987 and finally reaching 2.937 Mtce in 1990. The shares of the thermal energy and of electricity remained quite constant, while the share of the fossil fuels direct use decreased.

2.5.7 Residential

Energy consumption of population (excluding that of motor fuels which in the MAED model is accounted for within the Transportation sector) decreased between 1981-1989 from 8.021 Mtce to 7.333 Mtce with an average annual rate of 1.1% and finally reaching 8.320 Mtce in 1990.

The biggest share in the population's consumption is represented by the direct use of fossil fuel in the rural area and district heat in urban area.

2.5.8 Comparison with Some Selected Countries

Comparing the structure of Romania's final energy consumption with that of other countries belonging to the United Nations - European Economic Commission region (see Table 2.14), the following remarks can be made:

- Romania holds the highest share of the Industry sector (Construction and Mining included) in the total final energy consumption (62.2-73.6%), while the average for ECE Region is 40.2% and for East European region is 48.4%.

  The too big share of Industry in the total consumption of final energy of Romania is due to the Basic Materials subsector (54.2% in 1989) that was oriented towards energy intensive products, often pollutant ones, like: steel and steel products, chemical fertilizers, cement etc. (see Table 2.15).

- Romania shows a very small share of the Transportation sector in the total consumption of final energy (4.6- 4.9% within 1986-1989) comparable only with

Table 2.14 Final Energy Consumption by Sectors in UN-ECE Countries (1988)

Unit: %

Country/Region	Industry[1]	Transport	Agriculture + Services+ Household
ECE Region [2]	40.2	25.7	34.1
Eastern Europe (excl. USSR)[2]	48.4	7.4	44.2
Albania[3]	47.6	18.3	34.1
Bulgaria[3]	64.5	11.9	23.6
Czechoslovakia[3]	51.2	6.7	42.1
Hungary	35.2	14.7	50.1
Poland	40.3	4.4	55.3
Romania[3,5]	**66.2**	**4.6**	**29.2**
Romania[4,5]	**73.6**	**4.9**	**21.5**
USSR	61.2	13.6	25.2
Western Europe	31.5	29.0	39.5
Austria	30.0	27.2	42.8
Belgium	37.0	24.6	38.4
Denmark	19.0	28.2	52.8
Finland	43.6	19.4	37.0
France	27.5	31.5	41.0
Germany,F.R.	30.0	27.0	43.0
Greece	29.4	39.3	31.3
Ireland	29.8	28.0	42.2
Italy	33.5	30.8	35.7
Netherlands	31.4	23.3	45.3
Norway	39.6	24.7	35.7
Portugal	40.5	35.0	24.5
Spain	37.6	39.7	22.6
Sweden	37.4	23.6	39.0
Switzerland	17.8	30.6	51.6
Turkey	28.5	24.1	47.4
United Kingdom	27.2	31.2	41.6
Yugoslavia	54.8	19.9	25.3
North America	30.1	36.6	33.3
Canada	36.4	28.9	34.7
USA	29.4	37.4	33.2

Source: United Nations, Economic Commission for Europe, Energy Balances for Europe and North America, Geneva, June 1990

Note:
(1) Including Construction and Mining
(2) 1986 statistics
(3) 1987 statistics
(4) 1989 MAED input data
(5) Including Non-energy use

Table 2.15 Production of Energy Intensive Products in Selected Countries (1989)

Unit: (kg. of output per capita)

STEEL		STEEL PRODUCTS	
Belgium	1103	Belgium	863
Austria	656	Japan	828
Romania	**623**	**Romania**	**443**
Germany, R.F.	589	U.S.S.R.	403
Canada	589	Canada	419
U.S.S.R.	558	Italy	394
Sweden	528	Bulgaria	338
Italy	438	Poland	337
Netherlands	383	U.S.A.	309
U.S.A.	355	France	285
France	344	U.K.	264
U.K.	328	Hungary	240
CHEMICAL FERTILIZERS		**CEMENT**	
Canada	441	Greece	1249
Netherlands	146	Spain	705
Romania	**121**	**Romania**	**528**
U.S.S.R.	119	U.S.S.R.	490
U.S.A.	94	France	463
Hungary	85	Germany, R.F.	460
Bulgaria	80	Poland	452
Poland	72	Canada	451
France	68	U.S.A.	287

Source: National Commission for Statistics

that of Poland (4.4%), while the average of the whole Economic Commission for Europe region is 25.7%, of Western Europe is 29.0% and that of North America 36.6%.

- The combined share of Agriculture, Services and Household sectors in the total consumption of final energy (21.5-29.2%) is comparable with that of Spain (22.6%), Bulgaria (23.6%), Portugal (24.5%), ex-Soviet Union (25.2%) and Yugoslavia (25.3%), but lower than that of the rest of UN-ECE Member States.

2.6 Electric Power System Development

In Romania, electricity supply is achieved through the Romanian Electricity Authority-RENEL that has been set up in November 1990 by the re-organization of the companies that belonged to the ex-Ministry of Electricity (MEE).

RENEL has a large scope of activities, consisting mainly in:

- generation, transmission and distribution of electricity;
- generation and transmission of thermal energy;

Connected with these responsibilities, RENEL undertakes research, studies, designs for developing the National Electric Power System and optimizing the operation of existing power equipment.

2.6.1 Past Electricity Demand

Romania's electricity consumption had an increasing annual average rate of 15.7% during the 1960-1970 period, while in the following 10 years (1970-1980), this rate decreased to 8.1%, mainly due to the shock caused on the Romanian economy by the first oil crisis in 1973. The second oil crisis in 1979 had, as a result, a more severe decrease of the average annual growth rate of electricity consumption during the 1980-1989 period (2 2%)

In the years 1990 and 1991, as a consequence of the deep changes faced by Romania, a serious decrease of electricity consumption occurred against 1989, namely with 14.1% in 1990 and with 26.5% in 1991.

Table 2 16 presents the structure of the electricity consumption by categories of consumers in 1970, 1980 and 1985- 1991. The following remarks can be made:

- electricity consumption of industry represents the most important part of the total electricity consumption of Romania Until 1989, the share of industrial consumption was about 70% In 1990 and 1991 this share decreased to 66% and 63%, respectively.

- residential consumption, public lighting and municipal services had a combined share of 7.6% in 1989; this share increased to 10 5% in 1990 and 16.5% in 1991.

Table 2.16 Electricity Consumption by Categories of Consumers

	1970	1980	1985	1986	1987	1988	1989	1990	1991(2)
CONSUMPTION									
GWh(1)	29387	63883	71223	75795	75177	78226	79027	67856	58118
%	100	100	100	100	100	100	100	100	100
of which									
- Industry	66 7	68 4	69 2	69 7	70 1	70 3	70 3	65 6	63 1
- Construction	2 3	2 3	1 8	1 8	2 0	2 0	1 9	2 0	1 9
- Transportation & telecomms	1 7	3 0	3 4	3 4	3 4	3 6	3 7	3 9	4 0
- Agriculture & forestry	2 4	4 4	5 5	5 4	5 2	4 6	5 3	4 7	4 1
- Municipal services	2 2	1 7	1 8	1 8	1 8	1 8	2 0	2 4	4 9
- Public lighting	1 2	0 4	0 1	0 1	0 1	0 1	0 1	0 2	-
- Domestic use	7 6	7 7	6 8	6 5	6 4	5 7	5 5	7 9	11 6
- Consumption in power plants	11 3	9 3	9 3	9 3	9 3	9 3	9 6	11 2	10 4
of which									
- for producing electricity	8 5	7 0	7 0	6 8	6 6	6 5	6 7	7 3	7 0
- Others	4 6	2 8	2 1	2 0	1 7	2 6	1 6	2 1	-

Source Romanian Electricity Authority-RENEL

Note (1) With electric sector's own consumption, without losses in distribution and transmission

2.6.2 Generation Facilities

In 1991 the total installed capacity of power plants in Romania was of 22,268 MW and the electricity generation of 56,912 GWh. The power plants belonging to RENEL hold about 92% of the total installed capacity and they generated around 96% of the total electricity output in 1991.

Tables 2.17 and 2.18, showing the development and structure of the installed capacity in Romanian power system, reflect the following:

- the total installed capacity increased 2.2 times within 1970-1980 and 1.4 times between 1980-1990.
- the weight of hydro-power plants in the total installed capacity increased from 16% in 1970 to 25% in 1991.
- the weight of thermal power plants based on coal in the installed capacity of thermal power plants increased from 49% in 1980 to 58% in 1990, while the weight of thermal power plants based on hydro-carbons decreased from 51% to 42% in the same period.

A feature of the Romanian energy system is represented by the presence of an important installed capacity in cogeneration power plants. In 1991 this capacity was of 6,182 MW, representing 37% of the total installed capacity of thermal power plants.

Tables 2.19 and 2.20 show the evolution and structure of the electricity generation by type of power plants (hydro and thermal plants) and by type of fuels, while Table 2.21 lists the

Table 2.17 Installed Capacity in Romania(1)

Unit: MW

	1970	1980	1985	1986	1987	1988	1989	1990	1991
TOTAL ROMANIA	7346	16109	19576	20393	21730	22376	22903	22479	22268
of which:									
- RENEL's plants	6528	14797	17983	18637	19889	20478	20987	20654	20571
- other plants	818	1312	1593	1756	1841	1898	1916	1825	1697
1. Thermal Power Plants	6146	12654	15155	15686	16673	16955	17320	16822	16581
of which:									
- RENEL's plants	5357	11374	13596	13963	14864	15090	15443	15026	14913
- other plants	789	1280	1559	1723	1809	1865	1877	1796	1668
2. Hydro Power Plants	1200	3455	4421	4707	5057	5421	5583	5657	5687
of which:									
- RENEL's plants	1171	3423	4387	4674	5025	5388	5544	5628	5658
- other plants	29	32	34	33	32	33	39	29	29

Source: Romanian Electricity Authority-RENEL

Note : (1) On 31 December

Table 2.18 Installed Capacity in RENEL's Power System by Fuel Type

Unit MW

	1970	1980	1985	1986	1987	1988	1989	1990	1991
TOTAL RENEL	6528	14797	17983	18637	19889	20478	20987	20654	20571
of which									
1 Hydro Power Plants	1171	3422	4387	4674	5025	5388	5544	5628	5658
2 Thermal Power Plants	5357	11374	13596	13963	14864	15090	15443	15026	14913
of which									
- coal		5553	7367	7502	8101	8342	8676	8747	8666(1)
- hydrocarbons		5821	6229	6461	6763	6784	6767	6279	6247(1)

Source Romanian Electricity Authority-RENEL

Note (1) Estimated

Table 2.19 Gross Electricity Generation in Romania

Unit GWh

	1970	1980	1985	1986	1987	1988	1989	1990	1991
TOTAL ROMANIA	35088	67486	71819	75478	74079	75322	75851	64309	56912
of which									
- RENEL's plants	32219	64013	68371	71644	70150	71597	72530	61557	54703
- other plants	2869	3473	3448	3834	3929	3725	3321	2752	2209
1 Thermal Power Plants	32315	54849	59923	64668	62869	61700	63222	53327	42663
of which									
- RENEL's plants	29548	51483	56565	60925	59019	58056	60000	50655	40529
- other plants	2767	3366	3358	3743	3851	3644	3222	2672	2134
2 Hydro Power Plants	2773	12637	11896	10810	11210	13622	12629	10982	14249
of which									
- RENEL's plants	2671	12530	11806	10719	11131	13541	12530	10902	14174
- other plants	102	107	90	91	78	81	99	80	75

Source Romanian Electricity Authority-RENEL

balance of electricity Examining the data included in Tables 2 19 to 2 21, the following remarks can be made

- During the 1970-1980 period, the electricity generation doubled from 35,088 GWh to 67,486 GWh, then followed a slower increase between 1980-1986, reaching the amount of 75,478 GWh in 1986, after which it remained quite constant until 1989 when it started to decline

  Until 1979, Romania was a net exporter of electricity with a maximum export of almost 3,800 GWh in 1972 After 1979, it became a net importer of electricity, the highest import reaching 9,476 GWh in 1990 It should be mentioned that at the same time restrictions in electricity supply were practised and the frequency deviated from the rated value In 1990 and 1991, electricity generation decreased by 15% and 25% respectively, against 1989

- The share of hydro-power plant in the total electricity generation increased from 8% in 1970 to 17% in 1989 and to 25% in 1991. Although the installed capacity of hydro power plants increased with over 2,000 MW between 1980-1990, the hydro power plants generation remained quite the same, within 10,000-13,000 GWh, due to a succession of dry years. In 1991, due to a change of hydrological conditions the hydroelectric generation reached 14,000 GWh.

- The share of electricity generation based on coal in the total thermal electricity, increased from about 35% in 1970, 1980 and 1985 to around 41% between 1986-1989 and then decreased to 34% in 1991, due to the severe reduction of the domestic lignite production.

Table 2.20 Gross Electricity Generation by Fuel Type in RENEL's Plants

Unit : GWh

	1970	1980	1985	1986	1987	1988	1989	1990	1991
TOTAL RENEL	32219	64013	68371	71644	70150	71597	72530	61557	54703
of which:									
1. Hydro Power Plants	2671	12530	11806	10719	11131	13541	12530	10902	14174
2. Thermal Power Plants	29548	51483	56565	60925	59019	58056	60000	50655	40529
of which:									
- coal	9796	17849	19876	20003	20689	24212	24398	15830	13654
- fuel oil and gas oil	828	6502	6757	10202	9323	6699	8284	11823	6094
- natural gas	18367	25759	29045	29642	27792	25991	26269	22573	20456
- other fuels	557	1373	887	1258	1215	1154	1049	429	325

Source: Romanian Electricity Authority-RENEL

Table 2.21 Electricity Generation Balance of Romania

Unit: GWh

	1970	1980	1985	1986	1987	1988	1989	1990	1991
1. Generation	35088	67486	71819	75478	74079	75322	75851	64309	56912
Import	28	472	3259	4430	5150	7199	7811	9476	7047
Export	2413	3007	49	-	-	-	-	-	-
2. Gross consumption	32703	67909	75078	79908	79228	82521	83662	73662	63959

Source: Romanian Electricity Authority-RENEL

The centrally generated thermal energy (steam and hot water) increased from about 496×10^9 MJ in 1975 to about 705×10^9 MJ in 1988 and 1989, then decreased to 649×10^9 MJ in 1990 (see Table 2.22). Out of this the share of the cogeneration plants in the total centrally generated thermal energy was between 55% and 59%.

Table 2.23 shows the evolution of the utilization time of the average installed capacity and peak load.

Table 2.22 Centralized Heat Generation in Romania

Unit: 10^6 MJ

	1975	1980	1985	1986	1987	1988	1989	1990	1991
Total ROMANIA	495503	633337	635280	660128	673250	705045	704622	648950	545628
of which:									
- cogeneration plant	271413	347839	349723	371486	376783	409356	418450	375100	303355
- thermal plant	224090	285498	285557	288642	296467	295689	286172	273850	242273
Total RENEL	157804	197437	213916	228201	238066	263002	269994	258112	221444
of which:									
- cogeneration plant	152160	191144	192714	207313	211831	238790	248943	235315	202478
- thermal plant	5644	6293	21202	20888	26235	24212	21051	22797	18966

Source: Romanian Electricity Authority-RENEL

Table 2.23 Utilization Time of Average Installed Capacity and of Peak Load

Unit: hours/year

	1970	1980	1985	1986	1987	1988	1989	1990	1991
1. Utilization Time of Average Installed Capacity:(1)									
. in Romania	5229	4280	3788	3701	3409	3366	3020	2849	2540
. in RENEL	5445	4407	3922	3840	3520	3493	3452	2972	2663
2. Utilization Time of Peak Load(2)	7180	7613	7013	7626	7458	7691	7423	6916	6547

Source: Romanian Electricity Authority-RENEL

Note: (2) Utilization Time of Average Installed Capacity=Annual Electricity Generation/Annual Average Installed Capacity
(3) Utilization Time of Peak Load=Annual Gross Electricity Consumption/Annual Peak Load

The severe decrease of the average utilization time of the installed capacity, from 5,229 hours/year in 1970 to 2,540 hours/year in 1991, was a consequence of several factors:

- advanced fatigue of the old units;
- low plant availability of some of the new units (especially those operating on coal);
- insufficient quantity and inadequate quality of the fuels delivered;
- the heat requirements to be met by cogeneration units is lower than that the unit design capacity.

2.6.3 Existing Power Development Plan

The difficult issues faced by the Romanian economy in the present transition period towards the market economy have at present and will have in the future, a strong impact on the power system development.

The main factors decisively influencing the development of power plants in the long term are:

- the demand of electricity and heat to be supplied;
- the evolution of technical and economic parameters of existing power plants;
- the situation of power plants under construction;
- the quantities and types of fuel that may be supplied to the power plants.

In the future it is foreseen a tendency of diminishing the industrial heat demand energy, while the residential consumption will slightly increase.

A factor that may influence both the total demand of electricity and its structure, is the tariff structure. At present, analyses are made within RENEL to redefine the tariff structure in order to reflect the generating expenses by season and day time. This could lead to the stimulation of less energy intensive consumers activity, among which the private ones, to energy saving improvement actions of energy intensive consumers and to providing more efficient electric appliances.

A higher attention is to be paid to the economic efficiency of both the rehabilitation of existing plants and the completion of the power plants under construction. A very difficult problem is to provide the necessary financial funds for these objectives.

In the future Romania will have to observe the European environmental standards in the energy field and power plants should meet specific environment protection regulation. In this regard, the realization of new nuclear power plants is expected to be an alternative to the power plants based on fossil fuels.

2.7 Country Plans and Targets

Before 1989, Romania's socioeconomic development was fulfilled according to five-year plans that were annually updated. At present, due to the quick and deep changes faced by Romania, the long-term planning is subject to a high rate of uncertainty. There are, however, some general targets of the transition to the market economy currently considered by the Government, such as:

- to continue the privatization of trade, tourism, small industry etc., which was started in 1990;
- preparation and implementation of privatization of large industries;
- aligning energy prices to international levels;
- restructuring, rehabilitation and efficiency improvement of the economic sectors;
- environmental protection enforcement;
- restructuring of the financial and banking system;

On the other hand the following short-term goals, can be mentioned:

- stopping the emphasized decrease of the economy that started in 1988;
- controlling inflation that began after 1990;

- fully implementation of the land law that will determine the biggest part of agriculture to become private, except for some state farms that will work as companies on shares;
- restructuring of the economy by reducing the energy-intensive and pollutant branches (metallurgy, chemistry, building materials) and developing some traditional sectors which have favourable conditions in Romania, such as: agriculture, food and light industries (textiles, clothes, leather, footwear), tourism, etc.
- developing the transport and telecommunications infrastructure.

As far as the energy development is concerned, the main targets are:

- increase of primary energy production by improving the extracting technologies;
- rehabilitation of existing power plants;
- the increase of annual average generation capabilities of some hydro power plants;
- initiating a coherent campaign of energy saving.

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Chapter 3

DEFINITION OF SCENARIOS OF DEVELOPMENT

3.1 General Background

The analyses carried out by means of the MAED model assume the description of functional relationships between the energy system and the socioeconomic system. It is also important to have in view the influences on the national economy induced by the foreign economic background: the fluctuation of international energy prices, the evolution of foreign trade, the country relations with other countries, access to modern technologies, etc.

As it was mentioned in section 1.3.1 the MAED model has been conceived for the analysis and forecast of the medium to long term demand for energy by economic sector and industry subsector, as well as by categories of end uses of final energy.

In order to understand the energy consumption mechanism the first step was to select a base year, for which the energy consumption by economic sector and by categories of final uses was to be reconstructed using the MAED model. In a second step, several probable socioeconomic, technological and demographic development scenarios of Romania were constructed and the corresponding demand of energy was estimated.

In the MAED methodology, a scenario means a set of coherent evolutions of the parameters related to the socioeconomic, technological and demographic development of the country. Out of the multitude of scenarios analyzed during the ENPP study, three scenarios have been retained for the study: a low (pessimistic) and a high (optimistic), practically covering extreme possible situations of Romania, and one medium (basic) scenario, representing a somewhat intermediate evolution.

Details concerning the reconstruction of the energy consumption for the base year and the input data related to the three scenarios are presented in Appendices A and B.

3.2 Reconstruction of the Base Year of the Study

The application of the MAED model requires, at a first stage, the selection of a base year of the study, chosen among the recent past years, and which is considered to be representative of the economic and energy background of the country.

At the outset of the ENPP study in 1991, it was decided to select the year 1989 as a base year for which the National Commission for Statistics had published the two yearly statistics reports, namely:

- Romanian Statistical Yearbook related to the economic activity and demographic information necessary for the study;

- The energy balance and the structure of the energetic equipment, regarding the energy consumption on economic sectors and subsectors.

Additionally, 1989 was the last year with a certain economic stability within the planned economy system that prevailed in the country for many years, and that was followed

by the complex process of the transition period towards market economy. Although energy and economic statistics for 1990 were also available, they were considered not to be representative for future energy forecasting in the light of the rapid changes in the old structures and relations between the energy and socioeconomic systems.

It was considered as very important for the ENPP study to start from a quite stable base year, taking into account that the changes induced by the transition period should be modelled within the development scenarios.

After the selection of the base year, the statistical data for this year were restructured in order to meet the MAED model requirements. In the process, it was also necessary to make intermediate calculations and hypotheses in order to make up for the lack of some statistic data. Details are given in Appendix A. Tables 3.1 and 3.2 present the regrouping of Romania's economic sectors according to the requirements of the MAED model related to the GDP formation and the final energy consumption, respectively. In addition, the forms of energy were grouped according to the following categories of final use:

- motor fuels;
- specific and thermal uses of electricity;
- fossil fuels direct use;
- centralised thermal energy generated both in cogeneration plants and thermal plants;
- special treatment: coke for the steel production, feedstock for the petrochemical industry and other industries;
- non-commercial fuels (vegetable waste, etc.).

Briefly speaking, reconstruction of the base year involves a quite long period since it requires carrying out the following activities:

- statistical data collection;
- reorganization of the statistical data according to the MAED requirements;
- intermediate calculations and hypotheses owing to lack of some statistical data;
- determination of the final energy for the base year using the MAED model and comparison of the results with the statistical consumptions;
- input data improvement and new iterations by means of MAED model until obtaining results similar to the true consumptions.

Details concerning the above-mentioned stages of the study are shown in the following sections.

3.2.1 GDP and Demography

The MAED model reflects the level of economic activity in terms of the total Gross Domestic Product (GDP) and of the GDP structure by economic sectors. Table 3.3 presents the GDP structure for base year of the study (1989).

Table 3.1 Regrouping of Romanian Economic Sectors According to the Structure of GDP Formation in the MAED Model

	Economic sector in the MAED model		Economic sector of the Romanian statistics
1.	Agriculture	1.	Agriculture and forestry
2.	Construction	2.	Construction
3.	Mining	3.	Extractive industries . coal, crude oil, natural gas . ferrous ore . non-ferrous ore
4.	Manufacturing	4.	Manufacturing industry
4.1	Basic materials		4.1.1 Ferrous metallurgy 4.1.2 Non-ferrous metallurgy 4.1.3 Chemistry 4.1.4 Building materials 4.1.5 Wood processing 4.1.6 Cellulose & paper
4.2	Machinery & equipment	4.2	Engineering & metal working
4.3	Non-durable goods		4.3.1 Glass, porcelain & ceramics 4.3.2 Light industry (textiles, clothes, leather, furs, footwear) 4.3.3 Food industry
4.4	Miscellaneous	4.4	Other branches of industry
5.	Energy	5.	Energy
6.	Transportation	6.	Transportation and telecommunications
7.	Services	7.1	Commerce
		7.2	Services
		7.3	Banking, financing
		7.4	Public administration

Table 3.2 Regrouping of Romanian Economic Sectors According to the Structure of Energy Consumption in the MAED Model

	Economic sector in the MAED model		Economic sector in the Romanian statistics
1	Agriculture	1	Agriculture and forestry
2	Construction	2	Construction
3	Mining	3	Extractive industries coal, crude oil, natural gas ferrous ore[1] non-ferrous ore[2]
4	Manufacturing	4	Manufacturing industry
4 1	Basic materials		4 1 1 Ferrous metallurgy[1] 4 1 2 Non-ferrous metallurgy[2] 4 1 3 Chemistry 4 1 4 Building materials 4 1 5 Wood processing 4 1 6 Cellulose & paper
4 2	Machinery & Equipment	4 2	Engineering & metal working
4 3	Non-durable goods		4 3 1 Glass, porcelain & ceramics 4 3 2 Light industry (textiles, clothes, leather, furs, footwear) 4 3 3 Food industry
4 4	Miscellaneous	4 4	Other branches of industry
5	Transportation	5	Transportation and telecomms
6	Services	6 1 6 2	Public administration Other sectors Commerce, Services, Banking, Financing, etc
7	Households	7	Residential

Notes (1) The consumption for ferrous ore extraction was estimated and deducted from the total consumption in ferrous metallurgy

(2) The consumption for non-ferrous ore extraction was estimated and deducted from the total consumption in non-ferrous metallurgy

Table 3.3 GDP Formation in the Base Year (1989)

Sector	GDP		Growth rate[1] (%)	Share (%)
	10^9 lei	10^9 US$		
1. Agriculture & forestry	110.9	6.34	- 3.1	13.9
2. Construction	50.6	2.89	-14.7	6.3
3. Mining	26.2	1.50	- 3.3	3.3
4. Manufacturing	348.5	19.91	- 7.6	43.7
4.1. Basic materials	118.6	6.78	- 7.6	34.0[2]
4.2. Machinery & equipment	114.1	6.52	-11.1	32.8[2]
4.3. Non-durable goods	106.3	6.07	- 3.1	30.5[2]
4.4. Miscellaneous	9.5	0.54	-10.4	2.7[2]
5. Energy	47.2	2.70	- 7.3	5.9
6. Transportation & telecomms.	60.0	3.43	1.0	7.5
7. Services	154.6	8.83	- 2.4	19.4
TOTAL	798.0	45.60		100.0

Source: National Commission for Statistics

Notes: (1) Relative to the 1988 GDP
(2) Relative to Total Manufacturing
(3) 1989 constant prices, exchange rate 17.5 lei/US $

The demographic information for the base year is given in Table 3.4, listing all demographic parameters requested by the MAED model.

Table 3.4 Demographic Indicators for the Base Year (1989)

Parameter	Unit	Statistic	Growth rate[1] (%)	Share[2] (%)
Total population	million	23.152	0.43	-
Urban population	million	12.312	2.93	53.2
Rural population	million	10.840	-2.27	46.8
Population living in large cities[3]	million	11.835	-	51.1
Potential labour force[4]	million	15.275	1.03	66.0
Labour force actually working	million	10.846	1.30	47.3
Number of dwellings	million	7.96	0.56	-
Household size	pers/dwel	2.91	-	-

Source: National Commission for Statistics
Notes: (1) Relative to 1988
(2) Relative to Total population
(3) More than 20,000 inhabitants
(4) In age of 15-64 years

3.2.2 Final Energy Consumption in the Base Year

Figure 3.1 shows Romania's energy balance in 1989. The final energy consumption and its distribution by sectors and energy forms are presented in Table 3.5 for the original data existing in the statistics of the NCS, while Table 3.6 shows the same information, but reorganized according to the MAED model requirements. Details concerning the reorganization of the statistical information for making them compatible with the MAED model input data are given in Appendix A.

According to Table 3.6 the total commercial final energy consumption in 1989 was 78.143 million tons coal equivalent (Mtce), out of which a very large share (71.3%) belonged to the Manufacturing industry, specially, Basic materials (56.8%).

The distribution of the final energy consumption in the base year by energy forms was as follows: fossil fuels direct use represented 20.766 Mtce (29.2% of the total consumption), centralized thermal energy 19.245 Mtce (27.0%), while motor fuels and electricity for specific uses had quite low shares, 9.5% and 10.1% respectively.

3.2.3 Energy Consumption by Sector

3.2.3.1 Agriculture, Construction and Mining Sectors

In 1989 the Agriculture sector consumed 3.110 Mtce, namely 4.4% of the total final energy consumption of Romania. This consumption consisted in motor fuels (54.5%), electricity for specific uses (16.5%), fossil fuels direct use (4.0%) and centralized thermal energy (25.0%).

Since the MAED model allows centralized thermal energy only in certain sectors (e.g. Manufacturing industry, Services and Household), in order not to alter the total consumption of the Agriculture, Construction and Mining sectors, the centralized thermal energy consumed by these sectors was considered as part of the direct use of fossil fuels.

Construction sector consumed 1.351 Mtce representing 1.9% of the total final energy consumption of Romania, distributed among motor fuels (60.2%), electricity (13.8%), fossil fuels (11.4%) and thermal energy (14.6%).

The Mining Sector consumption in 1989 was 2.232 Mtce representing 3.1% of the total final energy consumption. It consisted of motor fuels (8.4%), electricity (30.4%) fossil fuels direct use (25.3%) and thermal energy (35.9%).

3.2.3.2 Manufacturing Sector

In 1989 the energy consumption of this sector was 50.750 Mtce representing 71.3% of Romania's commercial final energy consumption. The distribution by energy forms was the following: motor fuels (1.7%), electricity (11.2%), fossil fuels direct use (26.4%), centralized thermal energy (29.0%), coke (11.2%) and feedstock (20.5%).

The Basic Materials subsector consumed 40.420 Mtce, representing 79.6% of the sector total consumption and 56.8% of Romania's commercial final energy consumption. This subsector consumption consists in : motor fuels (0.7%), electricity (9.7%) fossil fuels direct use (24.5%), centralized thermal energy (26.3%), coke (14.1%) and raw material (24.7%).

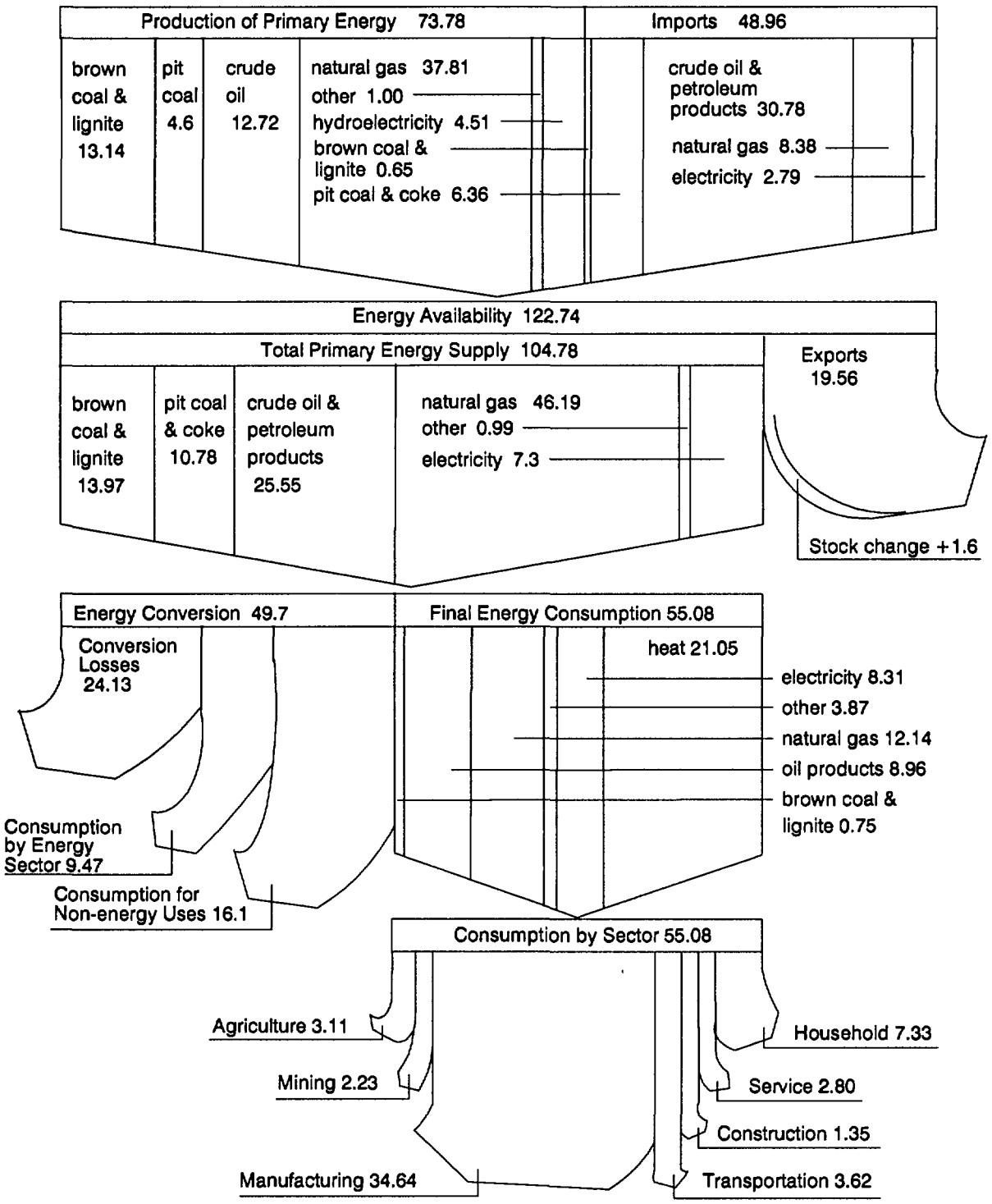


Figure 3.1 Energy Flow Chart of Romania (1989)

It should be noticed the big shares of some of the categories of end use, including: feedstock consumed by the chemical industry; thermal energy under the form of steam and process heat consumed by the chemical, metallurgical, cellulose and paper industries; direct use of fossil fuels in metallurgy, building materials industry and chemistry; coke consumption for steel production; as well as the low share of electricity consumption.

Table 3.5 Actual 1989 Statistics on Final Energy Consumption

Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total (Ktce)
	Hard coal	Lignite & brown coal	Coke	Fire wood & other	Total	Gasol	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	
1 Agriculture and forestry	4 9	26 5		98 8	130 2	19 4	1622 2	1 4	1 4	1644 4	41 8	0 7	42 5	1817 1	4169	513	5462	780	3110 1
2 Construction	1 0	3 6	0 3	74 2	79 1	18 6	787 7	6 5	0 3	813 1	74 3	0 1	74 4	966 6	1511	186	1383	198	1360 6
3 Industry	70 7	186 1	6340 2	1745 8	8342 8	1371 0	1122 1	918 6	469 6	3881 3	16627 6	2239 5	18867 1	31091 2	51717	6361	108712	15530	52982 2
3 1 Extractive industry		8 7		0 6	9 3	2 7	205 5	0 7	66 4	275 3	410 3	270 0	680 3	964 9	4217	519	5237	748	2231 9
3 2 Ferrous metallurgy[1]	4 5	0 2	5699 6	165 8	5870 1	0 6	46 4	188 9	1 3	237 2	3397 8	464 8	3862 6	9969 9	9018	1109	8732	1247	12325 9
3 3 Non ferrous metallurgy[2]	0 4	0 3	72 8	6 2	79 7	2 2	60 1	136 1	1 4	199 8	289 7	0 1	289 8	569 3	6297	775	3390	484	1828 3
3 4 Chemistry	0 3	4 3	270 9	705 3	980 8	1302 6	128 3	99 3	273 3	1803 5	7761 4	1001 6	8763 0	11547 3	12267	1509	46858	6694	19750 3
3 5 Building materials	56 1	23 5	27 1	230 4	337 1	1 9	112 5	373 6	6 3	494 3	1827 5		1827 5	2658 9	2676	329	2517	359	3346 9
3 6 Wood working	0 6	2 7	0 3	21 2	24 8	12 2	63 9	17 1	4 4	97 6	66 0		66 0	188 4	1154	142	5409	773	1103 4
3 7 Cellulose & paper		0 1		2 5	2 6	0 3	6 3	2 0	0 3	8 9	44 5		44 5	56 0	1709	210	7754	1108	1374 0
3 8 Engineering & metal working	5 3	98 7	143 0	110 7	357 7	19 7	151 0	35 6	37 6	243 9	1339 7	502 5	1842 2	2443 8	8808	1083	11240	1606	5132 8
3 9 Glass porcelain ceramics	0 5	1 1	0 5	2 3	4 4	0 8	6 0		10 8	17 6	903 6	0 1	903 7	925 7	360	44	393	56	1025 7
3 10 Light industry	0 1	6 1	0 1	5 9	12 2	8 3	15 6	1 8	13 0	38 7	52 2		52 2	103 1	1863	229	6340	906	1238 1
3 11 Food industry	0 7	30 3	65 9	47 9	144 8	17 5	271 3	56 2	48 4	393 4	261 9	0 4	262 3	800 5	1743	214	9934	1419	2433 5
3 12 Other branches of industry	2 2	10 1	60 0	447 0	519 38	2 2	55 2	7 3	6 4	71 1	273 0		273 0	863 4	1605	198	908	130	1191 4
4 Transportation and telecomms	14 9	9 8		23 7	48 4	63 4	1188 4	624 6	361 7	2238 1	12 2	294 0	306 2	2592 7	2921	359	767	110	3061 7
5 Services	2 9	85 8	0 2	215 4	304 3	62 3	272 4	5 2	28 0	367 9	217 8	328 8	546 6	1218 8	2932	361	7751	1107	2686 8
6 Households	25 0	419 4		819 3	1263 7	645 6	22 8		98 5	766 9	1725 6	417 2	2142 8	4173 4	4296	528	23097	3300	8001 4
Grand Total	119 4	731 2	6340 7	2977 2	10168 5	2180 3	5015 6	1556 3	959 5	9711 7	18699 3	3280 3	21979 6	41859 8	67546	8308	147172	21025	71192 8

Source National Commission for Statistics

Note (1) Including mining of ferrous ores

(2) Including mining of non-ferrous ores

Table 3.6 Final Energy Consumption in the Base Year (1989) According to the MAED Model Requirements

Sectors	Motor fuels		Electricity, specific uses	Thermal uses						Coal, specific uses		Feed-stock	TOTAL Commercial Final Energy		Non-commercial fuels	Non-supplied Energy	GRAND TOTAL[1]
				Fossil, direct use		District heating	Electricity		Total	Trains	Coke						
	Mtce	Pcal	TWh	Mtce	Pcal	Pcal	TWh	Pcal	Pcal	Mtce	Mtce	Mtce	Mtce	%	Mtce	Mtce	Mtce
Agriculture	1 694	11 858	4 169	0 903	6 323	-	-	-	6 323	-	-	-	3 110	4 4	-	-	3 110
Construction	0 813	5 691	1 511	0 352	2 461	-	-	-	2 461	-	-	-	1 351	1 9	-	-	1 351
Mining	0 187	1 309	5 512	1 367	9 572	-	-	-	9 572	-	-	-	2 232	3 1	-	-	2 232
Manufacturing	0 838	5 866	37 505	13 422	93 954	103 095	8 700	7 482	204 531	-	5 702	10 377	50 750	71 3	-	-	50 750
- Basic Materials	0 292	2 044	25 826	9 914	69 398	74 280	6 000	5 160	148 838	-	5 702	9 986	40 420	56 8	-	-	40 420
- Machinery & Equipment	0 171	1 197	7 208	1 720	12 040	11 240	1 600	1 376	24 656	-	-	0 015	4 595	6 5	-	-	4 595
- Non-durable goods	0 319	2 233	3 166	1 528	10 696	16 667	0 800	0 688	28 051	-	-	-	4 715	6 6	-	-	4 715
- Miscellaneous	0 056	0 392	1 305	0 260	1 820	0 908	0 300	0 258	2 986	-	-	0 376	1 020	1 4	-	-	1 020
Transportation	3 228	22 596	2 921	-	-	-	-	-	-	0 035	-	-	3 622	5 1	-	-	3 622
Service	-	-	2 844	1 217	8 519	8 518	0 088	0 076	17 113	-	-	-	2 795	3 9	-	0 700	3 495
Household	-	-	3 928	3 505	24 535	23 097	0 368	0 316	47 948	-	-	-	7 333	10 3	2 550	3 700	13 583
TOTAL	6 760	47 320	58 390	20 766	145 364	134 710	9 156	7 874	287 948	0 035	5 702	10 377	71 193	100 0	2 550	4 400	78 143

Note (1) Unit conversion 1 Mtce = 7 0 Pcal
1 TWh = 0 86 Pcal
1 TWh = 0 123 Mtce

The Machinery and Equipment subsector had a consumption of 4.595 Mtce, namely 9.1% of the total consumption of the Manufacturing industry sector and 6.5% of Romania's commercial final energy consumption. This was distributed as follows: motor fuels (3.7%), electricity (23.6%), fossil fuels direct use (37.4%), centralized thermal energy (35.0%) and feedstock (0.3%).

The Non-durable goods subsector consumed 4.715 Mtce, namely 9.3% of the total consumption of the Manufacturing industry and 6.6% of Romania's commercial final energy consumption. This consumption consisted in: motor fuels (6.8%), electricity (10.3%), fossil fuels direct use (32.4%) and centralized thermal energy (50.5%). It should be noticed the high share of the thermal energy consumed by the food and light industries and the fossil fuels direct use in the glass, porcelain and ceramic industry, as well as the food industry.

The Miscellaneous subsector consumed 1.020 Mtce, representing 2.0% of the total consumption of the Manufacturing industry and 1.4% of Romania's commercial final energy consumption. This one consists in motor fuels (5.5%) electricity (19.4%), fossil fuels direct use (25.5%), centralized thermal energy (12.7%) and feedstock (36.9%).

3.2.3.3 Transportation Sector

The energy consumption of this sector in 1989 was of 3.622 Mtce, representing 5.1% of the total commercial final energy consumption and mainly consisting in: motor fuels (89.1%) for road transport, diesel railways and ship, electricity (9.9%) for electric railway transport as well as subway, tram and trolley-bus public transport in cities, a very low amount of coal (1.0%) for manipulating locomotive engines in the railways depots and on some isolated mountain rails.

An important observation to be made concerning the consumption of the transport sector is that this includes motor fuel consumption of the population, which in 1989, was rationed as a result of restrictions imposed by the shortage of motor fuels for intercity and intracity passenger transport at the national level.

3.2.3.4 Service Sector

In 1989 the service sector consumed 2.795 Mtce, namely 3.9% of the total commercial final energy consumption, consisting in: electricity (12.9%), fossil fuels direct use (43.5%) and thermal energy (43.6%). It should be noticed the high share of fossil fuels direct use and centralized thermal energy for space heating, hot water and cooking in hospitals, hotels, restaurants and other services, as well as the low share of electricity.

3.2.3.5 Household Sector

The Household Sector consumed in the base year 7.333 Mtce, representing 10.3% of Romania's final energy consumption. This was derived into electricity (7.3%), fossil fuels direct use (47.7%), centralized thermal energy (45.0%).

It should be emphasized that these consumptions were reached in a period of energy shortage for Romania, when thermal energy was delivered in insufficient amounts, fossil fuels were hardly available, and electricity supply, especially for the population and services was often cut off. This determined that the normal conditions of population's energy comfort could not be achieved in that year. The non-supplied energy is estimated to about 23% in the Service

sector and to about 29% in the Household sector against the achieved consumption. This fact was taken into account during the reconstruction of the base year consumption by means of the MAED model and in the preparation of future scenarios.

3.2.4 Comparison of the Base Year consumption with the MAED Results

Based on the existing statistical data for the base year, the values of the MAED model input parameters were determined and the demand for final energy was estimated, using the model.

In order to obtain results similar to the statistical consumptions by economic sectors and energy forms, a few iterations were necessary, along which the input data of the model were gradually improved. Thus, at the end of this process of the base year input data validation, the MAED results were very close to the statistical consumptions (see Table 3.7).

3.2.5 Concluding Remarks

During the reconstruction of the base year consumption some difficulties occurred in adjusting statistical information in order to make them compatible with the requirements of the MAED model. These problems are related to:

- lack of some statistical data: GDP formation by industrial branches; breakdown by end-uses of some energy consumptions; efficiencies and useful energy consumption; breakdown of heat by temperature ranges in Manufacturing sector; distribution of energy consumption of the Transportation sector and of the volume of urban transportation by modes of transport, etc;
- compatibility of the available statistical data with the requirements of the MAED model, which required the transfer of some consumptions from one sector to another, i.e.: motor fuels from Services and Household sectors to Transportation sector and thermal uses from Transportation sector to Services;
- limits of the MAED model emphasized by Romania's particular condition within the study period: negative economic growth at the beginning of the period and the hope for an economic reactivation during the second part of the period; a big share of the thermal energy generated in cogeneration plants and thermal plants and also utilized in sectors like Agriculture, Construction and Mining for which the model does not allow such form of energy; and calculation of some requirements by a linear relation dependent on GDP, which is applicable to the steel production, feedstock consumption in petrochemical industry and the volume of freight transport; the model allows a unique value for the whole Manufacturing sector of the energy intensities by end-uses (motor fuels, specific uses of electricity, thermal uses), although from the point of view of GDP structure the same sector can be divided into four subsectors.

3.3 Scenario Selection and Definition

3.3.1 Scenario Approach and Selection of Intermediate Years

The MAED model requires the determination of the future evolution of all parameters affecting the various categories of energy demand, e.g.

Table 3.7 Verification of Base Year Final Energy Consumption with MAED Results

Unit Mtce

Sector	Energy form	Statistics[2]	MAED Results	Difference	
				Mtce	(%)
Agriculture	Motor fuels	1 694	1 696	0 002	0 118
	Electricity	0 513	0 513	-	-
	Fossil,direct use	0 903	0 904	0 001	0 110
	Subtotal	3 110	3 113	0 003	0 096
Construction	Motor fuels	0 813	0 814	0 001	0 123
	Electricity	0 186	0 186	-	-
	Fossil,direct use	0 352	0 352	-	-
	Subtotal	1 351	1 352	0 001	0 074
Mining	Motor fuels	0 187	0 187	-	-
	Electricity	0 678	0 678	-	-
	Fossil,direct use	1 367	1 369	0 002	0 146
	Subtotal	2 232	2 234	0 002	0 090
Manufacturing	Motor fuels	0 838	0 838	-	-
	Electricity	5 683	5 677	-0 006	-0 106
	Fossil,direct use	13 422	13 419	-0 003	-0 022
	Centralized heat	14 728	14 727	-0 001	-0 007
	Mettal coke	5 702	4 702	-	-
	Feed stocks	10 377	10 377	-	-
	Subtotal	50 750	50 740	-0 010	-0 020
Transportation	Motor fuels	3 228	3 226	-0 002	-0 062
	Electricity	0 359	0 356	-0 003	-0 834
	Steam coal	0 035	0 035	-	-
	Subtotal	3 622	3 617	-0 005	-0 138
Services	Fossil,direct use	1 217	1 217	-	-
	Centralized heat	1 217	1 188	-0 029	-2 383
	Electricity	0 361	0 361	-	-
	Non-supplied energy	0 700	0 712	-0 012	1 714
	Subtotal	3 495	3 478	-0 017	-0 486
Household	Fossil,direct use	3 505	3 505	-	-
	Centralized heat	3 300	3 328	0 028	0 848
	Electricity	0 528	0 528	-	-
	Non-commercial	2 550	2 550	-	-
	Non-supplied energy	3 700	3 728	0 028	0 757
	Subtotal	13 583	13 639	0 056	0 412
Total	Motor fuels	6 760	6 671	0 001	0 015
	Electricity	8 308	8 299	-0 009	0 108
	Fossil,direct use	20 766	20 766	-	-
	Centralized heat	19 245	19 243	-0 002	-0 010
	Coal,specific uses[1]	5 737	5 737	-	-
	Feed stocks	10 377	10 377	-	-
	Non-commercial	2 550	2 550	-	-
	Non-supplied energy	4 400	4 440	0 040	0 909
	Grand Total	78 143	78 173	0 030	0 038

Note (1) Metallic coke + Steam coal
(2) Processed statistics

- GDP level and structure;
- improvement in energy efficiency;
- market penetration of competing energy forms;
- total population and its distribution;
- population's living standard, etc.

While establishing the development scenarios for Romania a proper consideration was paid to the following aspects:

- the major government objectives discussed in section 2.7;
- the conclusions drawn from the comparison of the past and the present background of Romania's main macroeconomic and energy parameters and those of other countries (see sections 2.2, 2.3, 2.5).

The most important determinants of the energy demand that can be reflected in the MAED model, are indicated in Table 3.8.

As far as the study period is concerned, a range of about 20 years has been considered sufficient for determining the energy demand and the supply strategy, under the present conditions in the country.

The selection of intermediate years was made so that they should identify with those currently used in planning studies in the country. The study period was, in this respect, selected between 1989-2010, with the intermediate reference years: 1992, 1995, 2000 and 2005.

3.3.2 Major Policy Issues

3.3.2.1 Economic Growth

In the field of economic growth the following assumptions where taken into consideration:

a) The speed and the manner the country will move through the transition period leading to a market economy;

b) Increase of the national production of goods to satisfy the domestic demand and possible exports markets;

c) Investments stimulation;

d) Romania's integration in the European and world economy;

e) Incorporation of environmental issues in energy and electricity planning with the view of reducing the border to the environment.

Table 3.8 Main Factors Affecting the Energy Demand in MAED Model

Category	Factors
1. Macroeconomics	Total GDP GDP structure by economic sectors
2. Demography	Total population Distribution in rural/urban/large cities Total labour force Household size(inhabitants/household)
3. Consumption sector	
3.1 Industry	Specific energy intensity for each category of end-use Improvement of efficiency Electricity penetration into heat market
3.2 Transportation	Volume of freight and passenger transportation Distribution of freight and passenger transportation Specific energy consumption and load factor of each mode of transport
3.3 Service	Sector labour force Floor area Specific energy consumption by end-use category - Space and water heating; - Electrical appliances; - Air conditioning. Electricity penetration
3.4 Household	Type, size and share of dwellings: - single family house, apartment, room; - demolition rate; - share of dwellings with hot water facilities; - share of dwellings with air-conditioning; - improvement of insulation; - electrical appliances endowing.

3.3.2.2 Population

a) Providing decent living to the population;

b) Improvement of the social system;

3.3.2.3 Industry

a) Re-adjustment of the production rough processing industry (especially metallurgy, chemistry, heavy equipment engineering);

b) Development of industries with high values added;

c) Reduction of the energy and materials intensities;

d) Technological upgrading by combining rehabilitation of existing equipment and introducing new technologies.

3.3.2.4 Transportation

a) Reduction of subsidies and stimulation of the use of efficient transportation modes both for passenger and freight transportation;

b) Transportation upgrading by rehabilitation of existing infrastructure (road, railway and sea transport) and extension of this infrastructure;

3.3.2.5 Agriculture

a) Implementation of the land law;

b) Development of agricultural outputs that might meet domestic demand and create availabilities for export.

3.3.2.6 Household/Service

a) Providing decent energy comfort levels for both urban and rural areas;

b) Reduction of pollution in urban areas;

c) Significant increase of electrical appliance ownerships;

d) Development of the services sector by extending the existing ones and meeting the request of new services due to the development of commerce, banking activities, communications, etc.

3.3.3 Basic Assumptions

3.3.3.1 International Considerations

Romania's economic development will depend on the rate and extension of its integration into European and Euro-Asian economic organizations, such as the European Community, the Black Sea River-Side States Community, etc.

It will also depend on the foreign capital participation in the reconstruction of the Romanian economy which finally, will be conditioned by the internal stability.

Both from the economic and the energy point of view, international economic and political stability will favour Romania's normal development.

The Gulf war, the Yugoslavia's crisis together with the economic embargoes accompanying them, had a negative impact on Romania's economic development.

A concrete manifestation of prognoses as far as the gradual increase of oil price is concerned, the following couple of years, will have a negative impact on Romania's commerce.

Romania's economy being dependent upon the oil imports, will have to strive to adapt to the new prices

At present Romania exports agricultural products, machines, equipments, wooden products, textiles and other consumption goods Tourism development is forecast in the future, with small investments Concerning exports, these may reduce considerably by increasing energy utilization efficiency in all sectors Besides energy, Romania will import raw materials for supporting the output of rehabilitated companies and the new ones which will be established in different sectors

3.3.3.2 Economic Growth

a) Stopping the economic decline through 1993-1994, followed then by economic upsurge with an average annual rates of 3-5% ,

b) Gradual change of the GDP structure by reducing the share of Industry and increasing the share of Agriculture, Services and Transports,

c) Gradual reducing of subsidies for raw materials and fuels,as well as and for a range of services and products,

d) Utilization of foreign resources, especially for investments leading to the economy upgrading,

e) Increase of labour productivity in all sectors

The distribution of GDP by kind of economic activity is presented in Table 3 9 The future evolution of this structure relies on the following assumptions

- agriculture's contribution to total GDP will increase from 13 9% in 1989 to 21% in 2010 as a result of the new land law, of utilisation of modern technologies and the increase of mechanization
- the construction sector share will slightly decrease throughout the study period from 6 34% in 1989 to 4 5% in the year 2010 due to the diminishing of new investments which is not compensated and the increase of rehabilitation and modernization of old buildings
- the mining sector participation in GDP is foreseen to increase in 1992 to 4 2% against 3 28% in 1989 and then to slightly decrease to 3 5% in 2010 This sector will reduce its activity as some inefficient mines will be closed down and some ores will be exhausted
- the manufacturing sector is expected to play an important effect in the economy both by reducing its share in GDP to 38% in 2010 (against 43 67% in 1989) and by the expected changes in the structure of the value added of this sector As to the manufacturing's structure, the share of basic materials industries will decrease from 34% in 1989 to 31% in 2010, the share of Non-durable goods industries will increase from 30 5% in 1989 to 33 3% in 2010 and the machinery & equipment industries will remain constant to around 32% rate
- the share of services sector is forecast to grow from 26 9% (as it was achieved in 1989) to 29 5% in 2010 due to the development of both existing and new categories of services

Table 3.9 Share of Sectorial GDP - All Scenarios

Unit: %

	1989	1992	1995	2000	2005	2010
Total GDP	100.00	100.0	100.0	100.0	100.0	100.0
Agriculture	13.90	18.7	19.5	20.4	20.8	21.0
Construction	6.34	5.7	5.5	5.0	4.8	4.5
Mining	3.28	4.2	4.1	4.0	3.8	3.5
Manufacturing	43.67	38.2	38.0	38.0	38.0	38.0
of which:						
-Basic Materials	34.03	32.5	32.3	32.0	31.5	31.0
-Machinery and Equipment	32.74	31.5	31.7	32.0	32.0	32.0
-Non-durable Goods	30.50	32.3	32.3	32.3	32.8	33.3
-Miscellaneous	2.73	3.7	3.7	3.7	3.7	3.7
Energy	5.91	5.0	4.5	4.0	35.0	35.0
Services	26.90	28.2	28.4	28.6	29.1	29.5

3.3.3.3 Population

a) A stop in the decreasing trend in the next 1-2 years followed by a moderate increase similar to that in west European countries.

b) Development of small and medium-sized towns by developing small industry, services and tourism.

c) Development of rural settlements due to the land law (in force) and reduction of the migration rate from villages to towns.

d) Due to recession and economy adjustment it is estimated an increase of the unemployment until 1992-1993 and then its gradual reduction until 2010.

Romania's population is foreseen to grow from 23.152 million inhabitants in 1989 to 24.410 million inhabitants in 2010 with an average annual rate of about 0.25%, lower than 0.44% that registered between 1980-1989 (see Table 2.1).

The elements regarding the overall evolution of population on both urban and rural area within the study period, are presented in Table 3.10.

Urban population will further increase, reaching 16.857 million inhabitants in 2010 against 12.312 million in 1989 while the rural population will continue to decrease reaching 7.553 million inhabitants in 2010 against 10.840 millions inhabitants in 1989. In the year 2010 about 69% of Romania's population will live in urban areas against 53% in 1989. The urban population average growth rate would be 1.5% only against the 2% registered the latest 10 years. This is due both to economic adjustment characteristic of this period and to the impact of the land law on diminishing the migration rate from villages to towns until the year 2000. Population in the large cities will grow from 11.835 million inhabitants in 1989 to 14.524 million inhabitants in 2010 with an average annual rate of 1.0%, lower than that experienced

Table 3.10 Population Growth Forecast for All Scenarios

Unit million persons

Year	Total	Annual growth rate (%)	Urban	Annual growth rate (%)	Share[1] (%)	Large cities[2] (%)	Share[1] (%)	Rural	Annual growth rate (%)	Share[1] (%)	Population living outside large cities (%)	Household size (inh/dw)
1989	23 152		12 312	--	53 2	11 835	51 1	10 840		46 8	48 9	2 910
1992	23 256	0 15	12 791	1 30	55 0	12 236	53 0	10 465	-1 17	45 0	47 0	2 880
1995	23 400	0 20	13 289	1 30	56 8	12 800	54 7	10 111	-1 14	43 2	45 8	2 850
2000	23 690	0 25	14 246	1 40	60 1	13 361	56 4	9 444	-1 40	39 9	43 6	2 820
2005	24 050	0 30	15 423	1 60	64 1	13 950	58 0	8 627	-1 80	35 9	42 0	2 800
2010	24 410	0 30	16 857	1 80	69 1	14 524	59 5	7 553	-2 60	30 9	40 5	2 785

Source National Commission for Statistics for 1989-1991
ISPE and INCE for 1992-2010 forecast

Note (1) Relative to Total population
(2) More than 20000 inhabitants

the last 10 years (2 2%) as a consequence of the policy of developing small industry, tourism, handicraft industries etc in the small and mid-sized towns

The household size, expressed by the number of persons per dwelling, will slightly decrease from 2 91% (in 1989) to about 2 8% in the year 2010 due to the decreasing trend of demographic growth

As far as potential labour force is concerned (population between 15 and 64 years old) an average annual growth rate of 0 25% is foreseen, meaning a growth from 15 275 million persons in 1989 to 16 111 million people in 2010

The fraction of potential labour force actually working is estimated to decrease from 71 7% in 1989 to 66 9% in 1992 and to slightly increase up to 69 5% in 2010 (Table 3 11)

Table 3.11 Labour Force Forecast for All Scenarios

Population	U M	1989	1992	1995	2000	2005	2010
Total Labour Force (Age 15-64)	10^6 inh	15 275	15 349	15 444	15 635	15 873	16 111
Growth rate[1]	%		0 160	0 200	0 250	0 300	0 300
Actually Working Labour Force	10^6 inh	10 946	10 271	10 502	10 710	10 952	11 197
Growth rate[1]	%		-2 100	0 700	0 400	0 400	0 400
Labour force	%	71 700	66 900	68 000	68 500	69 000	69 500

Note [1] Average annual growth rate between reference years

3.3.3.4 Industry

a) Reduction of the share of some energy intensive and polluting industries in the Basic materials subsector, while increasing the share of Non-durable goods and Miscellaneous subsectors. Finally,the preservation of the share of Machinery and equipment subsector to such a rate that would allow, together with some imports, an adequate supply of equipment for the rest of the economy.

b) Improvement of the efficiency of energy and raw materials resources utilisation by selecting systems and introducing fiscal measures that might stimulate bridging the technological gap .

c) Increase of electricity penetration within the total energy consumption in industry.

3.3.3.5 Transportation

a) Development of the road network development by building up new highways;

b) Extension of the electric transportation for freight and passengers;

c) Restructuring of urban transportation in order to increase traffic fluency;

d) Increase of population mobility especially by increasing the share of private motor cars;

e) Increase of Constanţa harbour capacity and of the traffic on the Danube-Black Sea Canal by expanding harbour installations.

3.3.3.6 Household

a) Increase of centralized thermal energy share for space and water heating to the detriment of fossil fuels direct use;

b) Slight decrease of the number of persons living together in one dwelling (household size);

c) Increase of electricity consumption per dwelling due to the improvement of the ownership rate of electrical appliances;

d) Improvement of the thermal insulating rate both of the existing dwellings and of the new constructions;

e) Slight penetration of the electricity utilisation for both heating and air-conditioning purposes.

3.3.3.7 Service

a) Increase of the specific electricity consumption by improving the ownership ratio of electrical appliances;

b) Slight penetration of the air conditioning and electricity utilisation for space heating and hot water purposes.

3.3.4 Scenario Selection

At the moment when the present study was conducted no macroeconomic and technological medium and long run forecasts were available from the government For this reason a hierarchal analysis of the model parameters (sensitivity study) has been made in order to select some outstanding scenarios that should indicate the evolution trends of the energy demand

The analysis was based on determining the influence on the final energy demand of the GDP structure and the energy intensities In this respect, a so-called reference scenario has been conceived, where energy intensities of the basic year (1989) values were kept constant throughout the period 1989-2010

The influence of GDP structure upon the final energy demand has been studied taking into consideration the variation of either the share in GDP by economic branches (Manufacturing, Agriculture, Transportation, Services, etc) or the share of Basic Materials, Machinery and Equipment, Non-durable goods, Miscellaneous industries in the Manufacturing value added

The conclusions drawn out of these tests, are the following

- the increase of Manufacturing share lead to the reduction of Services and/or Agriculture share in GDP and increase of final energy demand of 1 36-1 46 mil tce per increasing percentage of the Manufacturing share against the reference variant

- increase of the share of Basic Materials in the manufacturing value added and the equivalent decrease of Machinery & Equipment and Miscellaneous industries against the reference variant lead to an increase of 1 3 mil tce per increasing percentage of Basic Materials share

- increase of the Non-durable goods and the equivalent decrease of the Machinery & equipments industries in the manufacturing value added does not lead to significant variations of the final energy demand against the reference variant

Therefore, as far as the evolution of the final energy demand is concerned, the share of Manufacturing within the total GDP and the share of Basic Materials industries in the Manufacturing value added will have a decisive influence

The influence of the variation of energy intensities against the reference variant has been determined separately for Agriculture, Manufacturing, Construction and Mining The conclusion of these tests are the following

- different rates of achieving the technological reform in agriculture do not considerably influence the total final energy demand

- Manufacturing rehabilitation and upgrading leads to reduction of up to 17% in the final energy demand against the reference variant

- variation of model parameters within transportation sector does not result on important variations of the final energy demand

After performing these sensitivity tests, three scenarios have been set up, namely :

- basic scenario (with moderately improved technologies);
- high scenario (with high technologies);
- low scenario (with slightly improved technologies).

3.3.5 General Description of the Scenarios

3.3.5.1 Basic Scenario (with moderately improved technologies)

This scenario is characterized by a moderate dynamics in achieving the goals of the reform, leading to effectively stopping of the output decline within the 1993-1994 period and the achievement of GDP average growth rate of about 4.2% through the 1992-2010 period. All fields of activity will be affected by a moderate process of rehabilitation and modernization determining the moderate increase of economic efficiency and the energy intensities cutting down.

The electricity penetration into manufacturing industries by means of new technologies will increase the electricity intensity in 2010, by 7% against the value reached in 1989. In addition, rehabilitation and modernization will determine the substitution of direct use of fossil fuels within the technological processes by thermal energy and/or electricity.

Freight and passengers transportation will be affected by structural changes imposed by economic adjustment and efficiency. The increase of the number of more efficient modes of transportation will reduce the specific consumption of motor fuels and electricity in the transportation sector.

The penetration of highly performant technologies in agriculture and animal farms will determine the increase of electricity intensities by 10% in 2010 against 1989.

As far as Household sector is concerned, the assumption was made that a normal comfort will be provided both in urban and rural areas. In the Services sector an increase of electricity demand has been assumed as a result of an increase in the use equipments and technologies. In both sectors, the centralized heat supply will continue to increase by improving the generating, transmission and measuring system. Finally, the penetration of electricity in thermal uses and air conditioning will be very low, even at the level of 2010, both for households and services.

3.3.5.2 Low Scenario (with slightly improved technologies)

This scenario is characterized by a lack of firmness in applying the reform, prolonging the period of production decline until 1994 and achieving a GDP average annual growth rate of 3,4% only within the 1992-2010 period. All fields of activity will be affected by a slow rehabilitating and modernization process determining a more reduced growth of economic and energy efficiency than in the Basic scenario.

Electricity penetration in industry will be reduced estimating that the effect of the increase of the energy efficiency will be compensated by the consumption growth through electricity penetration in industrial processes.

As to the freight and passengers transportation performance, the hypotheses of the Basic scenario are also valid for this scenario.

In agriculture a moderate rate of replacing the existing equipments with performant ones and a reduced rehabilitating and modernization of agricultural and animal farms has been assumed. Electricity penetration will determine the growth of electricity intensity by 7% in the year 2010 against 1989.

For the Household sector, the same hypotheses of the Basic scenario for the space heating are valid accompanied of a lower ownership level of electrical appliances. For the Services sector a lower growth of electricity consumption has been estimated, too, due to a slower modernization process. For both sectors, the penetration of electricity in thermal uses and air conditioning are kept at the same level as in the Basic scenario.

3.3.5.3 High Scenario (with high technologies)

The success of the High scenario is conditioned by the depth and the force of the reform implementation. The stopping of the output decline is estimated for 1993 and then, achieving average annual growth rates of GDP of about 5% between 1992-2010. The intense rehabilitation and modernization process occurring in all fields of activity will determine the growth of economic efficiency and the reduction of the energy intensities.

In this scenario the increase of electricity penetration will determine the growth of electricity intensities by 10% in 2010 against those performed in 1989. In addition, modern technologies penetration will determine an important reduction of the share of fossil fuels direct use in the total final energy demand.

Thermal energy (under the form of steam and hot water) will still occupy an important share in the total final energy demand, due to modernization and rehabilitating activities in the field of energy generation and distribution.

As to the transportation sector, the scenario retains the same hypotheses of the Basic scenario.

A significant growth of mechanization and the use of more efficient agricultural equipment, the improvement of the existing machines and an important growth of electricity penetration rate is expected in agriculture, by rehabilitating and modernization agricultural and animal farms. Therefore, the electricity intensity in agriculture is estimated to increase by 15% in 2010 against 1989.

For the Household and Services sectors the hypotheses of the Basic scenario are maintained as far as the energy demand for space heating and for hot water is concerned, while the specific electricity consumption will be higher than in the Basic scenario. Finally, for electricity penetration in thermal uses, the hypotheses of the basic scenario has been preserved both for the Services and Household sectors.

A more detailed description of the Basic scenario will be given in the following section, while the other two will be described in terms of their features. The details concerning input data for each scenario retained for the study are presented in Appendix B.

Table 3.12 GDP Growth Forecast
Basic Scenario

Year	Total GDP (10^9 US$ 1989)	Average annual growth rate (%)	Per capita GDP (US$ 1989/capita)
1989	45.6	-	1970
1992	31.3	-11.8	1346
1995	32.1	0.8	1372
2000	40.5	4.8	1710
2005	51.9	5.0	2158
2010	66.1	5.0	2708

3.4 Detailed Description of the Basic Scenario

3.4.1 GDP Growth

The Basic scenario considers that the GDP will continue to decrease in 1993. The GDP of 1993 will be 1% beyond the value estimated for 1992. In 1994 the GDP will experience a 1% increase against 1993 and in 1995 it will grow by 0.8% against 1994. For the study period an average annual growth rate of 5.0% is foreseen. The GDP projections until 2010 for the basic scenario are presented in Table 3.12.

3.4.2 Specific Energy Intensity in Industry

The assumed evolution of the final energy intensities in industry for the Basic scenario is presented in Table 3.13.

After 1995 the energy intensities in industry are expected to decrease due to two major factors:

- the structural adjustments of the industry;
- achievement of rehabilitation and new investments achievement with higher energy efficiency.

In 1990 and in 1991, although the production decreased almost in all sectors and some of the inefficient capacities were closed down, the energy intensities were close to those achieved in 1989 because of the operation under the nominal parameters.

Assuming that until 1995 large investments will not be made in order to determine major changes in the efficiency of industry, the energy intensities of various industrial sectors were maintained at the level achieved in 1989. Even in this hypothesis of minimal structural adjustment of manufacturing, it is to notice a reduction of the total energy intensity in all manufacturing.

o <u>Agriculture</u>

Motor fuels use is the main category of end-use of energy in the Agriculture sector. During the period 1989-2010 the specific energy intensity for motor fuels will increase with

Table 3.13 Summary of Final Energy Intensity in Industry
Basic Scenario

Unit: kWh/ US$

Sector	1989	1992	1995	2000	2005	2010
Agriculture:						
Total Final Energy Intensity	3.994	3.878	3.878	3.933	3.960	3.987
- Motor fuel	2.176	2.176	2.176	2.263	2.328	2.393
- Electr., specific uses	0.658	0.658	0.658	0.684	0.704	0.724
- Thermal uses	1.160	1.044	1.044	0.986	0.928	0.870
Construction						
Total Final Energy Intensity	3.801	3.801	3.801	3.607	3.469	3.362
- Motor fuel	2.288	2.288	2.288	2.197	2.128	2.060
- Electr., specific uses	0.523	0.523	0.523	0.539	0.549	0.560
- Thermal uses	0.990	0.990	0.990	0.871	0.792	0.742
Mining						
Total Final Energy Intensity	12.139	12.139	12.139	11.316	10.764	10.436
- Motor fuel	1.017	1.017	1.017	0.977	0.946	0.916
- Electr., specific uses	3.682	3.682	3.682	3.792	3.866	3.940
- Thermal uses	7.440	7.440	7.440	6.547	5.952	5.580
All Manufacturing						
Total Final Energy Intensity	14.168	13.851	13.804	12.215	11.018	10.274
- Motor fuel	0.343	0.350	0.350	0.336	0.326	0.315
- Electr., specific uses	1.883	1.844	1.839	1.885	1.905	1.923
- Thermal uses	11.942	11.657	11.615	9.994	8.787	8.036

an average annual growth rate of 0.45%. This is due to two contradicting causes; on the one hand, increase in the use of tractors and highly performant agricultural equipment that will replace part of the existing equipments and on the other hand, the increase of the use of agricultural equipment especially after 2000, meaning an increase of the mechanization rate aiming at replacing manpower in agriculture.

The specific energy intensity of electricity remains constant between 1989-1995, at the level of 0.658 kWh/US$, then, it will increase at 0.724 kWh/US$ in 2010, with an average annual growth rate of 0.6%, due to animal farm and irrigating systems rehabilitation and modernization.

As far as thermal uses are concerned, a continuous decrease of the energy intensity from 1.160 kWh/US$ in 1989 to 0.870 kWh/US$ in 2010, is foreseen meaning a decrease with an average annual rate of 1.4% mainly achievable by rehabilitating and modernization heating greenhouses as well as the animal units.

The total energy intensity in agriculture will remain almost constant throughout the study period, despite all structural changes that are taken into account.

o Construction

In this sector a reduction of the total energy intensity from 3.801 kWh/US$, in 1989 to 3.362 kWh/US$ in 2010 is foreseen. This reduction of 0.6% yearly will be achieved by upgrading technological processes, and increasing mechanization and labour productivity.

o Mining

The analyses concerning the efficiency of the mining sector foresee that the inefficient units should be gradually closed in the next ten years, while the modernization units should be brought to a proper mechanizing and fanning installations endowing.

Based on these assumptions, the total energy intensity of the sector is foreseen to diminish from 12.139 kWh/US$ in 1989 to 10.436 kWh/US$ in 2010.

o Manufacturing

Romanian manufacturing should face the market economy from the technological, productivity, efficiency point of view. In these respect several of studies have tried to determine the validity of industrial units and on this basis to project different strategies of the manufacturing structural adjustment. Among the hypotheses laying at the basis of these strategies it can be mentioned: the existing productive potential, the available investing resources, Romania's participation in the world division of labour, problems regarding manpower use as well as of professional reconversion, Romania's possible aligning duration to the European living standards, etc.

Within the basic scenario, it was taken into account a reduction of the total energy intensity with around 28% between 1989-2010 from 14.168 kWh/US$ as it was achieved in 1989, to 10.274 kWh/US$ in 2010 and the most important reduction will be achieved by the basic materials industry.

3.4.3 Energy Substitution in Industry

Regarding the electricity penetration into industrial processes it was considered its evolution will be very closely related to the modernization and rehabilitation process.

It was assumed that the rate of penetration of electricity into substitutable uses in industry is higher in the case of scenarios with a higher rate of growth of GDP. Table 3.14 presents the penetration of electricity within the Basic Scenario.

Electricity is forecast to penetrate into the market of high temperature or direct heating (a growth from 12.7% in 1989 to 15.0% in 2010) and the space heating and hot water (low temperature) beginning with the year 2000, reaching 1% in the year 2010.

By rehabilitation of the equipment in all sectors, important amounts of fuel for engines and fossil fuel will be substituted. It was estimated that electricity intensity will increase with 10% against the basic year, in Agriculture and with 7% in Constructions, Mining and Manufacturing.

3.4.4 Specific Energy Intensity in Transportation

Transportation sector consists of freight and passengers transportation. Synthetic elements concerning the specific energy intensity for freight transportation are presented in Table 3.15 and in Table 3.16 for the passenger transportation, while a more detailed presentation is included in Appendix B.

Table 3.14 Electricity Penetration in Industry - Basic Scenario

	1989	1992	1995	2000	2005	2010
Ratio of electricity intensity versus base year in:						
- Agriculture	1.000	1.000	1.000	1.040	1.070	1.100
- Construction	1.000	1.000	1.000	1.030	1.050	1.070
- Mining	1.000	1.000	1.000	1.030	1.050	1.070
- Manufacturing	1.000	1.000	1.000	1.030	1.050	1.070
Share of useful thermal energy which is supplied by electricity in Manufacturing for process:						
- Furnace/Direct Heat	0.127	0.127	0.127	0.130	0.140	0.150
- Space/Water Heating	0.000	0.000	0.000	0.001	0.005	0.010

Table 3.15 Activity Levels and Energy Intensities in Freight Transportation All Scenarios

	1989	1992	1995	2000	2005	2010
Total activity (%)	100.0	100.0	100.0	100.0	100.0	100.0
Truck	18.9	19.0	19.5	20.0	21.0	22.0
Local	80.6	80.6	80.6	80.8	81.3	81.3
Long-distance	19.4	19.4	19.4	19.2	18.7	18.7
Train	51.1	51.0	48.5	46.0	45.0	43.0
Steam	0.8	0.7	0.5	0.3	0.1	0.0
Diesel	59.2	57.3	55.5	53.7	51.9	50.0
Electric	40.0	42.0	44.0	46.0	48.0	50.0
Barge	28.5	25.8	28.0	30.0	30.0	31.0
Pipelines	4.2	4.2	4.0	4.0	4.0	4.0
Energy intensity(kWh/tkm)						
Truck						
Local	0.233	0.233	0.256	0.281	0.309	0.326
Long-distance	0.209	0.209	0.206	0.200	0.197	0.193
Train						
Steam	0.460	0.460	0.452	0.447	0.439	0.430
Diesel	0.124	0.124	0.122	0.121	0.119	0.116
Electric	0.057	0.057	0.056	0.056	0.055	0.053
Barge	0.047	0.047	0.046	0.045	0.045	0.043
Pipelines	0.047	0.047	0.047	0.047	0.047	0.047

Table 3.16 Activity Levels and Energy Intensity in Passenger Transportation All Scenarios

	1989	1992	1995	2000	2005	2010
Passenger transportation, intercity						
Total activity (%)	100.0	100.0	100.0	100.0	100.0	100.0
Car	8.6	9.3	10.0	11.2	12.3	13.5
Bus	33.8	32.9	32.3	31.5	30.7	29.8
Train	52.0	52.4	52.2	51.7	51.3	51.0
Steam	0.0	0.0	0.0	0.0	0.0	0.0
Diesel	50.0	49.0	47.0	46.0	43.0	40.0
Electric	50.0	51.0	53.0	54.0	57.0	60.0
Plane	5.6	5.5	5.5	5.6	5.7	5.6
Energy intensity (kWh/p-km)						
Car	0.264	0.264	0.257	0.247	0.231	0.198
Bus	0.086	0.086	0.082	0.079	0.075	0.074
Train						
Steam	0.387	0.387	0.385	0.377	0.371	0.351
Diesel	0.105	0.105	0.104	0.102	0.100	0.095
Electric	0.048	0.048	0.048	0.047	0.046	0.044
Plane	0.734	0.872	0.843	0.799	0.756	0.690
Passenger transportation, urban						
Total activity (%)	100.0	100.0	100.0	100.0	100.0	100.0
Car	19.0	19.0	20.0	22.0	24.0	28.0
Motor fuel	100.0	100.0	100.0	100.0	100.0	100.0
Electric	0.0	0.0	0.0	0.0	0.0	0.0
Mass transit	81.0	81.0	80.0	78.0	76.0	72.0
Motor fuel	60.0	60.0	59.0	57.0	55.0	53.0
Electric	40.0	40.0	41.0	43.0	45.0	47.0
Energy intensity (kWh/p-km)						
Car						
Motor fuel	0.593	0.593	0.593	0.568	0.544	0.494
Electric	0.000	0.000	0.000	0.000	0.000	0.000
Mass transit						
Motor fuel	0.052	0.052	0.053	0.052	0.053	0.054
Electric	0.026	0.026	0.026	0.026	0.026	0.026

a) Freight Transport

This includes transportation by trucks, trains, barges and pipeline transport. Romania is a country with a high transport rate, a consequence of the concentration of production in big industrial units mainly processing basic materials (steel, cement, refineries, etc.).

o Trucks

Transportation by the rationing of trucks decreased until 1989,due to restrictions related to fuels (motor fuels). By decreasing the fuels ration restrictions and the growing tendency of

the number of vehicles since 1991, it may be a foreseen a growth of the traffic the following years, especially for the short distance transport. It was estimated a growth of the share of trucks freight transportation from 18.9% as it was achieved in 1989, to 22% in 2010.

The small trucks performing local transports characterized by speed and promptness in carrying out less for the load factor. Their specific energy consumption will increase from 0.233 kWh/t-km as it was in 1989 to 0.326 kWh/t-km in 2010, while for the trucks performing long distance transport, a decrease of the specific consumption by 8% between 1989-2010, from 0.209 kWh/t-km to 0.193 kWh/t-km, has been estimated.

o Trains

At present, railway transports have been providing 50% of the freight transport. In the future, it was forecast a reduction of railway traffic correlated with the last years trends, attaining a share of only 43% of the total freight transportation in year 2010. Non-electrified railways will be decreasingly utilised while the electrified railways, with more reduced specific energy consumptions, will increase their share in the total amount of freight from about 20% in 1989 to 21.5% in 2010.

The specific energy consumption per transported ton-km is estimated to decrease for diesel freight trains from 0.124 kWh to 0.116 kWh and for electric trains from 0.057 kWh to 0.053 kWh through 1989-2010 period.

o Barges

The share of freight transports on river and sea is forecast to grow from about 25.8%, in 1989, to 31% in 2010. Due to the upgrading of Constanta harbour, the harbour installations utilisation factor will increase, creating the necessary facilities for handling some modern ships of great capacities.

Transport on the Danube river and the Black Sea Canal will increase by connecting it to the European sailing traffic circuit. The specific fuel consumption per transported ton-km is expected to decrease slowly, from 0.047 kWh in 1989 to 0.043 kWh in 2010.

o Pipeline

Pipelines are utilised for transport of crude oil, oil products and gas. It is forecast that this type of transport will maintain their the actual share in total transport of freight at about 4%, in the future as well as a specific consumption of 0.047 kWh/ton-km.

b) Passenger Transport

o Intercity Transport

In the case of intercity passengers transport it is estimated an increase of population mobility with about 1.1% yearly, through 1989-2010.

Taking into account the possibilities of extending facilities for passenger intercity transport, it was forecast to maintain both plane and train transport within the actual shares and to increase the share of the motor car transport from 8.6%, as it was in 1989, to 13.5% in 2010, to the detriment of the bus transport which will decrease its share from 33.8% in 1989 to

29.8% in 2010. Within the cost of the train transport, it is mentioned the increase of the share of electric trains transport from 50%, to 60% in 2010.

Regarding the specific energy consumptions it was forecast a moderate decrease by improving of the efficiency of the transport mode and their renewal with performant vehicles. It was also assumed the decrease of the average loading factor for both buses and trains by increasing their comfort rate. At the level of 2010, it is estimated an average energy specific consumption per passenger-km of 0.198 kWh for motorcars, 0.074 kWh for buses, 0.095 kWh and 0.044 kWh for diesel and electric trains, respectively, and 0.690 kWh for planes. One can notice that the lowest specific energy consumption is achieved by the railway sector.

o Urban (Intracity) Transport

The urban passenger transport is forecast to increase throughout the whole study period with an average annual rate of 1.8%. In addition, it is estimated that the share of the cars in the intercity transport, will increase as a result of increased needs of population's mobility. This variable is thus expected to increase from 19% in 1989 to 28% in 2010.

As far as mass transport is concerned, it is forecast a slight increase of the subway transport, tram and trolley buss transport share from 40% in 1989 to 47% in 2010. This option is also justified from the point of view of the energy specific consumption. The average consumption is 0.026 kWh for the electric mass transport.

Having in view the reduced specific energy consumptions in both freight and passenger transportation by electric trains, it was estimated to develop such systems, within economic limits, in the future, too.

Table 3.17 presents the assessment of the evolution of the electricity penetrating rate into the Transportation sector.

Table 3.17 Electricity Penetration in Transportation Sector
All Scenarios

	1989	1992	1995	2000	2005	2010
Share of electric trains in:						
-total freight transportation by rail	0.400	0.420	0.440	0.460	0.480	0.500
-total intercity travel by train	0.500	0.510	0.530	0.540	0.570	0.600
Share of electric mass transit in total intracity mass transportation	0.400	0.400	0.410	0.430	0.450	0.470

3.4.5 Life Style

Life style, living standard and comfort requirement are the main socioeconomic factors influencing the energy demand in the household department and services sector.

o Household

It was considered a necessity to provide a decent living standard for population, for the analyzed period. In this respect, it was forecast that after 1995 the average surface of new

dwellings will increase for all categories of dwellings. Thus, in 2010 it is estimated an increase of 13% of the new single-family dwellings surface and with about 7% of the apartments surface, both categories being provided with district heating and an increase of about 4% of the new dwellings surface provided with other heating systems.

As far as the new dwellings constructions structure is concerned, it is estimated that 20% will be single-family dwellings, 30% apartments both categories with district heating and 50% single-family houses with other heating systems

o Service

The services sector is forecast to evolve according to the development of socioeconomic activities This requires the modernization and the extension of the existing services, as well as the setting up of new services, necessary in the market economy Parallel, it is estimated a normal thermal comfort and the penetration of the air conditioning in certain services.

It is assumed an increase of electricity requirement both by increasing the services ownership rate and by covering the heating, household hot water consumptions

3.4.6 Specific Energy Intensity in Household/Service

o Household

The evolution of specific energy consumption in dwellings for the Basic Scenario is presented in Table 3 18.

Table 3.18 Energy Intensity (Useful) Assumed for the Household Sector Basic Scenario

(kWh/dw/yr)

	1989	1992	1995	2000	2005	2010
Space heating						
Constr before base year						
Single family/Central heating	5860 465	5860 465	5860 465	5801 860	5684 651	5567 442
Apartment/Central heating	4530 232	4530 232	4530 232	5375 930	5267 325	5158 721
Room heating	4686 046	4686 046	4686 046	4639 186	4545 465	4451 744
Constr after base year						
Single family/Central heating	5860 380	5860 380	5813 581	5735 721	5886 251	5950 270
Apartment/Central heating	5426 106	5426 106	5377 563	5323 925	5374 535	5232 223
Room heating	4685 746	4685 746	4650 865	4588 576	4602 418	4390 465
Water heating	2311 081	2779 535	2982 558	3115 116	3093 023	3076 453
Cooking	1218 605	1209 302	1197 674	1162 791	1104 651	1046 512
Air conditioning	302 326	302 326	302 326	302 326	302 326	302 326
Electrical appliances	513 460	923 000	979 000	1241 000	1458 000	1713 000

The energy consumption for a dwelling consists in the needs for heating, hot water, cooking, electric appliances and lighting appliances. The air conditioning consumption is estimated to be add to these main categories, in the year 2000.

The heating requirements represent the biggest component of the useful energy needs per dwelling. In order to reduce this consumption it was forecast the improvement of thermal insulation for the existing buildings. This action is considered to determine the reduction of energy demand for heating by about 1% in the year 2000, 3% in the 2005 and 5% in 2010. It was also assumed that new dwellings will be incorporated after 1995 and will have a better thermal insulation than the existing buildings.

The energy demand for hot water was foreseen to increase by 38% within the period 1989-2000 from 2311 kWh per dwelling and per year to 3200 kWh per dwelling and per year by providing both the necessary fuel and the necessary drinking water flows for well supplying a great number of towns. After the year 2000, it was assumed the growth of the share of dwellings provided with hot water facilities.

The energy intensity of cooking was considered to decrease slightly (about 0.7% yearly) from about 1220 kWh per dwelling and year in 1989 to about 1045 kWh per dwelling in year 2010. This was due to the assumptions regarding the decrease of the traditional way of cooking and the use of semi-prepared food.

The specific electricity consumption is foreseen to grow with an average yearly rate of 6% during the whole study period due to the important growing shares of dwellings equipped with electric appliances. Therefore, the growth of specific uses of electricity necessary per dwelling can be estimated from 496 kWh in 1989 to 1713 kWh in 2010. This will determine the growth of the specific electricity share from about 6% in 1989 to about 17% in 2010 within the total useful energy demand per dwelling.

As far as the use of air conditioning installations in dwellings is concerned it was forecast a small penetration, namely in 0.2% of the dwellings in the year 2000, reaching 0.4% in 2010.

The penetration of electricity into various thermal uses was to attain low values even for the year 2010, as it is shown in Table 3.19.

Table 3.19 Electricity Penetration in Household and Service
Basic Scenario

	1989	1992	1995	2000	2005	2010
Specific electricity consumption in:						
- Dwellings for uses other than space/water heating, cooking and A.C.(kWh/yr/dw)	513.46	923.0	979.0	1241.0	1458.0	1713.0
- Old-service sector buildings (kWh/yr/sqm)	37.92	50.0	58.0	60.0	65.0	80.00
- New-service sector buildings (kWh/yr/sqm)	0.00	50.0	59.5	65.0	68.0	85.00
Electricity penetration into thermal uses for:						
- Space heating household	0.006	0.006	0.011	0.014	0.017	0.020
- Water heating household	0.009	0.009	0.015	0.030	0.040	0.050
- Cooking household	0.001	0.002	0.010	0.030	0.050	0.100
- Thermal uses service sector	0.004	0.006	0.011	0.014	0.017	0.020

Table 3.20 Energy Intensity Assumed for the Service Sector Basic Scenario

	1989	1992	1995	2000	2005	2010
Space and water heating (useful, kWh/sqm/yr)						
Buildings constr before base year	255 814	253 256	250 698	248 140	245 581	243 023
Buildings constr after base year	0 000	244 186	238 372	232 558	226 744	220 930
Air conditioning, Specific consump (useful, kWh/sqm/yr)	58 140	58 140	58 140	58 140	58 140	58 140

o Service

The demand for useful energy in services mainly consists of the energy for space and water heating and the electricity for specific uses Table 3 20 presents the evolution of energy intensities of the services sector for the Basic Scenario

The main component of the energy for services is represented by the energy requirements for space heating and hot water By increasing the rate of thermal insulation the services sector buildings built up before 1989, one can estimate the continuous reduction of the necessary energy, namely, beginning with 1% in 1992 and reaching 5% in 2010

In line with the above, the average energy demand per surface unit in the services sector is estimated to decrease from about 256 kWh/sqm/yr in 1989 to 243 kWh/sqm/yr in 2010 For services developed in new modern buildings, it was estimated the requirements of thermal energy of 210 kWh/sqm/yr in 1989 and slowly decreasing to 190 kWh/sqm/yr in 2010

The necessary electricity in services depends on lighting, electric equipments and appliances utilized It is assumed in this respect that, parallel with the services modernization and rehabilitation, the increase of appliances and equipments will determine the growth of the electricity demand from 54 4 kWh/sqm/yr in 1985 to 80 kWh/sqm/yr in 2010 Regarding the services sector buildings constructed after 1989, it is estimated they will be better equipped than the existing ones and there are for to the greater specific electricity requirements, namely 55 kWh/sqm/yr in 1992, increasing up to 85 kWh/sqm/yr in 2010

The penetration of electricity in thermal uses in the Service sector was estimated to be modest, namely 2% in 2010 against 0 2% in 1992

The utilisation of air conditioning installations was considered very reduced, namely 1% of the occupied surface in the year 2000, reaching 5% in 2010

3.5 Detailed Description of the Low Scenario

All parameters are forecast to remain unchanged from the Basic Scenario except for the GDP growth rates, the energy intensities in industry and the energy intensity in dwellings and services

3.5.1 GDP Growth

The basic assumption for setting up this scenario consists in taking into consideration the continuation of GDP decrease in 1993, by 3%, against 1992, leading to a stop of the output decline (a 0.3% growth against 1993) and a 2% growth in 1995 against the previous year.

It is forecast an average annual rate of growth of 3.4% for the whole period 1992-2010. In 2010, GDP (in constant prices 1989) will be $57.2*10^9$ US$ against $45.6*10^9$ US$ as it was in 1989. The GDP growth for the Low Scenario is given in Table 3.21.

Table 3.21 GDP Growth Forecast
Low Scenario

Year	Total GDP (10^9 US$ 1989)	Average annual growth rate (%)	Per capita GDP (10^9 US$ 1989 / capita)
1989	45.6	-	1970
1992	31.3	-11.8	1346
1995	31.1	-0.2	1329
2000	34.1	3.6	1566
2005	45.9	4.3	1909
2010	57.2	4.5	2343

3.5.2 Specific Energy Intensity in Industry

Table 3.22 presents the evolution of the specific energy intensity in industry for the Low Scenario. As far as energy intensities in industrial sectors are concerned, within 1989-1995 they remained constant according to the assumptions of the Basic Scenario, but the change of manufacturing structure determined the total intensities from 14.168 kWh/US$ in 1989 to 13.804 kWh/US$ in 1995, meaning a 0.4% decrease.

Within the 1995-2010 period energy intensities of this scenario will be influenced by the reduced contribution of modernization and rehabilitation to industry.

o Agriculture

It was forecast a moderate growth of the agricultural equipment ownership rate of use and an improvement of the performance of the existing equipments. This will determine a slight increase of the mechanizing rate in agriculture. The specific consumption of motor fuels is estimated to increase from 2.176 kWh/US$ in 1989 to 2.328 kWh/US$ in 2010 implying an average annual growth of 3.2%.

The electricity intensity is estimated to grow from 0.658 kWh/US$ in 1989 to 0.704 kWh/US$ in 2010, by means of two contrary actions : one moderately improving the irrigating systems performances and modernization animal farms, the other improving the ownership rate of uses of electric equipments.

As far as thermal uses are concerned, it was forecast to slightly reduce intensity from 1.160 kWh/US$ in 1989 to 0.928 kWh/US$ in 2010, corresponding to an average annual rate

Table 3.22 Summary of Final Energy Intensity in Industry
Low Scenario

Unit kWh/US$

Sector	1989	1992	1995	2000	2005	2010
Agriculture						
Total Final Energy Intensity	3 994	3 878	3 878	3 929	3 929	3 960
-Motor fuel	2 176	2 176	2 176	2 241	2 241	2 328
-Electr , Specific	0 658	0 658	0 658	0 678	0 678	0 704
-Thermal	1 160	1 044	1 044	1 010	1 010	0 928
Construction						
Total Final Energy Intensity	3 801	3 801	3 801	3 634	3 634	3 443
-Motor fuel	2 288	2 288	2 288	2 220	2 220	2 128
-Electr , Specific	0 523	0 523	0 523	0 523	0 523	0 523
-Thermal	0 990	0 990	0 990	0 891	0 891	0 792
Mining						
Total Final Energy Intensity	12 139	12 139	12 139	11 365	11 365	10 580
-Motor fuel	1 017	1 017	1 017	0 987	0 987	0 946
-Electr , Specific	3 682	3 682	3 682	3 682	3 682	3 682
-Thermal	7 440	7 440	7 440	6 696	6 696	5 952
All Manufacturing						
Total Final Energy Intensity	14 168	13 851	13 804	12 390	12 039	10 696
-Motor fuel	0 343	0 350	0 350	0 339	0 340	0 326
-Electr , Specific	1 883	1 844	1 839	1 830	1 814	1 798
-Thermal	11 942	11 657	11 615	10 221	9 885	8 572

of -1%. This is due to the assumptions regarding the efficiency improvement of processing equipments as well as the improvement of utilising technologies (in heating houses, animal complex units, silos, etc)

o Construction

It was forecast a slight reduction of the total energy intensity, in construction, from 3 801 kWh/US$ in 1989 to 3 443 kWh/US$ in 2010 by improving the efficiecy of existing equipment and introduction of modern technologies.

As far as electricity intensity is concerned, it was suggested that the increase of equipments efficiencies will be compensated by the growth of electricity penetrating rate into the modernization and rehabilitation processes

o Mining

The attempts at making efficient and modernization mining activities have been estimated to determine the energy total intensity to 10 580 kWh/US$ in 2010 against 12 139 kWh/US$ in 1989.It is also assessed an important diminishing of thermal facilities

o Manufacturing

Due to slower process of modernization and rehabilitation works than in the Basic Scenario, one can estimate a decrease of the total energy intensity with about -1 3% through 1989-2010, from 14.168 kWh/US$ in 1989 to 10 696 kWh/US$ in 2010.

Regarding the electricity intensity this was considered to remain constant against the base year, assuming that the improvements of technological processes and the related decrease of its intensity will be compensated by the penetration of electricity into the industrial processes as a consequence (see Table 3.23).

As to the penetration of electricity in thermal uses this has been assumed to maintain the same shares as in the Basic Scenario.

Table 3.23 Electricity Penetration in Industry
Low Scenario

	1989	1992	1995	2000	2005	2010
Ratio of electricity intensity versus base year in:						
- Agriculture	1.000	1.000	1.000	1.030	1.030	1.070
- Construction	1.000	1.000	1.000	1.000	1.000	1.000
- Mining	1.000	1.000	1.000	1.000	1.000	1.000
- Manufacturing	1.000	1.000	1.000	1.000	1.000	1.000

3.5.3 Specific Energy Intensity in Household/Service

o Household

The evolution of the useful energy requirements for dwellings was determined (based on the assumption) of providing a decent living standard.

It was considered, necessary to provide living conditions and a thermal comfort similar to those in the Basic Scenario. The difference with the Basic Scenario, is the lower rate of use of with electric appliances which will determine a smaller consumption of electricity per dwelling.The specific electricity consumption in dwellings is forecast to grow with about 5.3% within the period 1989-2010, from 513.46 kWh/sqm/yr to 1480 kWh/sqm/yr (see Table 3.24).

o Service

The modernization and development of the Service sector was estimated in connection with the GDP evolution. It was assumed in this respect, a less growth of specific electricity intensity per sqm than in the Basic Scenario. Namely, for the existing buildings the specific electricity consumption in the year 2010 was estimated to 69 kWh/sqm/yr and for the new buildings to 73 kWh/sqm/yr (see Table 3.24).

Table 3.24 Electricity Penetration in Household and Service
Low Scenario

	1989	1992	1995	2000	2005	2010
Specific electricity consumption in:						
- Dwellings for uses other than space/water heating, cooking and A.C.(kWh/yr/dw)	513.46	923.00	948.00	1140.00	1290.00	1480.00
- Old-service sector buildings (kWh/yr/sqm)	37.92	50.00	55.00	55.00	57.00	69.00
- New-service sector buildings (kWh/yr/sqm)	0.00	50.00	55.50	57.00	61.00	73.00

The specific requirement of thermal energy per surface unit which consist mainly of the necessary energy for heating and preparing hot water was considered as in the Basic Scenario

3.6 Detailed Description of the High Scenario

The description of this scenario will emphasize on those parameters changing against the Basic Scenario, namely the GDP rate of growth, the specific energy intensity in Industry and the specific energy consumption in Household and Service sectors

3.6.1 GDP Growth

This scenario is characterized by the economic falling stop in 1993 due to the fact that GDP in 1993 will be equal to that in 1992 Throughout the period 1992-2010, it was forecast a GDP average yearly rate of growth of 5%

The value of GDP in the year 2010 will be $75,0*10^9$ US$ (in constant prices 1989) meaning 2950 US$ per inhabitant

Table 3 25 presents the evolution of the total GDP per inhabitant and the average annual rates of growth for the period corresponding to the High Scenario

Table 3.25 GDP Growth Forecast
High Scenario

Year	Total GDP (10^9 US$ 1989)	Average annual growth rate (%)	Per capita GDP (US$ 1989 / capita)
1989	45 60	-	1970
1992	31 30	-11 79	1346
1995	33 00	1 80	1410
2000	43 70	5 80	1845
2005	57 30	5 60	2383
2010	75 00	5 50	3073

3.6.2 Specific Energy Intensity in Industry

The evolution of specific energy intensity in Industry by Sector assumed for this Scenario is showen in Table 3 26 and the electricity penetration is shown in the Table 3 27

This scenario like the Basic Scenario had in view that, until 1995, no important investments would be made that should determine significant changes of energy intensities by sectors of industry Yet, the total energy will be diminished only by achieving manufacturing structural adjustments (motor fuel +electricity +thermal energy)

After 1995, industry is assumed to face the most intense process of modernization and rehabilitation that will determine the biggest reduction of the total energy intensities

Table 3.26 Summary of Final Energy Intensity in Industry
High Scenario

Unit kWh/US$

Sector	1989	1992	1995	2000	2005	2010
Agriculture						
Total Final Energy Intensity	3 994	3 878	3 878	3 927	3 987	4 071
- Motor fuel	2 176	2 176	2 176	2 284	2 393	2 502
- Electr , Specific	0 658	0 658	0 658	0 691	0 724	0 757
- Thermal	1 160	1 044	1 044	0 952	0 870	0 812
Construction						
Total Final Energy Intensity	3 801	3 801	3 801	3 559	3 362	3 213
- Motor fuel	2 288	2 288	2 288	2 174	2 060	1 945
- Electr , Specific	0 523	0 523	0 523	0 544	0 560	0 575
- Thermal	0 990	0 990	0 990	0 841	0 742	0 693
Mining						
Total Final Energy Intensity	12 139	12 139	12 139	11 120	10 436	10 123
- Motor fuel	1 017	1 017	1 017	0 967	0 916	0 865
- Electr , Specific	3 682	3 682	3 682	3 829	3 940	4 050
- Thermal	7 440	7 440	7 440	6 324	5 580	5 208
All Manufacturing						
Total Final Energy Intensity	14 168	13 851	13 804	11 889	10 493	9 776
- Motor fuel	0 343	0 350	0 350	0 332	0 315	0 298
- Electr , Specific	1 883	1 844	1 839	1 904	1 941	1 977
- Thermal	11 942	11 657	11 615	9 653	8 237	7 501

Table 3.27 Electricity Penetration in Industry
High Scenario

	1989	1992	1995	2000	2005	2010
Ratio of electricity intensity versus base year in						
-Agriculture	1 000	1 000	1 000	1 050	1 100	1 150
-Construction	1 000	1 000	1 000	1 040	1 070	1 100
-Mining	1 000	1 000	1 000	1 040	1 070	1 100
-Manufacturing	1 000	1 000	1 000	1 040	1 070	1 100

o Agriculture

Through the period 1995-2010, it was assumed the increase of specific intensities for motor fuels with an average annual rate of 0 7% This was due to a large rate of use of highly performant equipments allowing a high mechanizing level of agriculture The specific energy intensity for motor fuel is therefore, forecast to grow from 2 176 kWh/US$ in 1989 to 2 502 kWh/US$ in 2010

Due to a vast modernization and rehabilitating activity in all fields, to the penetration of performant technologies, too, with an average annual rate of 1.4% from 0.658 kWh/US$ for the period 1989-1995 to 0.757 kWh/US$ in 2010.

As far as electricity intensity is concerned, taking into account the vast rehabilitating and modernization activity of heating houses, animal farms, it has been estimated an average annual decrease of 1.7%, from 1.16 kWh/US$ in 1989 to 0.812 kWh/US$ in 2010.

o Construction

In the construction sector the important growth of mechanisation and the penetration of new technologies will have the following consequences, according to assumptions, on the specific energy intensities:

- the specific energy intensity of motor fuel will decrease from 2.288 kWh/US$ as it was estimated for the period 1989-1995 to 1.945 kWh/US$ in 2010 with an average annual rate of 1.1% through 1995-2010;

- electricity intensity is forecast to grow with an average annual rate of 0.6% within 1995-2010 from 0.523 kWh/US$ in 1995 to 0.575 kWh/US$ in 2010;

- thermal energy intensity is estimated to decrease from 0.990 kWh/US$ between 1989-1995 to 0.693 kWh/US$ in 2010, with an average annual rate of 2.3%.

o Mining

By mechanization and rehabilitation, the mining sector is estimated to reduce the total energy intensity by about 17%, from 12.139 kWh/US$ to 10.123 kWh/US$ in 2010. Regarding the evolution of the energy intensities of this sector, the following assumptions were made:

- a reduction of the motor fuel energy intensity from 1.017 kWh/US$ to 0.865 kWh/US$ in 2010;

- electricity intensity growth from 3.682 kWh/US$ in 1995 to 4.05 kWh/US$ in 2010;

- decrease of thermal energy intensity from 7.44 kWh/US$ in 1995 to 5.208 kWh/US$ in 2010;

o Manufacturing

In correlation with the strong rehabilitation process and the penetration of new technologies, the total specific energy intensity is estimated to decrease more than in the Basic Scenario. Throughout the whole period, the total energy intensity will decrease by about 30%.

As far as the evolution of motor fuel, electricity, thermal energy intensities are concerned, the following assumptions have been made:

- the motor fuel intensity will decrease from 0.343 kWh/US$ in 1989 to 0.298 kWh/US$ in 2010, with an average annual rate of 0.7%;

- electricity intensity will grow with an average annual rate of 0.2%, from 1.883 kWh/US$ in 1989 to 1.977 kWh/US$ in 2010;

- thermal energy intensity will decrease with an average annual rate of 2.2%, from 11.942 kWh/US$ in 1989 to 7.501 kWh/US$ in 2010.

3.6.3 Energy Intensity in Household/Service

o Household

It was taken into consideration for the High Scenario, a higher rate of use of electric appliances of dwellings and a higher energy efficiency than in the Basic Scenario. In keeping with this, it has been estimated the growth of electricity intensity in dwellings from 513.46 kWh/yr in 1989 to 1944 kWh/yr in 2010, meaning a growth of about 6.5% yearly (see Table 3.28).

Table 3.28 Electricity Penetration in Household and Service High Scenario

	1989	1992	1995	2000	2005	2010
Specific electricity consumption in:						
- Dwellings for uses other than space and water heating, cooking and air conditioning (kWh/yr/dw)	513.46	923.00	1006.00	1339.00	1604.00	1944.00
- Old-service sector buildings (kWh/yr/sqm)	37.92	50.00	59.60	64.70	71.50	90.80
- New-service sector buildings (kWh/yr/sqm)	0.00	50.00	61.20	70.10	74.80	96.50

o Service

The modernization and development of the sector of services was estimated to be achieved to a greater extent than in the Basic Scenario. It has been assumed in this respect, a growth of specific electricity consumption for the existing buildings from 37.92 kWh/sqm/yr in 1989 to 90.8 kWh/sqm/yr in 2010, and, for new buildings, from 50 kWh/sqm/yr in 1992 to 96.5 kWh/sqm/yr in 2010 (see Table 3.28).

Chapter 4

ANALYSIS OF ENERGY DEMAND

4.1 Analysis of Total and Per Capita Final Energy Demand

4.1.1 Total Final Energy Demand Forecast

The three scenarios of socioeconomic and technological development of Romania retained for the ENPP study are defined by the macroeconomic parameters synthetically presented in Table 4.1 and Figure 4.1.

Table 4.1 GDP Evolution for the Three Scenarios

Year	Total GDP (1) [10^9 US$]			Growth Rate(2) [%]		
	Low Scenario	Basic Scenario	High Scenario	Low Scenario	Basic Scenario	High Scenario
1989	45.6	45.6	45.6	-	-	-
1992	31.3	31.3	31.3	-11.788	-11.788	-11.788
1995	31.1	32.1	33.0	-6.179	-5.683	-5.247
2000	37.1	40.5	43.7	-1.858	-1.072	-0.386
2005	45.9	51.9	57.3	0.041	0.812	1.438
2010	57.2	66.1	75.0	1.085	1.784	2.398

(1) Total GDP expressed in US$ 1989: 1 US$ = 17.5 lei (1989)
(2) Average annual growth rate versus the base year

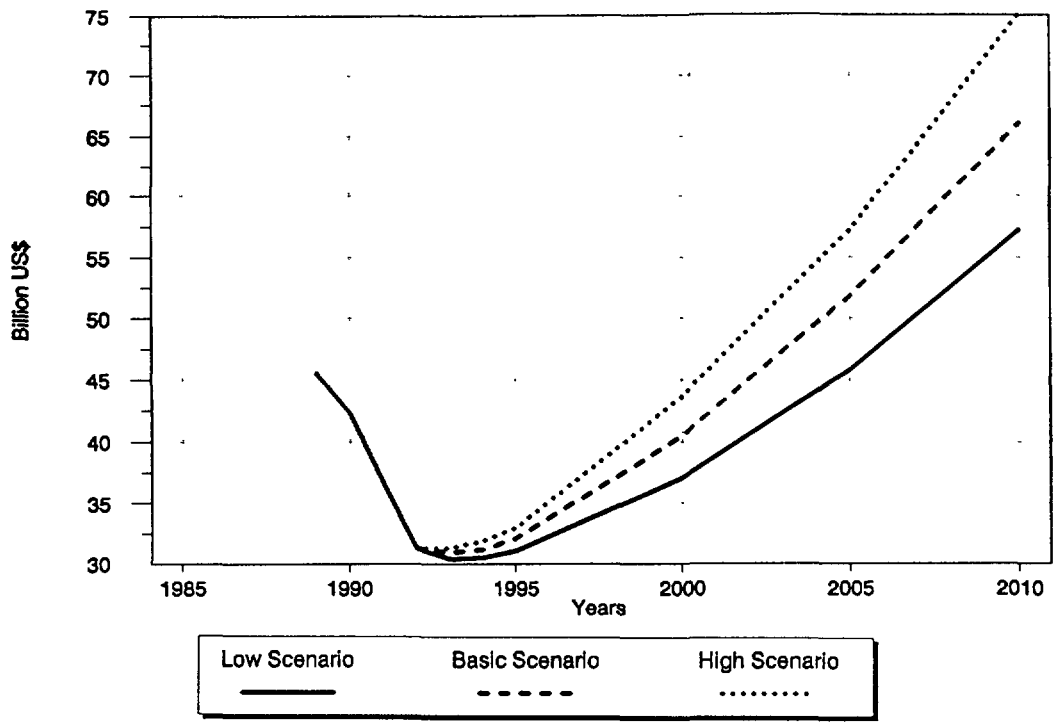


Figure 4.1 Trends in GDP Formation

The evolution of the final energy demand through the 1989- 2010 period resulting from the analyses performed by means of Module 1 of MAED model, is presented in Tables 4.2 and 4.3 and in Figure 4.2.

As shown in Table 4.2, in the year 2010 the final energy demand (including non-commercial energy) is estimated to be 77.017 Mtce in Low scenario, 82.225 Mtce in Basic scenario and 86.672 Mtce in High scenario against 78.170 Mtce in the base year (1989). The commercial energy demand in 2010 will be 74.723 Mtce (Low scenario), 79.930 Mtce (Basic scenario) and 84.377 Mtce (High scenario) against 75.620 Mtce in 1989. The average annual growth rate of commercial final energy demand during the study period is -0.057% in Low scenario, 0.264% in Basic scenario and 0.523% in High scenario.

Table 4.2 Total Final Energy Demand and Average Growth Rates

Year	Final Energy Demand(1) [Mtce]			Growth Rate (2) [%]		
	Low Scenario	Basic Scenario	High Scenario	Low Scenario	Basic Scenario	High Scenario
1989	78.170	78.170	78.170	-	-	-
1992	63.585	63.585	63.585	-6.65	-6.65	-6.65
1995	63.602	64.503	65.302	-3.34	-3.15	-2.95
2000	66.175	68.615	70.472	-1.50	-1.18	-0.94
2005	72.147	74.299	76.833	-0.50	-0.32	-0.11
2010	77.017	82.225	86.672	-0.07	0.24	0.49

(1) Including non-commercial fuels
(2) Average annual growth rate versus the base year (1989)

Table 4.3 Total Commercial Final Energy Demand and Average Growth Rates

Year	Final Energy Demand(1) [Mtce]			Growth Rate (2) [%]		
	Low Scenario	Basic Scenario	High Scenario	Low Scenario	Basic Scenario	High Scenario
1989	75.620	75.620	75.620	-	-	-
1992	61.035	61.035	61.035	-6.893	-6.893	-6.893
1995	61.053	61.953	62.752	-3.503	-3.267	-3.061
2000	63.625	66.065	67.922	-1.638	-1.220	-0.971
2005	69.725	71.877	74.411	-0.506	-0.317	-0.100
2010	74.723	79.930	84.377	-0.057	0.264	0.523

(1) Commercial final energy
(2) Average annual growth rate versus the base year (1989)

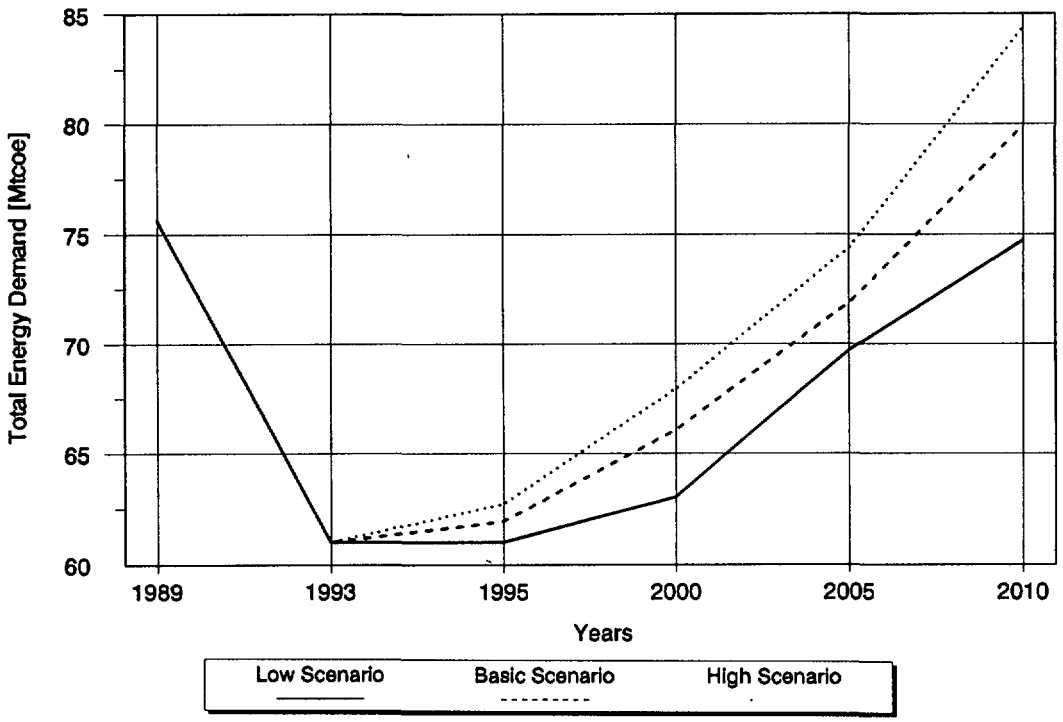


Figure 4.2 Trends in the Demand for Final Energy

A comparison of the evolution of the average growth rate of the GDP and final energy demand shows that in all three scenarios the final energy demand has the same trend as that of the GDP, but at a lower level (compare Figs. 4.1 and 4.2).

For a clearer illustration of the development of the final energy demand Figure 4.3 presents the values obtained for the reference years 1995, 2000 and 2010 against the Base year 1989 for all three scenarios.

It can be noticed that in 2010 the energy demand in Basic scenario exceeds by 7.0% the value of the Low scenario and is 5.6% less than that of the High scenario.

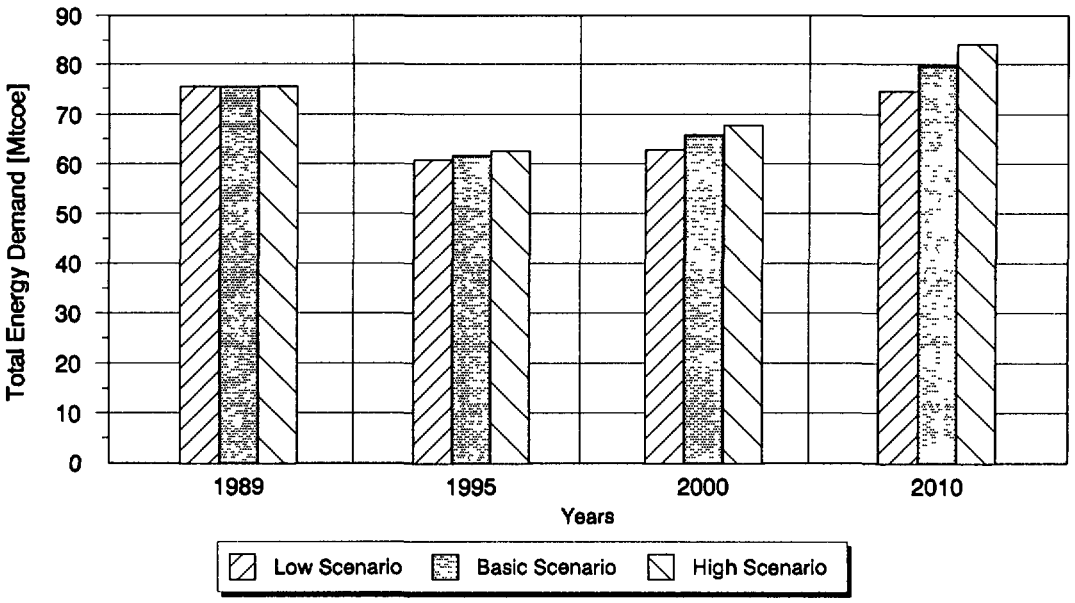


Figure 4.3 Comparison of Total Final Energy Demand for the Three Scenarios

4.1.2 Trends of the Final Energy Per Capita and GDP Per Capita

The evolution of the final energy per capita and the GDP per capita is presented in Table 4.4, while the average annual growth rates of the final energy and GDP per capita are shown in Table 4.5.

As it has been previously discussed, the Romanian economy is, at present, characterized by a high energy intensity, mainly due to the big share of energy intensive industries. This is due to a high energy consumption per capita and to a low GDP per capita.

Table 4.4 Trends of Per Capita Final Energy and GDP per Scenario

Year	Population [10^6]	Energy per Capita(1) [tce / capita]			GDP per Capita(2) [10^3 US$ / capita]		
		Low Scenario	Basic Scenario	High Scenario	Low Scenario	Basic Scenario	High Scenario
1989	23.152	3.266	3.266	3.266	1.970	1.970	1.970
1992	23.256	2.625	2.625	2.625	1.346	1.346	1.346
1995	23.400	2.609	2.648	2.682	1.329	1.372	1.410
2000	23.690	2.662	2.789	2.867	1.566	1.710	1.845
2005	24.050	2.899	2.989	3.094	1.909	2.158	2.383
2010	24.410	3.061	3.274	3.457	2.343	2.708	3.073

(1) Commercial final energy

(2) GDP expressed in 1989 US$ (1 US$ 1989 = 17.5 lei)

Table 4.5 Growth Rate(1) of Final Energy per Capita and GDP per Capita in the Three Scenarios

Year	Energy per Capita [%]			GDP per Capita [%]		
	Low Scenario	Basic Scenario	High Scenario	Low Scenario	Basic Scenario	High Scenario
1989	-	-	-	-	-	-
1992	-7.04	-7.04	-7.04	-11.92	-11.92	-11.92
1995	-3.68	-3.44	-3.23	-6.35	-5.85	-5.42
2000	-1.84	-1.43	-1.18	-2.06	-1.28	-0.59
2005	-0.74	-0.55	-0.34	-0.20	0.57	1.20
2010	-0.31	0.01	0.27	0.83	1.53	2.14

(1) Average annual growth rate versus the base year (1989)

For this reason, the main assumption made in setting up the three scenarios aimed at reducing the energy intensities both by improving technologies and, especially by changing the structure of the economy.

The forecasted final energy demand per capita for the year 2010 represents 3,06 kgce in the Low scenario, 3,274 kgce in Basic scenario and 3,457 kgce in High scenario against 3,266 kgce in 1989. The GDP per capita in 2010 reaches 2,343 US$ in the Low scenario, 2,708 US$ in the Basic Scenario and 3,073 US$ in the High scenario against 1970 US$ in 1989.

Consequently in the year 2010, the final energy demand per capita in Basic scenario will be 6.96% higher than in Low scenario and 5.59% lower than in High scenario, while the GDP per capita in the Basic scenario will be 15.58% higher than in the Low scenario and 13.48% lower than in the High scenario.

Having in view the inter-relation between the two indices it can be noticed a stronger variation of the average annual growth rate of GDP per capita within the study period against that of the final energy per capita. Table 4.6 and Figure 4.4 present the GDP per capita and final energy per capita for Romania in the years 1989 and 2010 compared to those achieved in some selected ECE-UN countries, at the level of 1988.

4.2 Analysis and Comparison of the Sectoral Energy Demand

The sectoral final energy demand resulting from the analyses performed by means of the MAED program, is summarized in Table 4.7 and Figure 4.5, and presented in more detail in Tables 4.8, 4.9, 4.10, as well as in Appendix C.

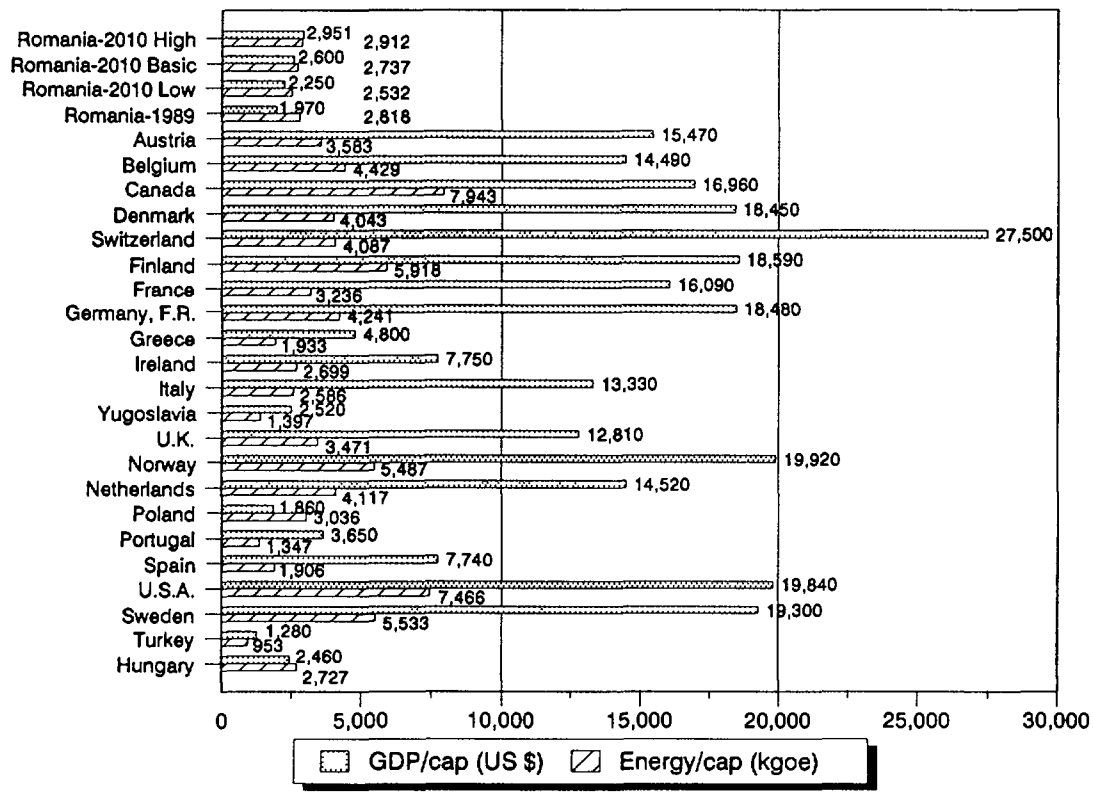


Figure 4.4 Comaprison of the MAED Results for Per Capita Values of Final Energy with Selected Countries

Table 4.6 Comparison of Final Energy per Capita and GDP per Capita of Romania with some Selected Countries

Country	Population (Million)	GDP per Capita (US$ 1988/cap)	Final Energy per Capita (kgce/cap)[1]
Austria	7.6	15470	3583
Belgium	9.9	14490	4429
Canada	26.0	16960	7943
Denmark	5.1	18450	4043
Switzerland	6.6	27500	4087
Finland	5.0	18590	5918
France	55.9	16090	3236
Germany, F.R.	61.3	18480	4241
Greece	10.0	4800	1933
Ireland	3.5	7750	2699
Italy	57.4	13330	2586
Yugoslavia	23.6	2520	1397
U.K.	57.1	12810	3471
Norway	4.2	19920	5487
Netherlands	14.8	14520	4117
Poland	37.9	1860	3036
Portugal	10.3	3650	1347
Spain	39.0	7740	1906
U.S.A.	246.3	19840	7466
Sweden	8.4	19300	5533
Turkey	53.8	1280	953
Hungary	10.6	2460	2727
Romania[2]	23.2	1970	2818
1989	25.4	2250	2532
2010 - Low	25.4	2600	2737
- Basic	25.4	2951	2912
- High			

Note: (1) - without feedstocks;
(2) - US$ 1989.

4.2.1 Industry Sector

This sector includes four categories of activities: Agriculture, Construction, Mining and Manufacturing. In 1989, this sector had a final energy consumption of 57.40 Mtce, namely 76% of the total final energy demand of Romania. Manufacturing, the biggest energy consumer of the economy, registered an energy consumption of 50.74 Mtce in 1989, namely 88.4% of the industry energy consumption and 67.1% of the total final energy consumption of Romania.

In the MAED model, forecasting of the Industry energy demand is related to the evolution of the economic activity (expressed in terms of value added) and to the energy intensities. The assumption made about the evolution of these parameters for setting up the three scenarios are presented in Section 3.4 and in Appendix B.

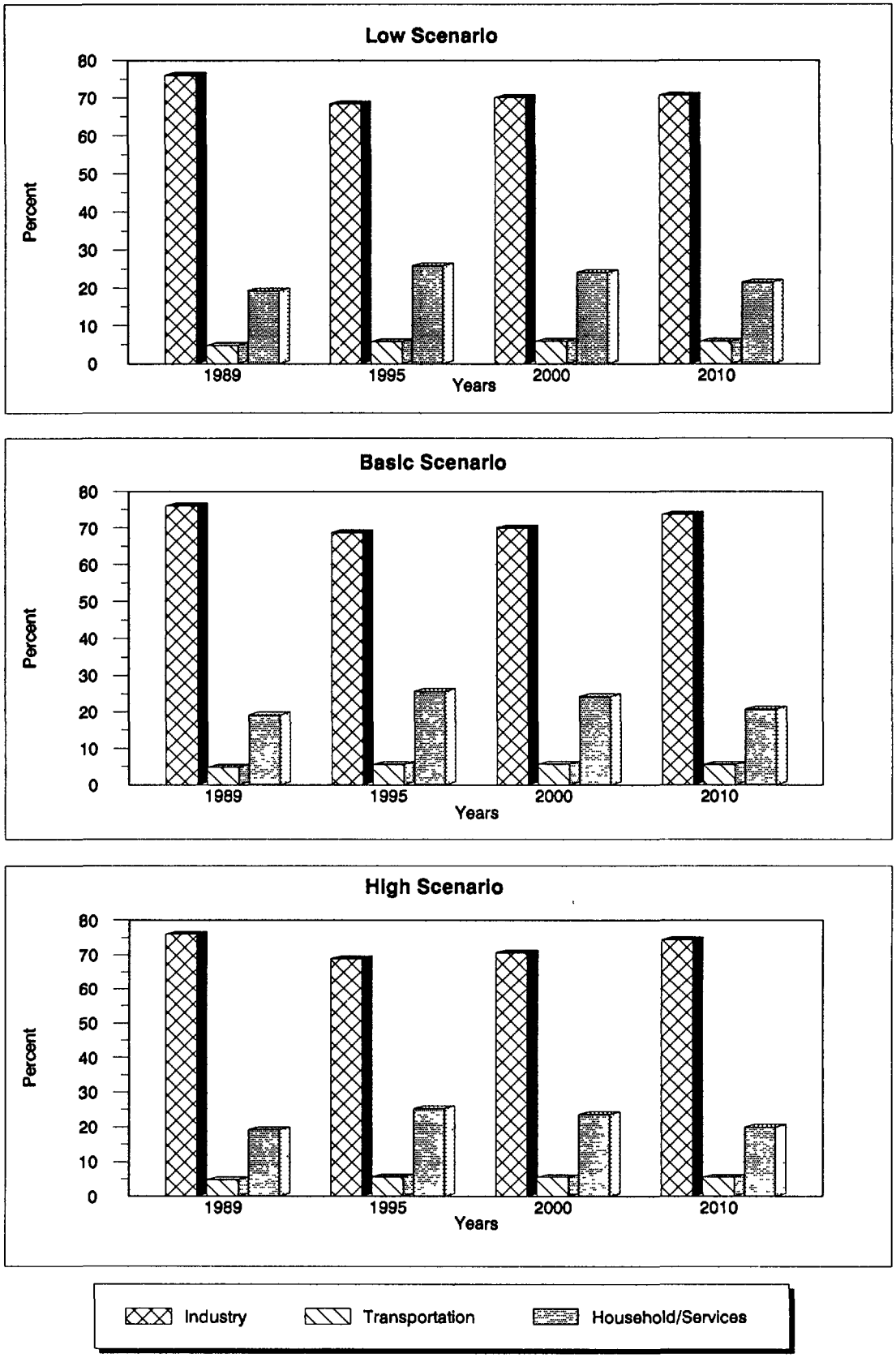


Figure 4.5 Final Energy Demand by Sector

Table 4.7 Final Energy Demand Forecast by Sector 1989-2010

Sector	Growth rate(*) [%]	Amount [Mtce]		Share [%]	
	2010	1989	2010	1989	2010
Low Scenario	-0 06	75 6	74 7	100 0	100 0
1 Industry	-0 27	57 4	54 2	76 0	72 6
-Agr/Cons/Min	1 73	6 7	9 6	8 9	12 9
-Manufacturing	-0 61	50 7	44 6	67 1	59 7
2 Transportation	0 96	3 6	4 4	4 8	5 9
3 Household/Service	0 47	14 6	16 1	19 2	21 5
Basic Scenario	0 26	75 6	79 9	100 0	100 0
1 Industry	0 11	57 4	58 8	76 0	73 6
-Agr/Cons/Min	2 4	6 7	11 0	8 9	13 8
-Manufacturing	-0 3	50 7	47 8	67 1	59 8
2 Transportation	1 07	3 6	4 5	4 8	5 6
3 Household/Service	0 61	14 6	16 6	19 2	20 8
High Scenario	0 53	75 6	84 4	100 0	100 0
1 Industry	0 43	57 4	62 8	76 0	74 4
-Agr/Cons/Min	3 00	6 7	12 5	8 9	14 8
-Manufacturing	-0 04	50 7	50 3	67 1	59 6
2 Transportation	1 28	3 6	4 7	4 8	5 6
3 Household/Service	0 70	14 6	16 9	19 2	20 0

(*) Average annual growth rate versus the base year (1989)

Figure 4 6 illustrates the evolution of value added and energy intensity for the Manufacturing sector, estimated in the three scenarios

In the Basic Scenario the total final energy demand in the Industry sector changes from 57 4 Mtce in 1989 to 42 5 Mtce in 1995, 46 3 Mtce in 2000 and 58 8 Mtce in 2010 with an average annual growth rate of 0 11% throughout the whole period The share of this sector energy demand within the total energy demand of Romania decreases from 76% in 1989 to 73 6% in 2010

The Manufacturing sector energy demand varies from 50 7 Mtce in 1989 to 36 8 Mtce in 1995, 39 2 Mtce in 2000 and 47 8 Mtce in 2010, the share of this sector within the total energy demand decreasing from 67 1% in 1989 to 59 8% in 2010

The final energy demand of Agriculture, Construction and Mining sectors varies from 6 7 Mtce in 1989 to 5 7 Mtce in 1995, 7 1 Mtce in 2000 and 11 0 Mtce in 2010, with the share of these sectors in the total energy demand of Romania increasing from 8 9% in 1989 to 13 8% in 2010

Table 4.8 Final Energy Demand by Sector (Low Scenario)

	1989	1992	1995	2000	2005	2010
A. Final commercial energy [Mtce]						
1 Industry	57 4	42 0	41 7	44 1	49 9	54 2
- Agr/Cons/Min	6 7	5 6	5 6	6 6	8 0	9 6
- Manufacturing	50 7	36 4	36 1	37 5	41 9	44 6
2 Transportation	3 6	3 4	3 5	3 7	4 0	4 4
3 Household/service	14 6	15 6	15 8	15 2	15 8	16 1
Total	75 6	61 0	61 0	63 0	69 7	74 7
B. Share of total [%]						
1 Industry	76 0	68 9	68 4	70 0	71 5	72 6
- Agr/Cons/Min	8 9	9 2	9 2	10 5	11 5	12 9
- Manufacturing	67 1	59 7	59 2	59 5	60 0	59 7
2 Transportation	4 8	5 7	5 7	5 9	5 7	5 9
3 Household/service	19 2	25 4	25 9	24 1	22 8	21 5
Total	100 0	100 0	100 0	100 0	100 0	100 0
C. Growth rate [%] (1)						
1 Industry	-	-9 89	-5 19	-2 37	-0 87	-0 27
- Agr/Cons/Min	-	-5 80	-2 94	-0 14	1 11	1 73
- Manufacturing	-	-10 46	-5 50	-2 70	-1 18	-0 61
2 Transportation	-	-1 89	-0 47	0 25	0 66	0 96
3 Household/service	-	2 23	1 32	0 37	0 49	0 47
Average	-	-6 90	-3 51	-1 64	-0 51	-0 06

(1) - Average annual growth rate versus the base year (1989)

In the High Scenario, the final energy demand of the Industry sector varies from 57 4 Mtce in 1989 to 43 3 Mtce in 1995, 48 0 Mtce in 2000 and 62 8 Mtce in 2010, the share of the sector in the national energy demand decreasing from 76 6% in 1989 to 74 4%in 2010

In the Low Scenario, the final energy demand of the Industry sector varies from 57 4 Mtce in 1989 to 41 7 Mtce in 1995, 44 1 Mtce in 2000 and 54 2 Mtce in 2010, the share of the sector in the national energy demand decreasing from 76 0% in 1989 to 72 6% in 2010

The final energy demand, at the level of the year 2010, in the Basic scenario (58 8 Mtce) is by 8 49% higher than that in the Low scenario (54 2 Mtce) and by 6 8% lower than in the High scenario (62 8 Mtce)

4.2.2 Transportation Sector

The Transportation sector mainly consists of two kinds of activities freight transportation and passenger travel (urban and intercity) The characteristic parameters of the Transportation sector energy demand are ton-km of freight and passenger-km of travel The assumptions regarding the evolution of these parameters are presented in Chapter 3 4 and Appendix B and are illustrated in Figure 4 7

Table 4.9 Final Energy Demand by Sector (Basic Scenario)

	1989	1992	1995	2000	2005	2010
A. Final commercial energy [Mtce]						
1 Industry	57 4	42 0	42 5	46 3	51 7	58 8
- Agr/Cons/Min	6 7	5 6	5 7	7 1	8 9	11 0
- Manufacturing	50 7	36 4	36 8	39 2	42 8	47 8
2 Transportation	3 6	3 4	3 5	3 8	4 1	4 5
3 Household/service	14 6	15 6	15 9	16 0	16 0	16 6
Total	75 6	61 0	61 9	66 1	71 8	79 9
B. Share of total [%]						
1 Industry	76 0	68 9	68 7	70 0	72 0	73 6
- Agr/Cons/Min	8 9	9 2	9 2	10 7	12 4	13 8
- Manufacturing	67 1	59 7	59 5	5 93	59 6	59 8
2 Transportation	4 8	5 7	5 6	5 7	5 7	5 6
3 Household/service	19 2	25 4	25 7	24 3	22 3	20 8
Total	100 0	100 0	100 0	100 0	100 0	100 0
C. Growth rate [%](1)						
1 Industry	-	-9 89	-4 88	-1 93	-0 65	0 11
- Agr/Cons/Min	-	-5 80	-2 7	0 5	1 8	2 4
- Manufacturing	-	-10 46	-5 2	-2 3	-1 0	-0 3
2 Transportation	-	-1 89	-0 47	0 49	0 82	1 07
3 Household/service	-	2 23	1 43	0 84	0 57	0 61
Average	-	-6 90	-3 28	-1 21	-0 32	0 26

(1) Average annual growth rate versus the base year (1989)

Table 4.10 Final Energy Demand by Sector (High Scenario)

	1989	1992	1995	2000	2005	2010
A. Final commercial energy [Mtce]						
1 Industry	57 4	42 0	43 3	48 0	53 9	62 8
- Agr/Cons/Min	6 7	5 6	6 0	7 7	9 7	12 5
- Manufacturing	50 7	36 4	37 3	40 3	44 2	50 3
2 Transportation	3 6	3 4	3 6	3 8	4 2	4 7
3 Household/service	14 6	15 6	15 9	16 1	16 3	16 9
Total	75 6	61 0	62 8	67 9	74 4	84 4
B. Share of total [%]						
1 Industry	76 0	68 9	68 9	70 7	72 4	74 4
- Agr/Cons/Min	8 9	9 2	9 6	11 3	13 0	19 9
- Manufacturing	67 1	59 7	59 3	59 4	59 4	54 5
2 Transportation	4 8	5 6	5 7	5 6	5 7	5 6
3 Household/service	19 2	25 4	25 3	23 7	21 9	20 0
Total	100 0	100 0	100 0	100 0	100 0	100 0
C. Growth rate [%] (1)						
1 Industry	-	-9 89	-4 59	-1 61	-0 39	0 43
- Agr/Cons/Min	-	-5 80	-1 8	1 30	2 30	3 0
- Manufacturing	-	-10 46	-5 0	-2 1	-0 9	-0 04
2 Transportation	-	-1 89	0 0	0 49	0 97	1 28
3 Household/service	-	2 23	1 43	0 89	0 69	0 70
Average	-	-6 90	-3 04	0 97	-0 10	0 52

(1) Average annual growth rate versus the base year (1989)

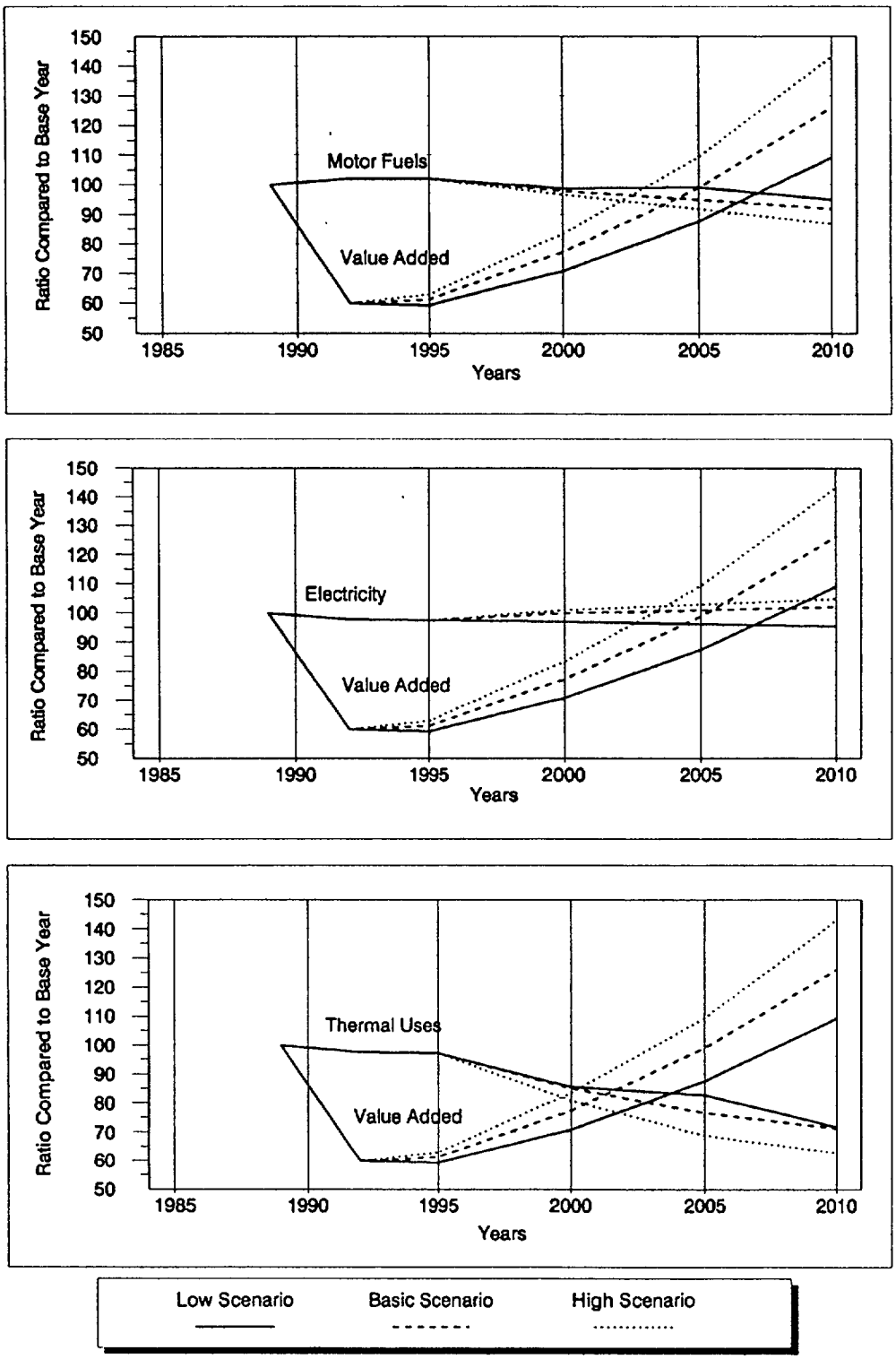
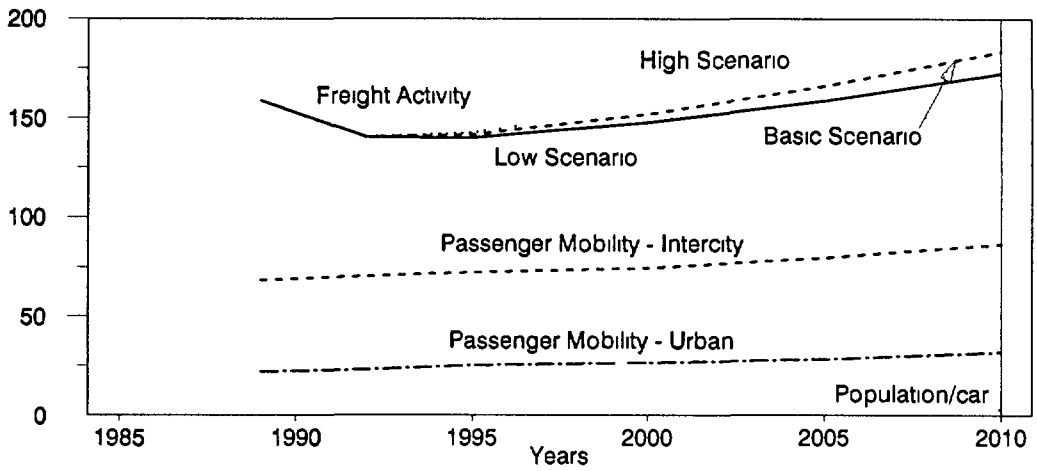


Figure 4.6 Value Added and Energy Intensity Assumptions for the Manufacturing Sector

The energy demand for the Transportation sector is estimated to represent 4.4 Mtce in the Low scenario, 4.5 Mtce in the Basic scenario and 4.7 Mtce in the High scenario in 2010 against 3.6 Mtce in 1989. This represents an average annual growth rate within the study period of 0.96% in Low scenario, 1.07% in Basic scenario and 1.28% in High scenario.

At the level of 2010, the energy demand for Transportation sector in Basic scenario is higher than in Low scenario by 2.27% and lower than in High scenario by 4.44%.



Note: Units in billion ton (Freight), Passenger-km (Passenger) and Population/car

Figure 4 7 Principal Determining Factors of Energy Demand of the Transportation Sector

Table 4 11 presents the evolution of the energy demand for the Transportation sector by types of activities in the three analyzed scenarios (the details are shown in Appendix C) The energy demand for passenger travel is estimated to grow from 1 5 Mtce to 1 88 Mtce in 2010 and the energy demand for freight transportation will be 2 2 Mtce in Low scenario, 2 66 Mtce in Basic scenario and 2 82 Mtce in High scenario in the year 2010 against 2 11 Mtce in 1989, representing an average annual growth rate on the study period of 0 81% in the Low scenario, 1 11% in the Basic scenario and 1 39% in the High scenario

Table 4.11 Breakdown of the Total Final Energy Demand by Activities in the Transportation Sector

Scenario / Activities	Amount [Mtce]		Share [%]	
	1989	2010	1989	2010
Low Scenario				
Total	3 616	4 382	100 0	100 0
- Freight	2 112	2 500	58 4	57 1
- Passenger	1 504	1 882	41 6	42 9
intercity	1 116	1 226	30 9	28 0
urban	0 388	0 656	10 7	14 9
Basic Scenario				
Total	3 616	4 542	100 0	100 0
- Freight	2 112	2 661	58 4	58 6
- Passenger	1 504	1 882	41 6	41 4
intercity	1 116	1 226	30 9	27 0
urban	0 388	0 656	10 7	14 4
High Scenario				
Total	3 616	4 702	100 0	100 0
- Freight	2 112	2 820	58 4	60 0
- Passenger	1 504	1 882	41 6	40 0
intercity	1 116	1 226	30 9	26 1
urban	0 388	0 656	10 7	13 9

4.2.3 Household/Service Sector

The energy demand in the Household sector is influenced both by the variation of the number of dwellings, determined by the evolution of the total population and the number of persons per dwelling, and by the specific energy demand for various final facilities (cooking, space heating, hot water preparation, specific electric appliances, etc.) depending on a range of factors, such as: tradition, living standard, population income, etc., and their implications on the ownership of various appliances (hot water facilities, air conditioning, electrical appliances, etc.)

The energy demand forecast for the Service sector is achieved by projecting manpower in the sector, the specific area per employee and the specific energy consumption per square metre. The projections of the main parameters determining the energy demand of this sector are illustrated by Figure 4.8 (Household) and Figure 4.9 (Service) and the assumptions on which these projections are based are presented in Chapter 3.4 and Appendix B

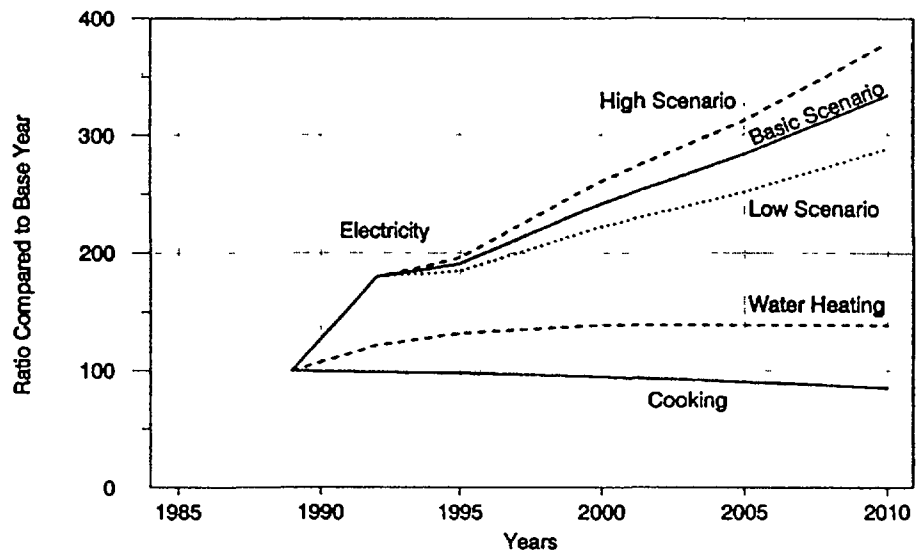


Figure 4.8 Specific Energy Consumption By End-Use in the Household Sector

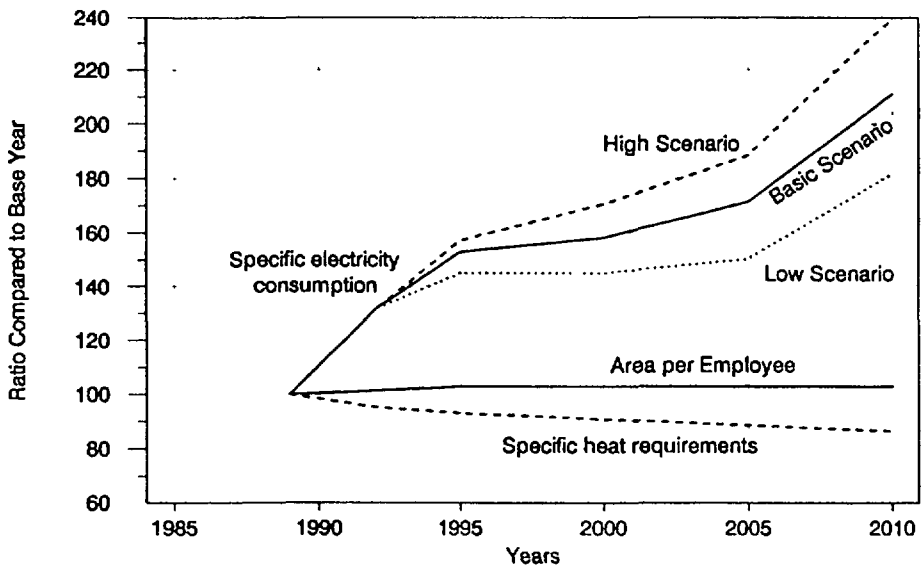


Figure 4.9 Principal Determining Factors of Energy Demand of the Service Sector

In all three scenarios the energy demand for Household/Service sector increases very fast within the period 1989-1992 due to the removal of constraints that existed until 1989 regarding the energy supply of this sector.

The final energy demand of the Household/Service sector in year 2010 will reach 16.1 Mtce in Low scenario, 16.6 Mtce in Basic Scenario and 16.9 Mtce in High scenario against 14.6 Mtce that was achieved in 1989. The share of this sector in the total energy demand will be, at the end of the study period, between 20.0% and 21.5% against 19.2% in 1989 (out of which only 10.1 Mtce were provided, meaning about 70% of the sectoral demand and about 13.4% of the whole commercial final energy demand).

At the level of the year 2010, the Household/Service sector energy demand in Basic scenario is 3.1% higher than in the Low scenario and 1.8% lower than in the High scenario.

4.3 Analysis of Final Energy Demand by Energy Form

The MAED forecast of final energy demand by energy form are summarized in Table 4.12 and detailed results for the three scenarios are shown in Table 4.13 and illustrated in Figure 4.10 (for more detailed results see Appendix C). Two major types of energy i.e. commercial and non-commercial are considered.

In the year 1989, the distribution of total final energy demand by form was 91.1% for commercial energy (out of which 8.6% motor fuel, 10.6% electricity, 64.6% fossil fuels and 7.3% coke) and 3.3% for non-commercial energy.

4.3.1 Non-commercial Energy

It was considered that the use of non-commercial fuels would be constant (2.55 Mtce) in all three scenarios until 1995, and after that it would fall down up to 2.295 Mtce in 2010, a decrease mainly due to the growth of their efficiency.

4.3.2 Commercial Energy

As it has been already stated in Chapter 3, commercial energy forms were classified according to MAED model requirements, into fossil fuels, electricity, motor fuels, coke and feedstock. Specifically, for the purposes of the study, fossil fuels include some petroleum products (i.e. fuel oil, kerosene, etc.) lignite, brown and hard coal, charcoal, natural gas, firewood and agriculture waste. Motor fuels consist of some petroleum products such as gasoline, diesel and aviation fuel.

The following description presents the results of the MAED forecasts by energy form.

4.3.2.1 Fossil Fuels

In the MAED model, fossil fuels are considered to be consumed for thermal uses, i.e. for water and space heating, steam generation and direct heating in Industry and for cooking, water and space heating in Household/Service. Hence, the forecast of fossil fuels in Industry is based on the growth of the industrial value added and on the specific energy intensity for thermal uses, whereas for Household and Service it will depend on the growth of population and on the floor area in the Service sector.

Table 4.12 Summary of Energy Demand Forecast by Energy Form

Energy Form	Growth rate(*) 1989 - 2010 [% per year]	Amount [Mtce]		Share [%]	
		1989	2010	1989	2010
Low Scenario					
Total commercial	-0.057	75.62	74.72	100.0	100.0
of which :					
Fossil	-1.099	25.21	19.99	33.34	26.75
District heat supply	-0.228	19.25	18.35	25.46	24.56
Electricity	1.403	8.30	11.12	10.98	14.88
Motor fuels	1.468	6.76	9.18	8.94	12.29
Basic Scenario					
Total commercial	0.264	75.62	79.73	100.0	100.0
of which :					
Fossil	-0.813	25.21	21.24	33.34	26.57
District heat supply	0	19.25	19.25	25.46	24.08
Electricity	2.227	8.30	13.18	10.98	16.49
Motor fuels	1.969	6.76	10.18	8.94	12.74
High Scenario					
Total commercial	0.523	75.62	84.38	100.0	100.0
of which :					
Fossil	-0.679	25.21	21.85	33.34	25.89
District heat supply	0.218	19.25	20.15	25.46	23.88
Electricity	2.878	8.30	15.06	10.98	17.85
Motor fuels	2.446	6.76	11.23	8.94	13.31

(*) - Average annual growth rate versus the base year (1989)

In 1989, the fossil fuels demand was about 65% for Manufacturing, about 23% for Household/Service, 6% for Mining, 4% for Agriculture and 2% for Construction.

The fossil fuel demand varies from 25.21 Mtce in 1989 to 18.90 Mtce in 1995, 18.64 Mtce in 2000 and 19.99 Mtce in 2010 in the Low scenario. This demand will reach 19.21 Mtce in 1995, 19.33 Mtce in 2000 and 21.24 Mtce in year 2010 in the Basic scenario and 19.50 Mtce in 1995, 19.80 Mtce in 2000 and 21.85 Mtce in 2010 in the High scenario. These figures correspond to a decrease of the demand of fossil fuel over the study period at an average annual rate of 1.01% in the Low scenario, 0.81% in the Basic scenario and 0.68% in the High scenario.

The share of fossil fuels in the total commercial energy in the year 2010 will decrease from 33.34% in 1989 to 26.75% in the Low scenario, 26.57% in the Basic scenario and 25.89% in the High scenario. This decrease of the fossil fuels share in the total commercial energy is mainly due to the consideration of both a restructuring of the economic and to the growth of electricity penetration into thermal uses in Manufacturing.

Table 4.13 Distribution of Final Energy Demand by Energy Form

[Mtce]

	1989	1992	1995	2000	2005	2010
A. Low Scenario						
- Fossil	25.206	19.273	18.895	18.638	19.680	19.986
- District heat supply	19.246	13.551	13.736	14.668	17.018	18.355
- Soft solar	0	0.001	0.001	0.001	0.002	0.003
- Electricity	8.296	6.271	6.394	7.529	9.127	11.121
- Motor fuels	6.758	5.832	5.928	6.698	7.815	9.179
- Coal, spec. uses	5.737	5.730	5.721	5.713	5.706	5.702
- Feedstocks	10.377	10.377	10.377	10.377	10.377	10.377
Total commercial	75.620	61.035	61.052	63.625	69.724	74.723
B. Basic Scenario						
- Fossil	25.206	19.273	19.215	19.334	19.781	21.240
- District heat supply	19.246	13.551	14.009	15.280	17.075	19.250
- Soft solar	0	0.001	0.001	0.001	0.002	0.003
- Electricity	8.296	6.271	6.599	8.297	10.437	13.176
- Motor fuels	6.758	5.832	6.032	7.065	8.498	10.179
- Coal, spec. uses	5.737	5.730	5.721	5.714	5.706	5.702
- Feedstocks	10.377	10.377	10.377	10.377	10.377	10.377
Total commercial	75.620	61.035	61.954	66.067	71.878	79.930
C. High Scenario						
- Fossil	25.206	19.273	19.501	19.797	20.205	21.852
- District heat supply	19.246	13.551	14.255	15.689	17.467	20.155
- Soft solar	0	0.001	0.001	0.001	0.002	0.003
- Electricity	8.296	6.271	6.772	8.933	11.538	15.059
- Motor fuels	6.758	5.832	6.125	7.411	9.115	11.226
- Coal, spec. uses	5.737	5.730	5.721	5.714	5.706	5.702
- Feedstocks	10.377	10.377	10.377	10.377	10.377	10.377
Total commercial	75.620	61.035	62.753	67.923	74.412	84.377

4.3.2.2 District Heating

Total district heat (steam and hot water) is considered to be consumed for thermal purposes in Industry and for water and space heating in Household/Service. Total district heat supply in 1989 was about 19.25 Mtce (134.75 Pcal) which was consumed by 76.5% in Industry and 23.5% in Household/Service. In the same year, the amount of heat that could not be supplied from centralized sources, as a result of the imposed constraints, mainly in the Household/Service sector, was partially compensated with fossil fuels and partial, energy curtailments (about 4.41 Mtce).

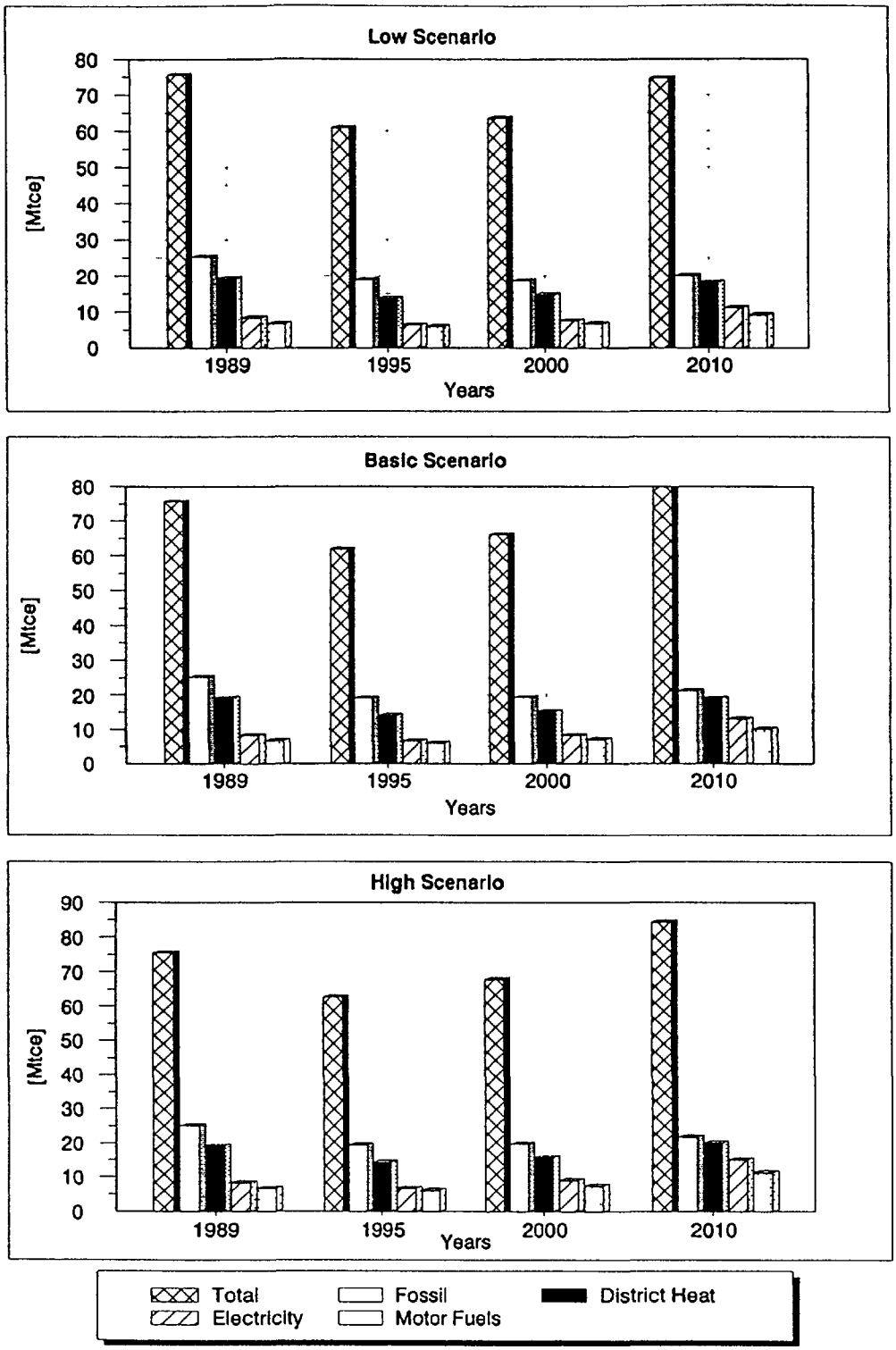


Figure 4.10 Distribution of Final Energy Demand by Energy Form

Total district heat supply is expected to be 13.74 Mtce in 1995, 14.67 Mtce in 2000 and 18.36 Mtce in 2010 (below the value of the base year) in Low scenario; 14.01 Mtce in 1995, 15.28 Mtce in 2000 and 19.25 Mtce in 2010 (equal to the value achieved in the base year) in Basic scenario; and 14.26 Mtce in 1995, 15.69 Mtce in 2000 and 20.16 Mtce in 2010 (about 4.76% higher than the value registered in 1989) in High scenario. The average annual growth rate of the district heating through the study period, represents -0.23% in the Low scenario and 0.22% in the High scenario.

The results indicated that by year 2010, it is expected that the share of the district heating in Industry should decrease at 66.6% in Low scenario, 68.8% in Basic scenario and 69.6% in High scenario, respectively, and the afferent ratio of the Household/Service sector, will properly increase.

4.3.2.3 Electricity

The total electricity demand in 1989 was about 8.30 Mtce (about 67.45 TWh) which was consumed by 85.0 % in industry, 4.3% in Transportation and 10.7% in Household and Service. The forecast of electricity demand is based on:

- the trend of the specific electricity intensity, determined by the growth of end-use efficiencies, in parallel with the growth of electricity penetration into thermal uses in Manufacturing;

- the growth of the number of dwellings, of the service floor area and the penetration of electricity in Household/Service sector.

The electricity demand is forecast to vary from 8.296 Mtce (67.55 TWh) in 1989 to 6.39 Mtce (51.98 TWh) in 1995, 7.53 Mtce (61.21 TWh) in 2000 and 11.12 Mtce (90.41 TWh) in 2010 in the Low scenario. This demand will reach 6.60 Mtce (53.65 TWh) in 1995, 8.30 Mtce (67.45 TWh) in 2000 and 13.18 Mtce (107.12 TWh) in the Basic scenario and 6.77 Mtce (55.06 TWh) in 1995, 8.93 Mtce (72.63 TWh) in 2000 and 15.06 Mtce (122.43 TWh) in 2010 in the High scenario. These represent average annual growth rates over the study period of about 1.4% in the Low scenario, 2.23% in the Basic scenario and 2.88% in the High scenario.

The share of electricity in total commercial final energy will grow from the level of the year 1989 (10.98%) to 14.88% in the Low scenario, 16.49% in the Basic scenario and 17.85% in the High scenario in year 2010.

The share of Transportation sector in the total electricity demand in 2010 will decrease to about 3.0-3.7%, the share of Industry will decrease to about 71-74% and the share of Household/Service sector will grow to about 23-25%.

4.3.2.4 Motor Fuels

In 1989, the motor fuels demand was about 6.76 Mtce, out of which about 48% for Transportation, 25% for Agriculture, 12% for Construction, 3% for Mining and 12% for Manufacturing. The share of motor fuels in the total national demand was about 8.9%.

The motor fuels demand is estimated, to be 5.9 Mtce in 1995, 6.7 Mtce in 2000 and 9.2 Mtce in 2010, in Low scenario; of 6.0 Mtce in 1995, 7.1 Mtce in 2000 and 10.2 Mtce in 2010 in Basic scenario, respectively of 6.1 Mtce in 1995, 7.4 Mtce in 2000 and 11.2 Mtce in 2010 in High scenario. These imply that the demand will increase with an average annual growth rate of about 1.5% in the Low scenario, 2.0% in the Basic scenario and 2.4% in the High scenario. As a result, the motor fuels weight in the country's total energy demand would increase from 8.9% in 1989 to 12.3% in Low scenario, 12.7% in Basic scenario and 13.3% in High scenario.

For 2010, the Transportation sector weight in the total demand of motor fuels is estimated to decrease from about 48% in 1989 to about 43% in Low scenario, 40% in Basic

scenario and 38% in High scenario subsequent to the stepwise replacement and improvement of the existing automotive park.

4.3.2.5 Other Energy Forms

This category includes the demand for coal as coke in steel industry and the natural gas and oil products as feedstock in the petrochemical industry.

These sectors of the Romanian economy are very energy intensive. In 1989 the demand for coke and feedstock represented about 21% of the total final energy demand of the country. For this reason, these sectors should be essentially reorganized under the Romanian economy transition from centrally planned economy to market-oriented one.

Due to the fact that the MAED methodology treatment of coke and feedstock demand was not conceived for modelling of economic crisis, such as the actual situation of Romania, the present study adopted the hypothesis of keeping the coke and feedstock demand of the level recorder in the base year (1989), considering that it will be separately calculated using other methods and based on a clear strategy concerning the steel and petrochemical industry.

4.3.3 Comparison of Results from Various Scenarios

A comparative analysis of the three scenarios adopted is worked-out for the reference years: base year (1989), 1995, 2000, and 2010.

In 1989, the total final energy demand of the country was about 75.6 Mtce, out of which about 76% in Industry, 4.8% in Transportation and 19.2% in Household/Service. The structure of energy was the following: 33.3% fossil fuels, 25.5% district heat, 11% electricity and 8.9% motor fuels.

The final energy demand forecast results for the three scenarios in 1995 indicates the following:

- Low scenario: 61.0 Mtce (68.4% in Industry, 5.7% in Transportation and 25.9% in Household/Service);
- Basic scenario: 61.9 Mtce (68.7% in Industry, 5.6% in Transportation and 25.7% in Household/Service);
- High scenario: 62.8 Mtce (68.9% in Industry, 5.7% in Transportation and 25.3% in Household/Service).

The structure of energy demand by energy form in year 1995 was the following: 31% fossil fuels, 22.5-22.7% district heat, 10.5-10.8% electricity and 9.7-9.8% motor fuels.

Very little differences are observed between the scenraio results for 1995 due to the assumptions that up to that year all scenarios assume that this corresponds to the period of restructuring of the economic programmes and that the effect of these policies will be noticed in the subsequent period.

The final energy demand resulting from the three scenarios for the year 2000 is as follows:

- Low scenario: 63 Mtce (70% in Industry, 5.9% in Transportation and 24.1% in Household/Service);

- Basic scenario: 66.1 Mtce (70% in Industry, 5.7% in Transportation and 24.3% in Household/Service);

- High scenario: 67.9 Mtce (70.7% in Industry, 5.7% in Transportation and 23.7% in Household/Service).

In year 2000, the final energy demand begins to show important differences among the scenarios in line with the assumptions for socieoeconomic and technological development. In the Low Scenario, with low annual growth rate of GDP and only slight technological improvements, the total final energy demand reaches the same level as in the High Scenario for the year 1995. In the High Scenario, with the intense rehabilitation and modernization process occurring in all fields of activity, the final energy demand is about 5 Mtce higher than in the Low Scenario for the same year.

In 2010 the breakdown of the total demand of final energy in Romania for the three scenarios is as follows:

- Low Scenario: 74.7 Mtce (72.6% in Industry, 5.9% in Transportation and 21.5% in Household/Service;

- Basic scenario 79.9 Mtce (73.6% in Industry, 5.6% in Transportation and 20.8% in Household/Service);

- High scenario 84.4 Mtce (74.4% in Industry, 5.6% in Transportation and 20% in Household/Service).

In the total final energy demand fossil fuels would represent 25.9-26.7%, district heat 23.9-24.6%, electricity 17.8-14.9% and motor fuels 13.3-12.3% in the same year.

At the horizon of the study, the differences between total final energy demand between the Low and High Scenario increases to about 10 Mtcoe. In addition, important changes are observed in the structure of the energy demand by energy form with respect to the one in the base year, in particular, the decrease of the contribution by fossil fuels and the increase of that of electricity and motor fuels.

4.4 Comparison of Final Energy Demand Results with Forecasts from other Studies

The results obtained from the utilization of the MAED model in forecasting the Romanian final energy demand could not be compared against other studies, basically because of the lack of published reports on such studies.

4.5 Analysis of Electricity Demand and Comparison with other Studies

The evolution of electricity demand forecast by means of the MAED model was compared with the values obtained in the study "Least Cost Capacity Development Study, Romania, stage I - Preliminary Report" performed by Ewbank Preece Ltd. in July 1992.

The Ewbank study forecasts the electricity demand for the period 1990-2010. The GDP growth and structure are based on the scenarios drawn up by World Bank in "Romania - the Challenge of Transition", adapted to the decrease of the production of 1991. The study proposes two scenarios (high and low).

Table 4.14 presents comparatively the evolution of GDP and of the electricity demand in the Ewbank Preece Ltd and MAED scenarios while Table 4.15 shows the structure of the electricity demand by sectors for the same scenarios. It can be noticed that the GDP projections from the Ewbank scenarios are very close to the MAED forecast, even if it starts from an over-estimated value for 1992, while the projection for the electricity demand in the Ewbank Study is considerably lower than the MAED results. This is the consequence of some assumptions made in the Ewbank study relating to the electricity intensities (reduction with 22-27% during 1992-2010), which are estimated to be very difficult to achieve.

Table 4.14 Comparison of total GDP and Total Final Electricity Between the MAED and Ewbank Preece Ltd

	1989	1992	1995	2000	2010
1. Total GDP [10^9 US$][(1)]					
a) MAED					
- Low Scenario	45.6	31.3	31.1	37.1	57.2
- Basic Scenario	45.6	31.3	32.1	40.5	66.1
- High Scenario	45.6	31.3	33.0	43.7	75.0
b) Ewbank Preece Ltd					
- Low Scenario	45.6	34.9	34.6	41.8	56.2
- High Scenario	45.6	35.7	38.6	49.7	77.2
2. Average annual growth rate of GDP [%][(2)]					
a) MAED					
- Low Scenario	-	-11.8	-6.2	-1.9	1.1
- Basic Scenario	-	-11.8	-5.7	-1.1	1.8
- High Scenario	-	-11.8	-5.2	-0.4	2.4
b) Ewbank Preece Ltd					
- Low Scenario	-	-8.5	-4.5	-0.8	1.0
- High Scenario	-	-7.8	-2.7	0.8	2.5
3. Total Electricity [TWh]					
a) MAED					
- Low Scenario	67.54	50.98	51.98	61.21	90.41
- Basic Scenario	67.54	50.98	53.65	67.45	107.12
- High Scenario	67.54	50.98	55.06	72.63	122.43
b) Ewbank Preece Ltd					
- Low Scenario	67.54	49.781	47.602	55.298	71.088
- High Scenario	67.54	50.289	50.886	62.682	94.071

(1) GDP expressed in US$ 1989: 1 US$ = 17.5 Lei (1989)
(2) Average annual growth rate versus the base year (1989)

Table 4.15 Comparison of Sectorial Share of Electricity Demand Between the MAED and Ewbank Preece Ltd[1]

Unit : [%]

	1989	1992	1995	2000	2010
1. MAED					
a) Low Scenario					
Industry	85.0	72.0	69.8	70.0	71.7
Transportation	4.3	5.5	5.4	4.8	3.7
Household/Service	10.7	22.5	24.7	25.3	24.6
b) Basic Scenario					
Industry	85.0	72.0	69.8	70.8	73.2
Transportation	4.3	5.5	5.3	4.4	3.3
Household/Service	10.7	22.5	24.9	24.8	23.5
c) High Scenario					
Industry	85.0	72.0	69.9	71.2	74.1
Transportation	4.3	5.5	5.2	4.1	3.0
Household/Service	10.7	22.5	24.9	24.6	23.0
2. Ewbank Preece Ltd					
a) Low Scenario					
Industry	85.0	69.0	65.3	62.5	59.3
Transportation	4.3	4.5	5.5	4.7	4.5
Household/Service	10.7	26.5	29.2	32.8	36.2
b) High Scenario					
Industry	85.0	68.4	64.8	60.6	56.6
Transportation	4.3	4.6	5.0	5.0	4.2
Household/Service	10.7	27.0	30.0	34.4	39.2

(1) Average annual growth rate versus the base year (1989).

Chapter 5

ANALYSIS OF ELECTRICAL LOAD DEMAND

5.1 Introduction

The energy demand forecasted for the three scenarios by means of Module 1 of MAED is expressed in terms of final energy (at the gate of the consumer), i.e. it excludes losses in conversion, transmission and distribution and the energy sector's own consumption.

In order to determine the amount of electricity that should be supplied by power plants the losses in transmission and distribution were added to the total demand of electricity by means of the ELOSS parameter, and the consumption of refineries and cokeries works was forecasted ouside the MAED model and was added directly to the electricity demand of industry, to be considered in the calculations of Module 2 of MAED.

Table 5.1 presents the resulting demands of electricity for the three scenarios taken into account for the economic optimization of the electric generating system expansion.

Proper planning of the electricity supply to cope with the increasing demand asks for not only the annual electricity demand but also for the corresponding peak and hourly loads every year. The distribution of the electrical load over time which characterizes the pattern of

Table 5.1 Electricity Generation Requirements[1]

Unit: GWh/year

		1989	1992	1995	2000	2005	2010
Low scenario	Energy generated	76036	58300	58700	69300	83700	102100
	Losses in T & D	4304	4863	4896	5780	6981	8516
	Refinery own consumption	4208	2393	1766	2242	2435	3068
	Final energy (Module 1 MAED)	67524	51044	52038	61278	74284	90516
Basic scenario	Energy generated	76036	58300	60660	76370	95800	121000
	Losses in T & D	4304	4863	5060	6370	7991	10093
	Refinery own consumption	4208	2393	1889	2474	2860	3668
	Final energy (Module 1 MAED)	67524	51044	53711	67526	84949	107239
High scenario	Energy generated	76036	58300	62200	82300	106100	138400
	Losses in T & D	4304	4863	5188	6865	8850	11544
	Refinery own consumption	4208	2393	1895	2728	3340	4287
	Final energy (Module 1 MAED)	67524	51044	55117	72707	93910	122569

[1] Net generation

electricity consumption is very important for the selection of the generating units to be added to the existing system each year and for the optimal operation of the power system.

Module 2 of MAED is designed to convert the total annual electricity demand (in terms of energy) of each economic sector to the power demand (load curve) first for each sector and then for the total system.

Module 3 of MAED transforms the hourly load curve of the power system into period load duration curves (LDC), i.e. in to the format required by the WASP model.

5.2 Assumptions on Electricity Consumption Pattern

In Module 2 of the MAED model, electricity consumers are aggregated into two major sectors, i,e. Industry (including Agriculture, Construction, Mining and all Manufacturing subsectors considered by Module 1) plus the Transportation sector and the Household/Service sector. Each major sector can be divided into up to five types of clients (subsectors).

Due to the large share of the Manufacturing sector in the total electricity consumption in Romania, a particular use of the Module 2 has been adopted by displacing Agriculture, Construction and Mining sectors from the first major sector to the second one and by properly modifying the results of Module 1 passed to Module 2.

In this way each sector and subsector considered in Module 1 is represented also in Module 2 as a type of client, i.e.:

- Industry/Transportation:
    - * Basic materials;
    - * Machinery & equipment;
    - * Non-durable goods;
    - * Miscellaneous;
    - * Transportation.
- Household/Service:
    - * Agriculture (including irrigations);
    - * Construction;
    - * Mining;
    - * Household;
    - * Service.

The consumption features of each subsector as well as the its share within the sector and the share of sector within the total consumption determine the pattern of the load curve for the whole system.

The characteristics of the electricity demand of each sector were determined on the basis of four "load modulation coefficients" shaping the hourly consumption changes, i.e.:

- the coefficients determined by the annual rate of growth of electricity consumption of the sector (trend coefficient);

- the modulation coefficients expressing the electricity consumption of each sector according to the type of day (for eight day types) for each season;

- the seasonal coefficients to express variations of electricity consumption of each sector according to the time of the year or season;

- the hourly variation of the electricity consumption of each type of client for each sector, season and type of day. This is accompanied by the share of each subsector in the total daily consumption of electricity for the sector.

The multiplication of these coefficients for a given hour in the year by the average electricity demand of the sector allows obtaining the value of the electric load imposed by the sector at the respective hour.

Regarding the future evolution of these coefficients, the following assumptions have been made:

- trend coefficients were derived from the growth of electricity demand during the study period;

- daily weight coefficients have been considered constant within the study period, with the exception of the share of Saturday which was changed against the base year 1989. This is because saturday became the second holiday in the week since 1990;

- clients' share within total daily consumption of the sectors were prediced based on the changing trends in the future, meaning the reduction of the Basic materials share and the growth of Non-durable goods, Household and Service sectors share;

- hourly variation of the electricity consumption of the various clients was generally considered constant, but with certain variations according to the expected rehabilitation of some industries and with the change of some energy intensities.

It should be noticed that electricity consumption before 1989 had several particularities which will not be found in the future. Thus, within 1984-1989, electricity consumption increased but the peak loads had been cut off due to some fuel restrictions, which determined a load factor of about 80-84%. After 1989 the electricity consumption drastically decreased and, beginning with the 1993-1995 period, the electricity consumption is expected to increase in the absence of the previous restrictions.

5.3 Analysis of Consumption and Load Duration Curves

5.3.1 Reconstruction of the Load Curves for the Base Year

The determination of the load characteristics for the MAED study requires hourly load records by type of client for a minimum of one year. In Romania such records are available for 72 types of economic activities (excluding households).

The main problem in reconstructing the load curves for the base year was to aggregate the 72 types of economic activities into the nine economic subsectors previously mentioned (the tenth subsector is Household). The selected aggregation is consistent with the regrouping of the economic activities for GDP formation and energy consumption calculation presented in Appendix A, Tables A.2 and A.14.

Finally, the load curves reconstructed with Modules 2 and 3 of MAED have been compared with the actual load curves for the total system in the base year. Table 5.2 shows the actual and reconstructed peak load and electricity consumption by period (quarter) in the base year. As can be seen in this table, the results of MAED were in close agreement with the statistical data for the base year.

Table 5.2 Comparison of Actual and Reconstructed 1989 Peak Load and Energy Requirements by Period

Period (quarter)	Peak load (MW)		Energy (GWh)	
	Actual	MAED	Actual	MAED
I	10528	10540	18848	18838
II	10381	10378	18797	18810
III	10497	10500	19076	19080
IV	10560	10563	19315	19307

5.3.2 Future Consumption Shares

A factor which has a special impact on the peak load is represented by the share of each type of client in the total electricity demand of the sector. Out of the statistical data presented in Appendix D one can notice the big share of the Basic materials subsector which has varied within the range of 64-70%. On the other hand, the relatively significant share of Agriculture (19-25%) is due mainly to irrigation whose consumption is seasonable, especially in summer.

Table 5.3 shows the evolution of various clients' shares within the two sectors: Industry/Transport and Household/Service, for the three scenarios. One can notice in the first major sector the big share of the Basic Materials subsector. Although its share decreases slightly in time, it will remain at the level of 67% of the respective sector until the year 2010 in all three scenarios. It should be noted that the electricity consumption in cokeries and refineries was assumed to be grouped under the consumption by the Basic Materials subsector of the Manufacturing Sector.

The Machinery & Equipment subsector practically keeps a constant share in all three scenarios (13-15%), slightly reducing in the years 1992 and 1995. The shares of the three other subsectors: Non-durable goods, Miscellaneous and Transportation are quite reduced and have almost the same trend in all three scenarios.

Within the second major sector, Agriculture keeps a quite identical share in the three scenarios, with a slight increasing trend in the second part of the study period from 18% in 1995 up to about 22-23% in 2010. The construction subsector has the same share in all three scenarios with a decreasing trend from 8% in 1989 to 3% in 2010. The mining subsector has

Table 5.3 Consumption Share by Type of Client

Unit: %

		1989	1992	1995	2000	2005	2010
Low scenario	Industry/Transport:						
	* Basic materials	70	68	66	66	67	67
	* Machinery & equipment	15	13	14	14	15	15
	* Non-durable goods	6	7	7	7	7	7
	* Miscellaneous	3	3	3	4	4	4
	* Transportation	6	9	10	9	7	7
	Household/Service:						
	* Agriculture (incl. irrigation)	23	19	18	19	20	22
	* Construction	8	5	4	4	4	3
	* Mining	30	18	21	20	20	19
	* Household	23	30	30	30	30	30
	* Service	16	27	27	27	26	26
Basic scenario	Industry/Transport:						
	* Basic materials	70	68	66	66	67	67
	* Machinery & equipment	15	13	14	15	15	15
	* Non-durable goods	6	7	7	7	7	8
	* Miscellaneous	3	3	4	4	4	4
	* Transportation	6	9	9	8	7	6
	Household/Service:						
	* Agriculture (incl. irrigation)	23	19	18	19	21	22
	* Construction	8	5	4	4	4	3
	* Mining	30	18	21	20	20	20
	* Household	23	30	30	30	30	30
	* Service	16	27	27	27	25	25
High scenario	Industry/Transport:						
	* Basic materials	70	68	66	67	67	67
	* Machinery & equipment	15	13	14	15	15	16
	* Non-durable goods	6	7	7	7	8	8
	* Miscellaneous	3	3	4	4	4	4
	* Transportation	6	9	9	7	6	5
	Household/Service:						
	* Agriculture (incl. irrigation)	23	19	18	19	21	23
	* Construction	8	5	4	4	4	3
	* Mining	30	18	21	21	21	20
	* Household	23	30	30	30	28	28
	* Service	16	27	27	26	26	26

quite the same share in all three scenarios and over the study period (18-21%), except for the base year (30%).

The other two subsectors: Household and Service have an increasing share over time, towards 54-56% of the total sector in 2010. Their share is slightly higher in the Low and Basic scenario, against the High scenario.

5.3.3 Future System Peak Load

Before 1989, the losses in transmission and distribution were almost constant, at about 6% of the total consumption. In 1990 and 1991 the losses grew to about 9% due to the changes in the structure of the economy, namely the increase of the weight of the medium and

low voltage consumption. This latter figure was taken into account to establish the electricity generation requirements throughout the study period (see Table 5.1).

Based on these electricity requirements, on the consumption share of each subsector and its load characteristics, the peak load value, as well as its average annual growth rate was established for the reference years (see Table 5.4). The peak load annual growth rate follows the electricity demand trend.

Table 5.4 System Peak Load Requirements

Year	Low scenario		Basic scenario		High scenario	
	MW	% Increase	MW	% Increase	MW	% Increase
1989	10563	-	10563	-	10563	-
1990	9923	-6.06	9923	-6.06	9923	-6.06
1991	9321	-6.06	9321	-6.06	9321	-6.06
1992	8756	-6.06	8756	-6.06	8756	-6.06
1993	8814	0.65	8910	1.76	8985	2.61
1994	8872	0.65	9067	1.76	9219	2.61
1995	8930	0.65	9227	1.76	9460	2.61
1996	9247	3.55	9671	4.81	10010	5.81
1997	9575	3.55	10136	4.81	10592	5.81
1998	9914	3.55	10623	4.81	11208	5.81
1999	10266	3.55	11134	4.81	11860	5.81
2000	10630	3.55	11670	4.81	12550	5.81
2001	11077	4.20	12244	4.92	13224	5.37
2002	11542	4.20	12847	4.92	13933	5.37
2003	12028	4.20	13480	4.92	14681	5.37
2004	12533	4.20	14144	4.92	15470	5.37
2005	13060	4.20	14840	4.92	16300	5.37
2006	13609	4.21	15587	5.03	17249	5.82
2007	14183	4.21	16371	5.03	18254	5.82
2008	14780	4.21	17195	5.03	19317	5.82
2009	15402	4.21	18061	5.03	20442	5.82
2010	16050	4.21	18970	5.03	21633	5.82

In the Low scenario, the decrease of electricity consumption during the 1989-1992 period is followed by a slow growth of about 0.65% per year during 1993-1995, and a more emphasized growth of about 3.6% between 1995-2000 and 4.2% within 2000-2010 period.

In the Basic and High scenario, the growth rates are higher: 1.76% and 2.61% respectively, until 1995, about 4.81% and 5.81% between 1995 and 2000 and about 5% and 5.6% respectively, during the 2000-2010 period.

Under these conditions in 2010, the peak load is estimated to be about 16,000 MW, in the Low scenario, 19,000 MW in the Basic scenario and 21,600 MW in the High scenario.

Table 5.5 summarizes the main features of the electricity generation system for the reference years. It is to be noticed a slight reduction of the load factor until 2010, with quite low differences between scenarios, since the clients' shares vary quite little.

Table 5.5 Main Features of Electricity Generation System

Year	Peak (MW)			Energy (GWh/yr)			Load factor (%)		
	Low	Basic	High	Low	Basic	High	Low	Basic	High
1989	10563	10563	10563	76036	76036	76036	82 17	82 17	82 17
1990	9923	9923	9923						
1991	9321	9321	9321						
1992	8756	8756	8756	58300	58300	58300	75 80	75 80	75 80
1993	8814	8910	8985						
1994	8872	9067	9219						
1995	8930	9227	9460	58700	60660	62200	75 04	75 05	75 07
1996	9247	9671	10010						
1997	9575	10136	10592						
1998	9914	10623	11208						
1999	10266	11134	11860						
2000	10630	11670	12550	69300	76370	82300	74 20	74 50	74 66
2001	11077	12244	13224						
2002	11542	12847	13933						
2003	12028	13480	14681						
2004	12533	14144	15470						
2005	13060	14840	16300	83700	95800	106100	73 17	73 69	74 31
2006	13609	15587	17249						
2007	14183	16371	18254						
2008	14780	17195	19317						
2009	15402	18061	20442						
2010	16050	18970	21633	102100	121000	138400	72 61	72 81	73 03

5.3.4 Comparison of Results with other Load Forecasts

Another forecast was carried out by Ewbank Preece in the paper entitled "Least Cost Capacity Development Study, Romania-July 1992"

In this paper the electricity demand and peak load forecast are based on the statistical data beginning with 1980, concerning the electricity consumption and the average annual growth rates by the main categories of customers The Ewbank Preece forecast is quite close to the MAED Low scenario.

Table 5.6 shows the comparison of MAED Low scenario and Ewbank Preece forecasts of electricity generation and peak load requirements.

Table 5.6 Comparison of MAED and Ewbank Preece Forecasts

Year	Peak load				Electricity generation			
	EWBANK Scenario MW	MAED Low Scenario MW	Difference EWBANK-MAED		EWBANK Scenario GWh	MAED Low Scenario GWh	Difference EWBANK-MAED	
			MW	%			GWh	%
1992	8534	8756	-222	-2.60	55317	58300	-2983	-5.39
1995	8961	8930	31	0.34	55975	58700	-2725	-4.87
2000	11464	10630	834	7.27	68950	69300	-350	-0.51
2005	13956	13060	896	6.42	82718	83700	-982	-1.19
2010	17653	16050	1603	9.08	103478	102100	1378	1.33

Figures 5.1 and 5.2 present also the evolution of the peak load and electricity generation in the three scenarios taken into account in the MAED study, as well as according to the Ewbank Preece forecasting.

5.4 Conclusions

The peak load slightly decreased between 1989-1992 with values that are identical in all three scenarios.

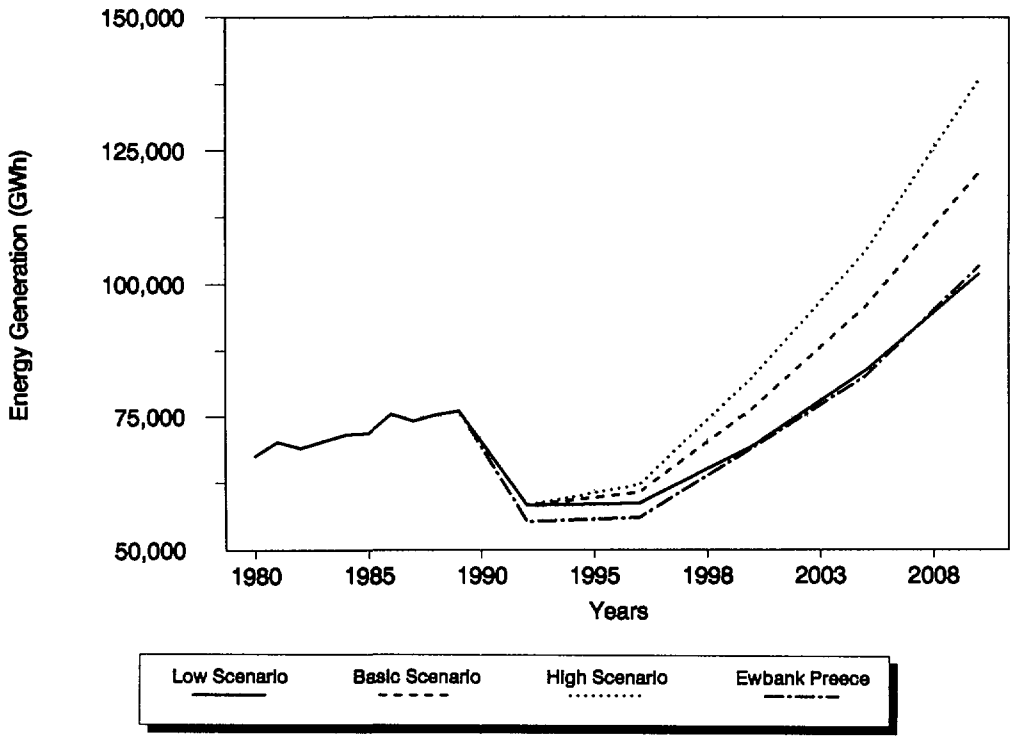


Figure 5.1 Forecast of Energy Generation

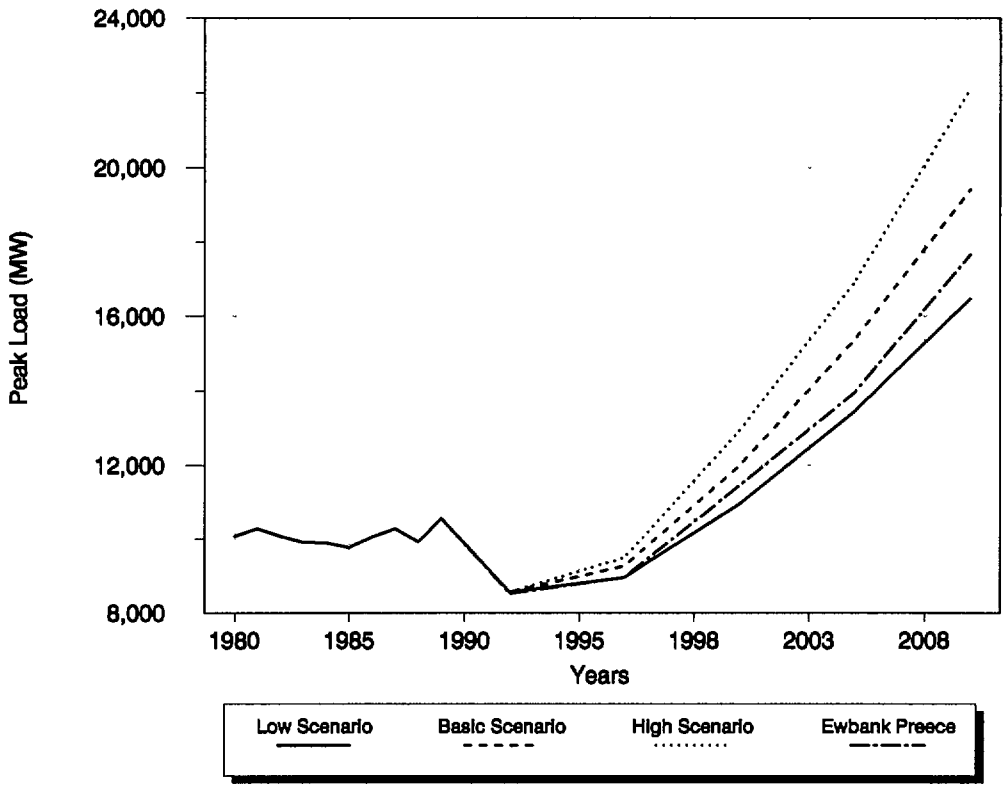


Figure 5.2 Forecast of Peak Load

After 1992, a growth will follow until 2010, with an average annual rate of about 3.4% in the Low scenario, about 4.4% in the Basic scenario and about 5.2% in the High scenario.

Under this growth, the system peak load in 2010 will reach around 16,000 MW in the Low scenario, 19,000 MW in the Basic scenario and 21,600 MW in the High scenario.

Regarding the increase of the peak load from year to year, it varies in the Low scenario from about 60 MW/year, in the first years after 1992 up to about 600 MW/year, towards the year 2010. For the Basic and High scenarios, this increase is more significant: from around 150 MW/year to about 900 MW/year and from about 230 MW/year to 1,200 MW/year, respectively, over the same years.

Concerning the load factor, it is to be noticed a slightly decreasing trend until the end of the study period in all scenarios, its lowest value reaching 72.61% in the Low scenario in the year 2010, while in the Basic and High scenario, the minimum value will be 72.81% and 73.03% respectively in the same year.

The study of load curves by means of MAED methodologies, requires a great number of input data concerning the various types of customers, the shape of the daily consumption and its variation during the year, etc. All these data involve a careful survey of the main consumers to be able to determine their features as accurately as possible. Certain works will be undertaken in this respect in the country, in order to bring up to date the already existing data and at the same time referring to an ever larger number of important customers, and taking into account the evolution of the structure of various economic branches.

Chapter 6

ELECTRICITY GENERATION SYSTEM EXPANSION ANALYSIS

6.1 Introduction

Romania's electricity demand until the year 2010 for the three scenarios that are the object of this study have been presented in Chapter 5. In order to meet these levels of electricity demand, optimal expansion programmes for the power generating system have been determined using the WASP III model (microcomputer version ELECTRIC-ENPEP).

When comparing the levels of electricity demand in Romania, in the far future, and the levels of electricity generation achieved until 1991, it should be noticed that the existing power plants cover the forecasted demand in all three scenarios, up to a certain point of the study period, offering the possibility to perform rehabilitation works for some units. These works would extend the operation of thermal units beyond their design life or improve the current performance of some other units.

A feature of the Romanian electric power system is the existence of a quite important installed capacity in cogeneration units, either in operation or under construction. At present, the opportunity of concluding the cogeneration units under construction is analyzed according to the remaining investments needed to complete those plants and the amount of thermal energy that should be supplied by each plant. Since the WASP program cannot analyze thermal energy supply, the cogeneration plants were modeled exogenously so that they might cover the thermal energy demand.

Another issue that influenced the optimization process of the power plants expansion programme is the fact that the first nuclear power plant of Romania is under construction at Cernavodă. This plant had been initially designed with 5 CANDU units of 700 MW each, with different stages of completion and various percentage of remaining investments costs.

6.2 Basic Input Data

The Romanian Electricity Authority-RENEL provided statistical data concerning the operation of existing power plants. These data have been analyzed and processed according to the WASP-III model requirements. Some other information which was not available from RENEL, was extracted from the study "Least Cost Capacity Development" made by Ewbank Preece for Romania and from various technical papers and adjusted to local conditions.

6.2.1 Planning Period

The time horizon considered in the ENPP study for the generation expansion analysis was taken as 1992-2010. This covers several years when decisions on investments for short and medium term may need to be made.

In addition, the study also considered a post planning period (2010-2015) to account for operation for several years of the plants (intensive in capital cost requirements) that may be added to the system during the planning period. Within this post planning period the demand of electricity is kept constant to the level of year 2010 so that neither retirements nor additions of units will be necessary.

6.2.2 Load Forecasts

The load curves forecast in the three scenarios Low, Basic and High was determined by means of the MAED model and the resulting peak loads are shown in Table 5.4. According to this forecast the annual growth of the peak load is estimated between 60 MW in the Low scenario through the 1992-1995 period and up to 1200 MW in the High scenario through the years 2005-2010. By year 2010, peak load will reach about 16,000 MW in the Low Scenario, 19,000 MW in the Basic Scenario and 21,600 MW in the High Scenario, by year 2010.

The load duration curves (LDC) resulting from Module 3 of MAED for the four periods of the reference years have been used in the analyses of WASP model.

Since only the information for the reference years is available to Module 3, it is necessary to make an additional hypothesis for intermediate years. For this reason, MAED assumes that the LDC per period that are calculated for each reference year are the same for all the years between the previous last and current reference year. For the present study this hypothesis has been modified in order to keep constant the LDC per period between the current reference year and the next reference year. For example, the default MAED assumption is to keep constant the LDC for the year 2000 during the period 1996-2000, while for the present study the same LDCs were kept constant during the period 2000-2004.

6.2.3 Existing and Committed Generating Units

6.2.3.1 Existing System

At beginning of 1992, the total installed capacity of the Romanian power plants was 22,367 MW, out of which 21,485 MW in the interconnected system and 882 MW in isolated power plants. The analyses made in the present study refer to the interconnected system, which in 1992 has the following structure of installed capacity (MW):

Total			21,485
of which:	in hydro power plants		5,569
	in thermal power plants		15,916
	of which:	coal - fired	8,627
		condensation plants	6,754
		cogeneration plants	1,873
		oil & gas - fired	7,289
		condensation plants	2,830
		cogeneration plants	4,459

Appendix E presents the list of the power plants within the interconnected system, the number of units and their size, the total installed capacity of the power plants, their grouping by type and codes.

Two hypotheses were taken into account in connection with the existing power plants evolution: *Hypothesis 1*, which takes into account the retirement of thermal units beyond their design life, and *Hypothesis 2*, which had in view the rehabilitation of some thermal units beyond their design life and of some units that are working inefficiently .

The second hypothesis reduces the need for new investments and improves the availability of the electric power system. Retirements of existing hydro plants were not taken into account for the present analyses.

6.2.3.2 Committed System

At the beginning of the study period (1992) several power plants of different types: hydro, thermal, classical and nuclear, have been under construction in different completion stages. The plants considered as firmly committed additions are listed in Table 6.1.

Table 6.1 Firm Committed Additions Up to 1997

Plant type	Capacity (MW)	Fuel Type	Year of Commissioning	Plant Code
1. New units				
Hydroelectric	10		1992	HV 12
	12		1992	HB 04
	22		1993	HV 13
	13		1995	HB 05
Thermal units				
• cogeneration units	50	lignite	1993	TC 50 # 18
	50	hydrocarbon	1993	50 TH # 7
	50	lignite	1994	TC 50 # 19
	50	lignite	1995	TC 50 # 20
	50	lignite	1996	TC 50 # 21
	50	lignite	1996	TC 50 # 22
• condensing units	330	lignite	1994	330 T # 8
2. Rehabilitated units	330	lignite	1996	A3 TR # 1
	330	lignite	1996	A3 TR # 2

At present, RENEL analyzes the opportunity of completing these plants having in view both the acute lack of funds for investments and the considerable decrease of the electricity consumption of the Romanian economy, as well as the decrease of the demand for thermal energy of some customers for which cogeneration plants are under construction.

For these reasons, among those hydro power plants, under construction or firmly committed the present analyses considered only those plants requiring some small additional capital costs. Hydro power plants being in the initial stage of the construction have been included among the hydro candidate plants.

Out of the cogeneration plants under construction, only the units in advanced stage of completion and those which should cover some firm demand for thermal energy have considered as firmly committed. The thermal classical plants under construction are almost all cogeneration power plants, except for one condensation unit of 330 MW at Turceni.

Although the first two units of the Cernavodă NPP are in an advanced completion stage, they were not included in the list of firmly committed units and were included in the list of candidate units, for two reasons:

1) to be able to determine the exact year in which new capacity will be required having in view that during the first years of the study period the electricity demand can be met by the existing plants, due to the decrease of electricity demand that has been experienced since 1989.

2) to be able to make an economic comparison between the Cernavodă units and some thermal units if they are rehabilitated.

6.2.4 Candidate Plants for Future Electric System Expansion

For the future development of the electric power generating system both thermal power plants (classical and nuclear) and hydro power plants, were considered as candidates for expansion.

Since the available fuels from domestic resources do not meet the demand for the existing thermal power plants and for those under construction, the fuel needed for the expansion candidates, thermal-classical plants, is supposed to be supplied by imported fuel.

6.2.4.1 Thermal Power Plants (classical and nuclear)

The study was carried out considering as expansion candidates 12 types of new thermal-power plants, 10 classical types and 2 nuclear ones, which are presented in Table 6.2.

The classical thermal-power plants have different unit size (300 MW, 500 MW and 660 MW) utilising imported coal, fuel oil and natural gas. The plants working on coal or on fuel oil are considered in two versions: with flue gas desulphurisation (FGD) installations or without such installations. The plants working on natural gas are of the combined cycle type.

The nuclear power plants considered as expansion candidates included two plants provided with units of 700 MW each. Both types have the same technical and economic parameters, proper to the Cernavodă NPP units, except for the specific capital cost. For the first type of nuclear plant expansion candidate the specific capital cost represents the average values of the investments needed to complete the first two units of Cernavodă NPP and for the second type, it represents the average of the three following units.

Table 6.3 presents the technical parameters of each type of thermal-candidate plant.

In order to analyze the efficiency of the rehabilitation of some existing thermal units compared to the installation of new power plants, 9 types of units of the existing system have been considered. After rehabilitation, those plants will have the technical features shown in Table 6.4

6.2.4.2 Hydroelectric Power Plants

Referring to the hydroelectric power plants, as it had been previously stated, those in an advanced stage of completion were considered as firmly committed and included in the so called fixed system of the study. The remaining hydroelectric power plants were considered

Table 6.2 Thermal Plant Candidates

	Plant Type	Gross Capacity (MW)	Code Name	Fuel Source
1	FGD Coal 300 MW	300	CD 3	Imported
2	No FGD Coal 300 MW	330	C- 3	Imported
3	FGD Oil 300 MW	300	OD 3	Imported
4	No FGD Oil 300 MW	300	O- 3	Imported
5	FGD Coal 500 mw	500	CD 5	Imported
6	No FGD Coal 500 MW	500	C- 5	Imported
7	FGD Oil 500 MW	500	OD 5	Imported
8	No FGD Oil 500 MW	500	O- 5	Imported
9	Combined Cycle Gas 330 MW	330	CC 3	Imported
10	Combined Cycle Gas 660 MW	660	CC 6	Imported
11	Cernavodă Nuclear Power Plant (unit 1, 2)	700	NUC1	Domestic
12	Cernavodă Nuclear Power Plant (unit 3, 4 and 5)	700	NUC2	Domestic

Note FGD - Flue Gas Desulphurisation

Table 6.3 Technical Characteristics of Thermal Candidates

	Code Name	Capacity (MW)		Heat Rate (kcal/kWh)		Fuel Type	FOR (%)	Scheduled Maintenance (days/yr)
		Min	Max	Base Load	Average Incremental			
1	CD 3	112	280	2640	2400	Coal	8 8	37
2	C- 3	113	311	2620	2380	Coal	7 8	37
3	OD 3	114	284	2631	2377	Oil	8 0	34
4	O- 3	114	286	2615	2362	Oil	7 0	34
5	CD 5	188	470	2590	2340	Coal	10 0	40
6	C- 5	189	473	2570	2320	Coal	9 0	40
7	OD 5	190	475	2575	2325	Oil	9 2	38
8	O- 5	191	478	2562	2312	Oil	8 2	38
9	CC 3	129	322	2070	1630	Natural Gas	4 0	32
10	CC 6	258	646	1930	1710	Natural Gas	4 0	34
11	NUC1	127	633	3257	2887	Nuclear Fuel	10 0	33
12	NUC2	127	633	3257	2887	Nuclear Fuel	10 0	33

Note FOR-Forced Outage Rate

Table 6.4 Technical Characteristics of Rehabilitated Thermal Plants

	Code Name in		Capacity (MW)		Heat Rate (kcal/kWh)		Fuel Type	FOR (%)	Scheduled Mainten (days/yr)
	FIXSYS	VARSYS	Min	Max	Base Load	Average Incremental			
1	20BL	BL20	80	189	2587	2358	Oil+Nat Gas	7 0	51
2	33BL	BL33	142	284	2520	2377	Oil+Nat Gas	6 0	55
3	20BZ	BZ20	80	188	2995	2603	Oil+Nat Gas	7 0	51
4	20BO	BO20	79	186	3082	2707	Oil+Nat Gas	7 0	51
5	315I	I315	135	258	3214	2954	Coal	8 0	47
6	20DE	DE20	80	175	2960	2765	Coal	7 0	53
7	20DO	DOI2	80	156	3447	3115	Coal	8 0	53
8	330T	A3TR	135	258	3057	2954	Coal	20 0	47
9	330T	A2TR	135	243	4187	3980	Coal	30 0	47

as candidates ranking them according to their efficiency and actual completion stage. These plants have been grouped into 18 projects according to their features and to the possibility of simultaneous commissioning, as shown in Table 6.5. These 18 hydroelectric projects totalize an installed capacity of 2000 MW, with an average generation capacity of about 4240 GWh/year.

Table 6.5 Hydroelectric Projects Candidates

	Code	MW
1	VH01	182
2	VH02	67
3	VH03	139
4	VH04	76
5	VH05	166
6	VH06	82
7	VH07	120
8	VH08	52
9	VH09	85
10	VH10	83
11	VH11	130
12	VH12	67
13	VH13	53
14	VH14	143
15	VH15	220
16	VH16	200
17	VH17	71
18	VH18	83

6.2.5 Other Input Information

6.2.5.1 Economic Parameters

The study was carried out in 1989 US$ constant prices (i.e. without taking into account inflation). In addition, the analyses were performed using a discount rate of 10% and a unit price of the unsupplied energy of 1 US$/kWh.

6.2.5.2 Project Costs

Table 6.6 shows the project costs for the candidate plants expressed in US$. The values of the project investment cost without the interest during construction (IDC) for the classical thermal power plants (10 types) suits to the values included in the study made by Ewbank Preece for Romania ("Least Cost Development Study").

The project cost for the two types of nuclear plants and for the 18 hydro projects were provided by RENEL without IDC. It must be stated that project costs without IDC for the nuclear units of Cernavodă and some hydro projects (VH01-VH06) are calculated for the remainder of the plants that are still to be completed at the beginning of the study period according to their stage of construction. The figures for IDC represent percentages of the total project cost and were calculated according to the respective time of construction for each project and the assumed discount rate.

Table 6.6 Project Cost and Economic Parameters (cost in 1992 US$)

	Project	Project Cost without IDC (US$/kW)	Construction Time (years)	DR=10%	
				% IDC	Project Cost with IDC (US$/kW)
a) New Thermal Power Plants					
1	CD 3	1350	6	22.67	1764
2	C- 3	1162	6	22.67	1503
3	OD 3	1088	6	22.67	1406
4	O- 3	905	6	22.67	1170
5	CD 5	1193	6	22.67	1543
6	C- 5	1028	6	22.67	1329
7	OD 5	962	6	22.67	1244
8	O- 5	790	6	22.67	1022
9	CC 3	788	5	19.21	975
10	CC 6	707	5	19.21	875
11	NUC1	1611	3	11.92	1839
12	NUC2	2197	5	19.21	2719
b) Rehabilitated Thermal Power Plants					
1	BL20	69	2	8.08	75
2	BL33	169	2	8.08	184
3	BZ20	90	2	8.08	98
4	BO20	91	2	8.08	99
5	I315	244	2	8.08	265
6	DE20	194	2	8.08	211
7	DOI2	128	2	8.08	139
8	A3TR	271	2	8.08	295
9	A2TR	82	2	8.08	89
c) Hydro Power Plants					
1	VH01	1593	4	15.63	1955
2	VH02	1420	4	15.63	1743
3	VH03	1500	4	15.63	1841
4	VH04	2100	4	15.63	2578
5	VH05	1100	4	15.63	1350
6	VH06	2300	4	15.63	2823
7	VH07	1900	7	26.00	2568
8	VH08	2000	7	26.00	2703
9	VH09	2180	7	26.00	2946
10	VH10	2000	7	26.00	2703
11	VH11	2150	7	26.00	2906
12	VH12	2500	7	26.00	3378
13	VH13	2600	7	26.00	3514
14	VH14	2600	7	26.00	3514
15	VH15	2500	7	26.00	3378
16	VH16	2600	7	26.00	3514
17	VH17	2700	7	26.00	3649
18	VH18	2800	7	26.00	3784

6.2.5.3 Fuel Prices

The fuel prices used within the WASP analyses are at the level of 1992, the base year of the study. As previously indicated, no escalation or inflation effects were considered for these prices. To account for inflationary effects, sensitivity analyses of the resulting optimal programs for various fuel price forecasts have been performed.

Since the prices of fuels in Romania are still aligning to the international levels, the prices for 1992 proposed by Ewbank Preece, for imported fuel oil (with 1% S and 3.5% S and more), natural gas and coal, were adopted in this study.

For the thermal plants based on the use of hydrocarbons (natural gas and oil) existing at the beginning of 1992, the following assumptions were made:

- Luduş and Fîntînele are supplied with natural gas from the gas fields in the area;
- the other condensation plants working on hydrocarbons and cogeneration plants use both gas and oil to certain ratios;
- the existing plants are not equipped with FGD installations and therefore, they should be provided with 1% S fuel oil.

For each existing condensation plant the delivered price of coal registered in the first quarter of 1992 (aligned to the international price of coal) and the transportation cost were taken into account. Similarly, for the existing lignite cogeneration plants an average price of the lignite transportation expenditures was determined.

In relation to the fuel cost for the expansion candidate plants, the following assumptions were made:

- the plants without FGD use fuels with lower sulphur content than those with FGD and therefore, they use more expensive fuels;
- the added fuel for coal-fired plants is fuel oil to a 5% ratio;

Table 6.7 presents the evolution of fuel price in the long term that has been forecasted by Ewbank Preece.

6.2.5.4 Optimization Constraints

For certain types of new plants, the maximum allowed number of units throughout the whole study period has been limited. For NUC1, this number is 2 to reflect the first two units of Cernavodă NPP and for NUC2, the number is 3 corresponding to the three following units of Cernavodă. For rehabilitated thermal units, the maximum allowed number of units is limited to the number of the units existing in the respective plant.

For the reliability index "Loss of Load Probability" (LOLP) a value of one day/year (0.274%) was taken into account.

The minimum reserve margin is set to 25% in the first part of the study period when several units with relatively high values of forced outage rates are in operation, while towards

Table 6.7 Fuel Price Forecast

	Unit	1992	1995	2000	2005	2010
Heavy Oil (CIF Constanţa) (42600 kJ/kg)						
3 5% S	US$/t	83 70	102 50	130 80	130 80	130 80
	US$/GJ	1 96	2 41	3 07	3 07	3 07
1 0% S	US$/t	111 40	130 20	158 50	161 00	163 60
	US$/GJ	2 61	3 06	3 72	3 78	3 84
Diesel (CIF Constanţa)	US$/t	181 00	199 50	247 40	247 40	247 40
(44700 kJ/kg)	US$/GJ	4 05	4 46	5 53	5 53	5 53
Coal (CIF Constanţa)	US$/t	42 50	42 50	46 60	46 60	46 60
(5900 kcal/kg)	US$/GJ	1 72	1 72	1 89	1 89	1 89
Natural Gas (at border)	US$/1000 m^3	95 00	114 40	147 00	147 00	147 00
(8000 kcal/m^3, S<10 mg/m^3)	US$/GJ	2 84	3 42	4 39	4 39	4 39
Liquefied Natural Gas	US$/1000 m^3	117 40	140 10	178 20	178 20	178 20
	US$/GJ	3 00	3 58	4 55	4 55	4 55

Note: Fuel prices do not include the transport cost.
The transport costs are
Heavy Oil 0.300 US$/GJ
Diesel 0.300 US$/GJ
Coal 0.600 US$/GJ
Natural Gas 0.315 US$/GJ

the study horizon the minimum reserve margin is decreased to 20% This takes into account the reduction of the share of these units in the total installed capacity, due to retirement or rehabilitation

6.2.5.5 Plant Loading Order

The loading order of the power plants was requested to be generated by WASP following a basic economic loading order based on the operation of plants at full capacity It was assumed for these calculations that the spinning reserve contribution for each hydro plant and hydrocarbons condensation plant was 10% of their capacity

Chapter 7

RESULTS OF THE ANALYSIS OF THE GENERATION SYSTEM EXPANSION

The analyses for determining optimal expansion plans of the power generation system were performed for the three scenarios of the electricity demand discussed in Chapter 5.

The reference optimal solutions have been obtained using an annual discount rate of 10%, while keeping constant the levels of investment cost, fuel prices, and operating costs throughout the study period. All costs are expressed in US$ constant money of 1992. Sensitivity analyses on the optimal expansion plans have been performed for variations of fuel prices and the discount rate.

7.1. Screening Curves Analysis

A simplified comparative analyses of the expansion candidates was carried out taking into consideration both the construction of new plants and the rehabilitation of some condensation thermal power plants of over 200 MW capacity to cover the future electricity demand, as it has been discussed in Chapter 6. This would have implied increasing the number of candidate thermal power plants up to 21: 10 types of new classical thermal power plants, 2 types of nuclear power plants, and 9 types of units that are candidates for rehabilitation.

In order to facilitate optimization by means of WASP and to reduce the number of alternatives subject to analysis, a new arrangement of the candidate plants was made outside the WASP model. This analysis was based on a ranking economic criterion of the expansion candidates, which was determined by calculating for each plant the total cost per kW according to the capacity factor of the plant.

The results of this analysis, shown in Table 7.1 and Fig. 7.1 through Fig. 7.8 (see details in Table E.2 of Appendix E), are meant to serve for guiding the optimization process. Table 7.1 lists the unit generation cost and annual production cost for the 5 units of the Cernavodă NPP, the combined cycle CC6 and for the various types of units taken into consideration for rehabilitation (BL20, BL33, BZ20, BO20, I315, DE20, DOI2, A3TR, A2TR).

On the basis of this analysis, the following classes of 12 thermal plants and 1 hydro power plant have been taken into consideration to define expansion configurations:

- for the baseload portion of the load curve - gas combined cycle units (1), nuclear units of Cernavodă NPP type (2), and rehabilitated condensation units (9) based either on hydrocarbons or on coal;
- hydraulic plants for peak and intermediate portions of the load curve (1).

The NPP unit 1 with a total generating cost of 35 $/MWh has been ranked on the first position among all expansion alternatives. It should be stated that this unit is under an advanced stage of construction.

The 6th position given to Cernavodă unit 2 with a cost of 40 $/MWh can be explained by the fact that this unit is already under construction and part of the investment has already been achieved.

Table 7.1 Results of Screening Curves Analysis

	Unit	Load factor [%]	Capital Cost $/kW	Unit Generation cost $/kWh	Annual Production cost $/kW-year
1	Unit 1 (700 MW) Cernavodă NUC1	80	1755	0.035	245
2	Rehabilitation 210 MW, Brăila	80	96	0.036	253
3	Rehabilitation 330 MW, Brăila	80	222	0.038	268
4	Rehabilitation 210 MW, Deva	80	256	0.039	276
5	Rehabilitation 200 MW, Brazi	80	131	0.040	279
6	Unit 2 (700 MW) Cernavodă NUC1	80	2091	0.040	281
7	Combined cycle 660 MW, CC 6	87	889	0.040	302
8	Rehabilitation 200 MW, Borzesti	80	131	0.041	288
9	Rehabilitation 315 MW, Isalnita	80	322	0.042	294
10	Rehabilitation 200 MW, Doicesti	70	169	0.043	265
11	Rehabilitation 330 MW, Rovinari	70	358	0.044	268
12	Rehabilitation 330 MW, Turceni(A3)	70	358	0.044	268
13	Unit 3 (700 MW) Cernavodă NUC2	80	2444	0.045	319
14	Unit 4 (700 MW) Cernavodă NUC2	80	2843	0.051	361
15	Unit 5 (700 MW) Cernavodă NUC2	80	2843	0.051	361
16	Rehabilitation 330 MW, Turceni(A2)	60	108	0.052	310

The combined cycle units running on gas occupy the 7th position (with a generating cost of 40 $/MWh) just after unit 2 of Cernavodă NPP, but before Cernavodă NPP unit 3. As to the rehabilitated units, most of them have been ranked, before Cernavodă NPP unit 3 from the economic point of view.

The above analysis proved that for the values of the load factor adequate for base load operation (70-85%), combined cycle plants with natural gas are competitive with the nuclear units of Cernavodă. Other types of plants based on fuel oil and coal, either with or without FGD installations are less economical than the nuclear plant. For this reason, for the WASP only nuclear units and combined cycle plants were considered for baseload operation.

For the load factor of 20-30%, adequate for peaking units, hydro projects VH1 to VH7 resulted economically attractive. These projects are in an advanced construction stage.

7.2. Results of the Reference Optimal Solutions

Several rehabilitated, condensation, thermal power units running on brown coal, pit coal, natural gas and fuel oil are included as part of the power plants optimal expansion programmes (also called reference optimal solutions). These optimal solutions also included units number 1 and 2 of Cernavodă NPP of 700 MW each, already under an advanced completion phase, and steam-gas combined cycle units of 660 MW for meeting the baseload portion of the load curve, and hydro power plants for meeting the peak and intermediate zones of the load curves.

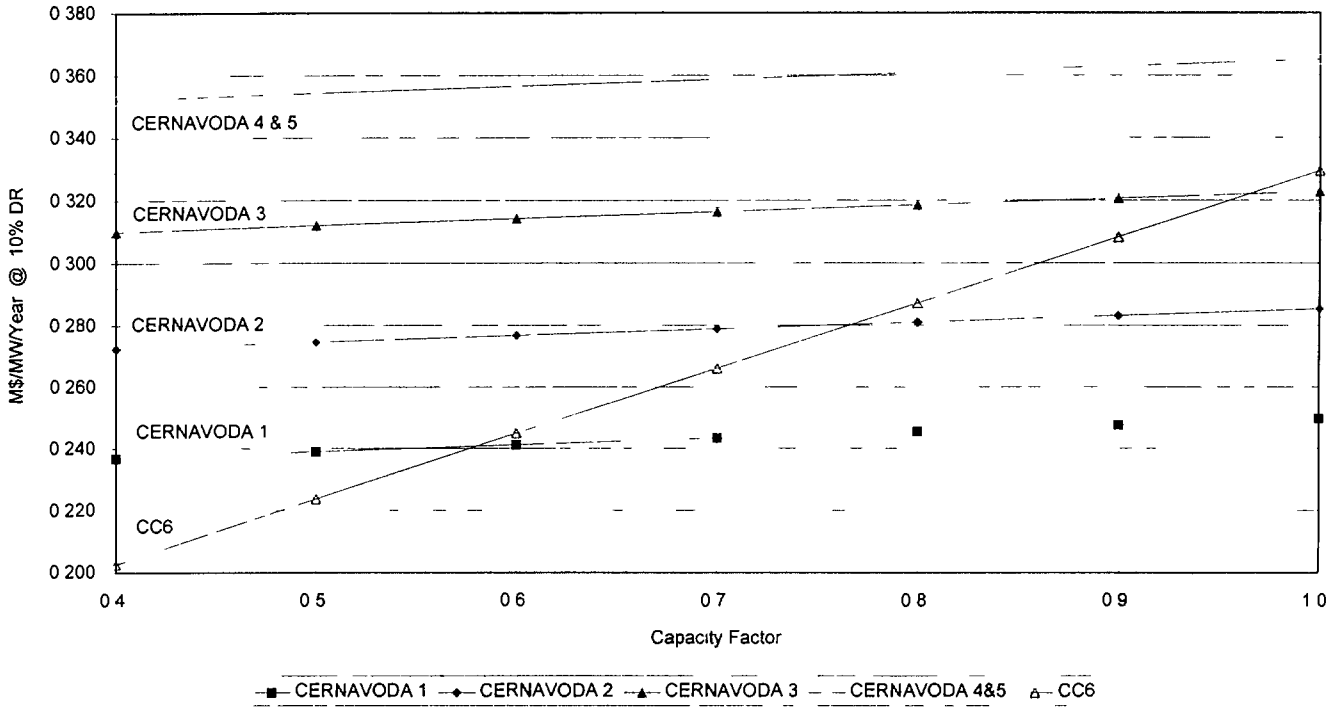


Figure 7 1 Screening Curve Analysis - Annual Production Costs for Nuclear and Combined Cycle Options

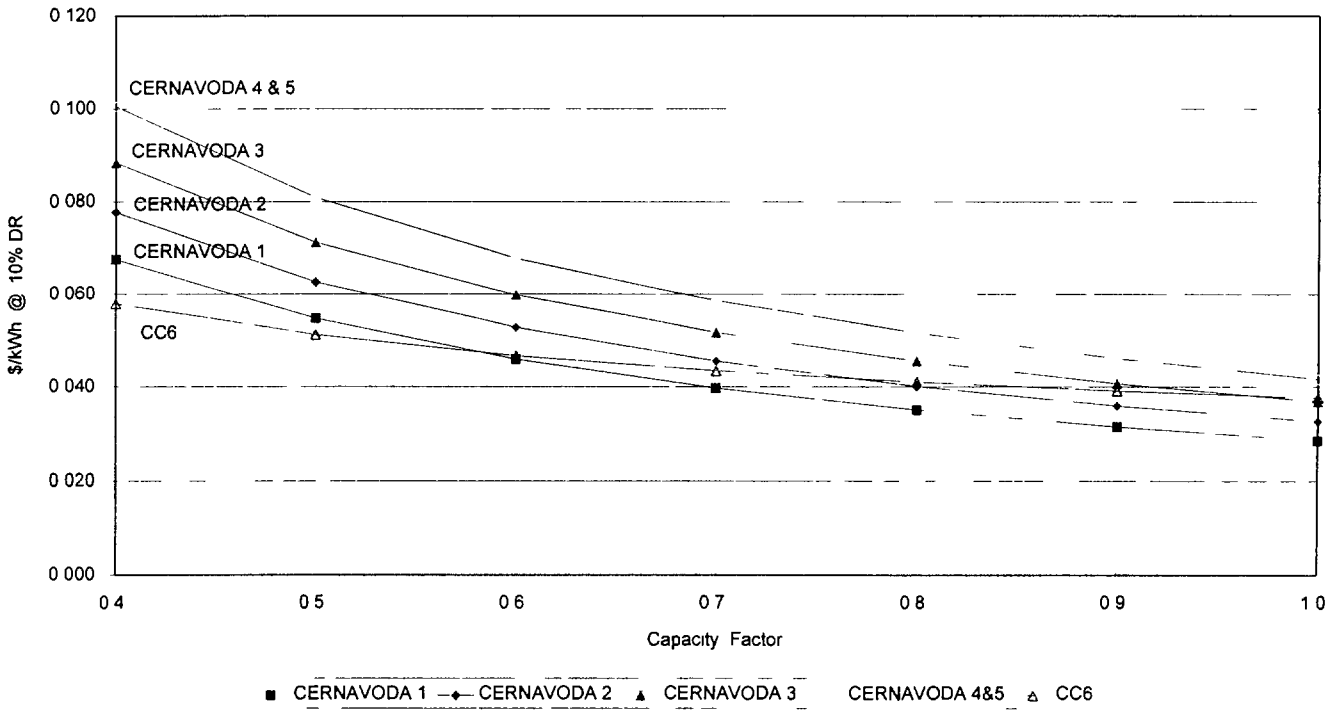


Figure 7 2 Screening Curve Analysis - Unit Generation Costs for Nuclear and Combined Cycle Options

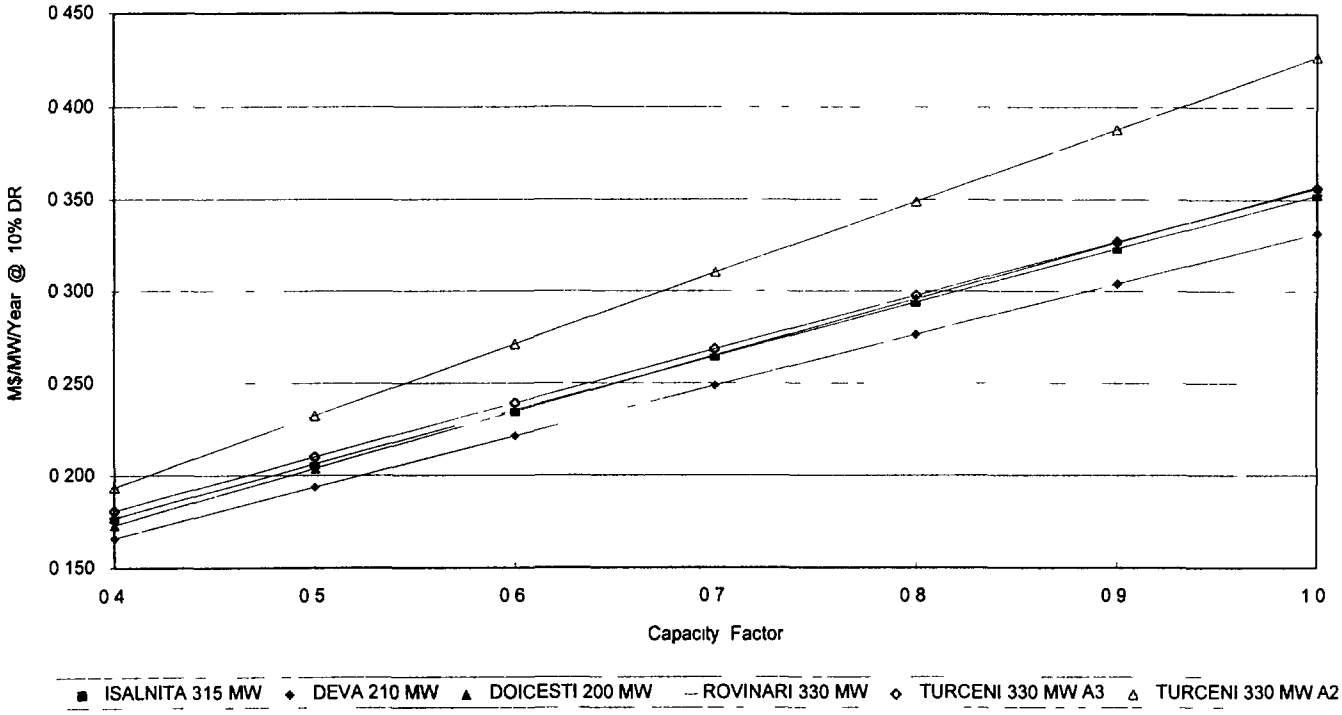


Figure 7.3 Screening Curve Analysis - Annual Production Costs for Coal Options

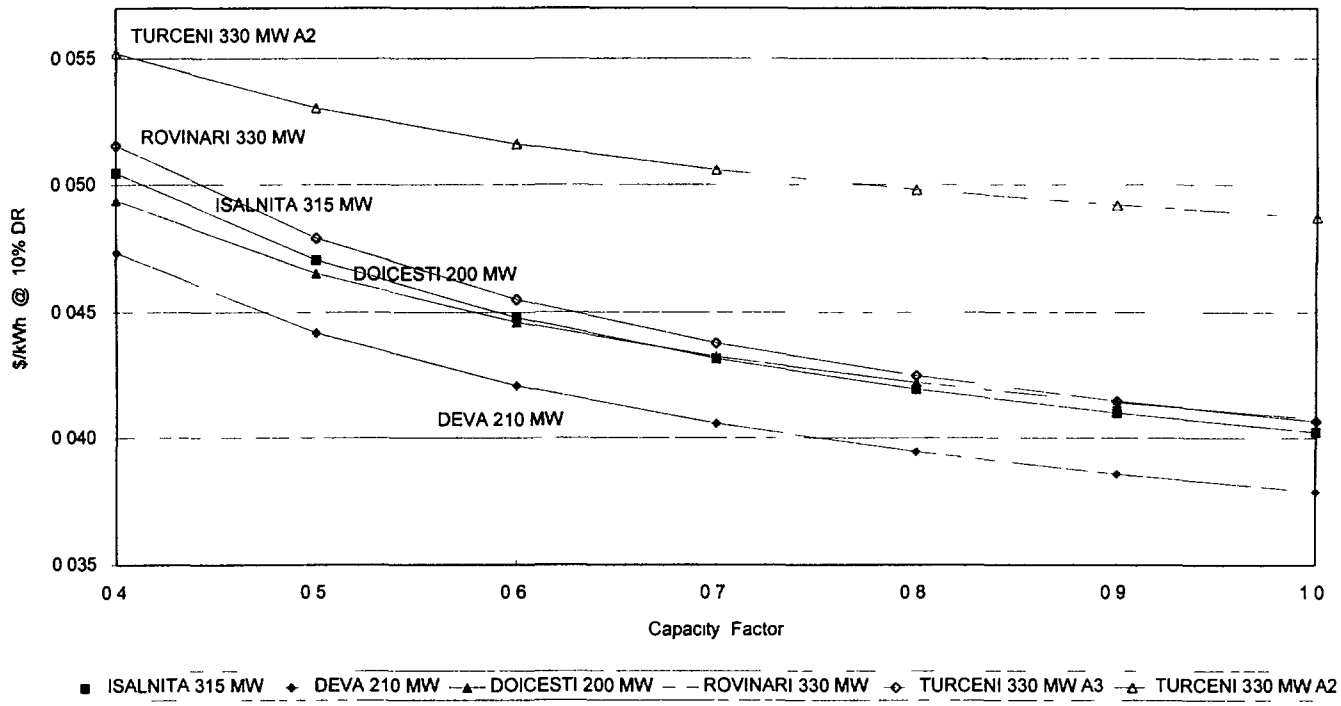


Figure 7 4 Screening Curve Analysis - Unit Generation Costs for Coal Options

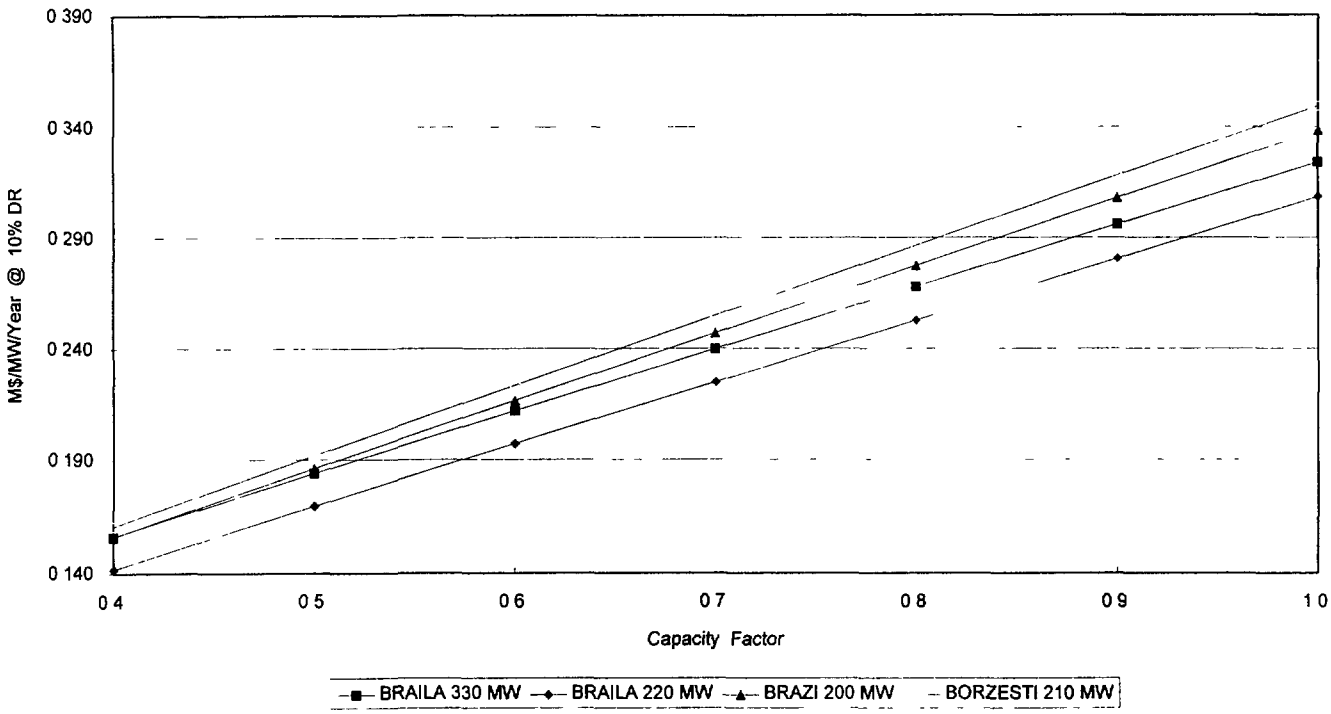


Figure 7.5 Screening Curve Analysis - Annual Production Costs for Oil and Gas Options

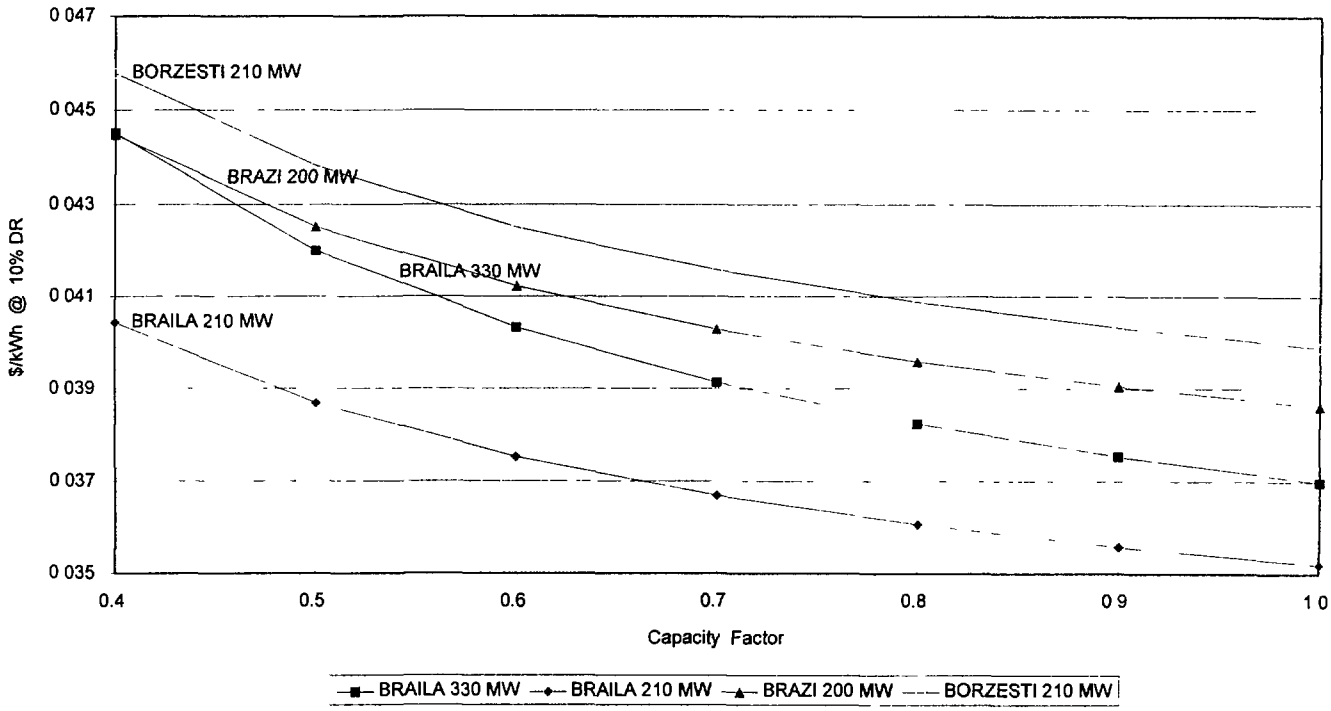


Figure 7.6 Screening Curve Analysis - Unit Generation Costs for Oil and Gas Options

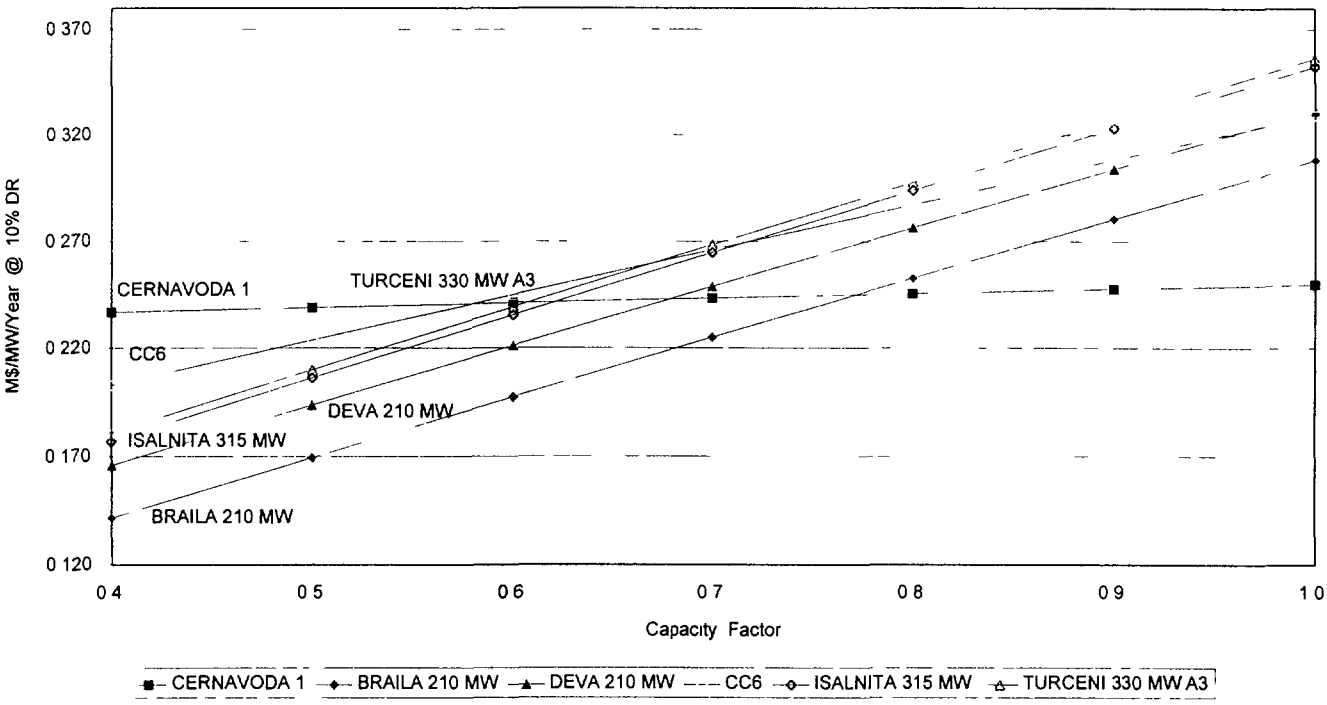


Figure 7.7 Screening Curve Analysis - Annual Production Costs for Mixed Options

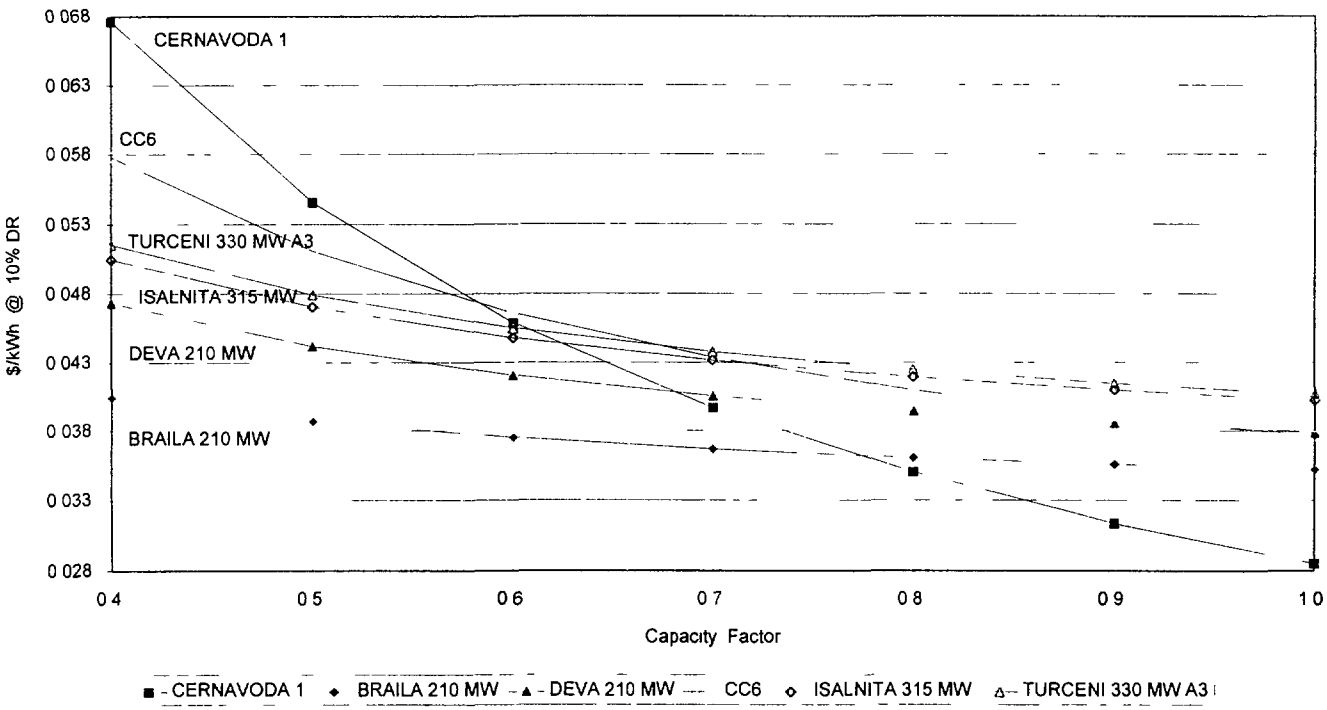


Figure 7.8 Screening Curve Analysis - Unit Generation Cost for Mixed Options

The sequence of plant additions and the value of the objective function for each reference solution are shown in Table 7.2. The objective function represents the present value of the cumulative annual expansion expenditures expressed in terms of 1992 US$, with all values discounted to 1st January 1992. Figure 7.9 graphically displays the evolution of the installed capacity and peak load for each of the scenarios. The schedule of additions of generating plant is shown in more detail in Appendix E

Table 7.2 Comparative Sequence of Projects (DR 10%)[1]

	Low	Basic	High
1992-1996	committed additions[2]	committed additions[2]	committed additions[2]
1997	-	-	NUC1#1
1998	-	NUC1#1	NUC1#2
1999	NUC1#1	CC6#1 NUC1#2	CC6#1-2
2000	I315#1 NUC1#2	I315#1	I315#1 CC6#3
2001	I315#2 CC6#1	I315#2 CC6#2	DE20#1 CC6#4
2002	DE20#1-2	BO20#1 CC6#3 DE20#1	BO20#1-2 CC6#5 DE20#2 I315#2
2003	DE20#3-4 A3TR#3 CC6#2	BO20#2 DE20#2 CC6#4-5	DE20#3-4 A3TR#3 CC6#6
2004	A3TR#4 CC6#3-4	BZ20#1 DE20#3 VH01	BZ20#1-2 CC6#7
2005	BL20#1 BZ20#1	BL20#1 DE20#4 CC#6	BL20#1 CC6#8-9
2006	BL20#2-3 BZ20#2 BO20#1	BL20#2 BZ20#2 CC6#7 VH02	BL20#2-3 CC6#10 VH01
2007	BO20#2 CC6#5	CC6#8-9	CC6#11-12
2008	CC6#6	BL20#3 CC6#10	CC6#13-14
2009	CC6#7	CC6#11-12	CC6#15-16 VH02
2010	CC6#8 VH01	CC6#13	CC6#17,18,19
Objective Function US$ Million (1992 value)	18106	20585	22894

(1) Code names of the plants are listed in Tables 6 1, 6 3 and 6 4 The symbol # is followed by the unit number of the same plant

(2) Committed additions are listed in Table 7 2

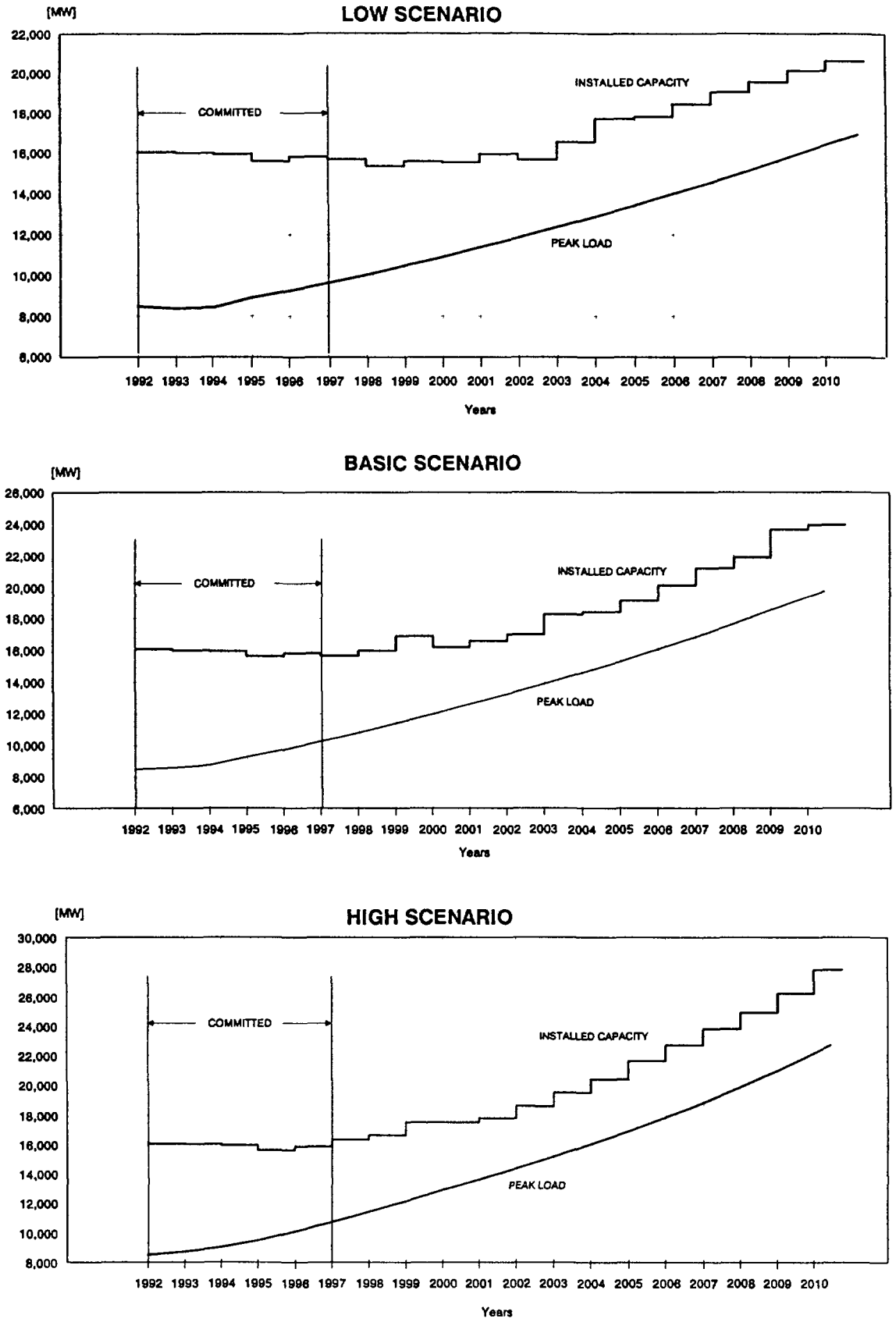


Figure 7.9 Evolution of Installed Capacity According to the Scenarios

Table 7.3 System Generating Capacity in 2010

	Low Scenario	Basic Scenario	High Scenario
Total added capacity (MW) (1)	10179	13476	17352
Total system capacity (MW)	20646	23943	27819
Number of Units Added			
Rehabilitation of Existing Units			
Oil and Natural Gas:			
BL20 (189 MW)	3	3	3
BZ20 (188 MW)	2	2	2
BO20 (186 MW)	2	2	2
Total	7	7	7
(%)(2)	6.4	5.5	4.7
Coal:			
I315 (258 MW)	2	2	2
DE20 (175 MW)	4	4	4
A3TR (258 MW)	4	4	4
Total	10	10	10
(%)(2)	11.0	9.4	8.1
New Units			
Combined Cycle (646 MW)			
Units	8	13	19
%(2)	25.0	35.0	44.0
Hydro projects			
MW	182	249	249
%(2)	0.9	1.0	0.9
Nuclear (633 MW)			
Units	2	2	2
%(2)	6.1	5.3	4.6

(1) From 1992 to 2010

(2) Percentage referred to total system capacity

Taking into consideration the total capacity retirements of 7070 MW over the study period, the system generating capacity in year 2010, for the three reference expansion plans, is summarized in Table 7.3, with particular emphasis on coal, gas and nuclear units.

Both condensation and district heating plants, existing or in construction that have been selected to be rehabilitated by the study, will consume 49-53 millions of tons of lignite in year 2010.

The installed capacity of combined cycle plants based on natural gas capacity will grow from 0 MW in 1992 to 5168 MW in 2010 in the Low scenario, 8398 MW in the Basic scenario and 12274 MW in High scenario, respectively. In year 2010, the corresponding power plants

of this type will require 8790, 14017 and 18940 millions of m^3 of natural gas to be provided by imports, in the Low, Basic and High scenario, respectively

Total investments over the whole study period are 7914, 10863 and 14254 million US$ for the Low, Basic and High Scenario, respectively On the other hand, the annual capital costs are between 0 16% to 3 78% of the annual GDP in the Low scenario, between 0 25% to 3 93% of the annual GDP in the Basic scenario, and between 0 24% to 4 56% of the annual GDP in High scenario (Table 7 4)

7.3 Sensitivity Analysis

Sensitivity analyses had in view to examine the impact of fuel prices increases, in particular natural gas price at different levels, and the annual discount rate on the optimal expansion programmes

Table 7.4 Comparison of Capital Costs against GDP

	LOW			BASIC			HIGH		
	GDP [10^9 US$]	Capital cost		GDP [10^9 US$]	Capital cost		GDP [10^9 US$]	Capital cost	
		[10^6 US$]	% (1)		[10^6 US$]	% (1)		[10^6US$]	% (1)
1992	31 3	0	0	31 3	0	0	31 3	0	0
1993	30 4	0	0	30 9	0	0	31 3	0	0
1994	30 5	49 9	0 16	31 2	76 5	0 25	31 9	210 0	0 66
1995	31 1	102 4	0 33	32 1	305 2	0 95	33 0	1025 8	3 11
1996	31 9	133 5	0 42	33 2	929 4	2 80	34 4	1568 7	4 56
1997	33 0	801 0	2 43	34 7	1362 5	3 93	36 2	1151 4	3 18
1998	34 3	1297 5	3 78	36 6	877 7	2 40	38 6	643 5	1 67
1999	35 7	859 3	2 51	38 5	664 5	1 73	41 1	623 3	1 52
2000	37 1	515 5	1 39	40 5	794 4	1 96	43 7	663 2	1 52
2001	38 7	683 5	1 77	42 6	747 8	1 76	46 1	821 3	1 78
2002	40 4	586 7	1 45	44 7	658 9	1 47	48 7	990 4	2 03
2003	42 1	296 0	0 70	47 0	738 6	1 57	51 5	1087 5	2 11
2004	43 9	363 4	0 83	49 4	875 4	1 77	54 3	1090 2	2 01
2005	45 9	576 8	1 26	51 9	884 3	1 70	57 3	1177 7	2 06
2006	48 0	614 1	1 28	54 5	796 9	1 46	60 5	1215 9	2 01
2007	50 1	572 8	1 143	57 1	641 6	1 12	63 8	1124 2	1 76
2008	52 4	369 5	0 71	60 0	350 8	0 59	67 3	691 5	1 03
2009	54 7	92 6	0 16	62 9	158 2	0 25	71 1	167 5	0 24
2010	57 2	-	-	66 1	-	-	75 0	-	-
TOTAL		7914 4			10862 7			14254 3	

(1) Referred to total GDP

The natural gas price escalation by 5% within the 1992-1995 period, by 23% within the 1996-2000 period and by 45% within 2001-2010 period results in bringing the nuclear program at the same level as that of the combined cycle power plants.

The price escalation of all classical fuels by 20% (including natural gas) results in totally detaching the nuclear power program from the expansion plans and their replacement by combined cycle units. The difference between the objective functions being of 10% in Low scenario, 7.5% in Basic scenario and 5.2% in High scenario.

If the discount rate is decreased to 8%, the nuclear power plants program becomes more attractive than that based on natural gas combined cycle units (Table 7.5). The increase of the discount rate to 15% is in favor to the gas combined cycle units even under the conditions of natural gas price increase by 5% during the period 1992 - 1995, 23% between 1996 - 2000 and by 45% between 2001 - 2010.

7.4 Comparison between the Optimal Solutions and Other Studies

In 1993, a study of the development of the electricity generating capacities was concluded by a foreign Consulting Company with regard to the period 1992-2020 on account of minimum costs (LCCD).

Table 7.5 Results of the Sensitivity Analysis

10^9 US$

	Low	Basic	High
1. Reference Optimal Solution (discount rate =10%)	18.106	20.585	22.894
2. Sensitivity Analysis			
2.1 Discount Rate : 8%	21.347	24.343	27.150
15%	12.761	14.404	15.922
2.2 Escalation of natural gas price by 5% (1992-1995); 23% (1996-2000); and 45% (2001-2010) and Discount Rate: 8%	22.343	26.012	29.457
10%	18.825	21.796	24.574
15%	13.093	14.972	16.711
2.3 Escalation of all fuel prices by 20% and Discount Rate: 10%	20.752	23.512	26.051
3. Change of CC6 with NUC2 and Discount Rate: 8%	19.903	24.935	28.198
10%	18.686	21.741	24.705
15%	13.598	15.996	18.326

In the LCCD, for the basic cases, the analyses take into consideration the same values as in the ENPP study for the discount rate 10%, the reliability limit (1 day/year), the same fuel prices as in the base year 1992, as well as the same alternatives for expanding the system capacities (new capacities and rehabilitations).

As distinct components it is noted the use of some price escalation for fuels over the study period, within the optimization process, even in the basic cases. As to the optimization technique the procedure used is the minimization of the objective function value by early retirement of some inefficient units and installing new capacities, in exchange.

Compared to the assumptions and results of the ENPP study, some differences are worth mentioning, such as:

a) consideration of a smaller number of units for rehabilitation and retirement of some units before their economic life;

b) the recommendation that the completion of units 2 and 3 of Cernavodă NPP be dependent on availability of capital in Romania and that unit 3 be considered as a marginal option to be examined in close detail against the other alternatives, and

c) for the peak portion of the electric load curve, open cycle 225 MW gas turbine units were found more economic than hydro power plants with seasonal reservoirs.

A common feature of both the LCCD and ENPP studies is the addition of new power plants of 660 MW combined cycle type based on natural gas. In the High Scenario of electricity demand forecast, up to 24 units of combined cycle were selected by year 2020, whereas in the Low scenario this figure is 17 units.

7.5 General Remarks about the Power Development Plans

Due to the transition crisis that Romania is facing and the structural adjustment that the economy will be subject to, it has been assessed that the electricity demand will start growing, after a strong fall until 1992- 1993, up to 102.1 TWh in the Low Scenario, 121.0 TWh and 138.4 TWh in the Basic and High Scenarios, respectively, in 2010. In keeping with this electricity demand forecast, new capacities for generating electricity are requested, beginning with 1997 in the High Scenario, 1998 in the Basic Scenario, and 1999 in the Low Scenario.

The first added capacities in all reference (optimal) expansion plans are the nuclear power plants of NUC1 type which are the units 1 and 2 of NPP Cernavodă, already in an advanced stage of construction. According to the evolution of electricity demand, the two nuclear units will have to be commissioned in the indicated years. The years in which the first nuclear power plant of NUC1 type units will be commissioned are shown in Table 7.6. These dates for commissioning the units are much delayed compared with the ones when the construction can be completed.

Table 7.6 Year of addition of the First Units of Cernavodă NPP

	Low Scenario	Basic Scenario	High Scenario
Unit 1	1999	1998	1997
Unit 2	2000	1999	1998

The rehabilitation of 7 condensation units of 200 MW based on natural gas and fuel oil, of 4 units of 200 MW based on hard coal and 6 units of 300 MW based on lignite was also preferable in all reference expansion plans.

For this reason, the analyses regarding rehabilitation works should be deepened and it is necessary to start the technical evaluation aiming at defining the works that have to be executed, their execution period, the necessary capital expenditures, and the expected performance of the rehabilitated plants. Finally, as long as some of the hypotheses used in the ENPP study change, it should be necessary to resume optimization and updating processes of the reference expansion programmes.

The demand of new electricity generating capacities is covered (within the optimal expansion plans) by combined-cycle units based on natural gas which prove to be more efficient at the price of 95$/1000 m^3 (the 1992 price level) than the nuclear units of NUC2 type. According to the evolution of electricity demand, commissioning of the first combined cycle unit would be necessary in the year 2001 in the Low Scenario, and in 1999 in the Basic and High Scenarios.

The results refer to a quite far period after the year 2000. In the coming years, it is expected that, as long as the economy advances towards achieving reforms under way, more precise information would be available regarding the evolution of energy consumption, the production of energy resources, availability of financial resources, and the long term possibilities for importing fuels. Consequently, studies for implementation and updating the strategy for development of the power generation system and new power plants, after the year 2000, should be resumed using this updated information.

For covering the peak and intermediate zones of the load curve the optimal solutions adopted new capacities represented by hydro power plants associated with reservoirs. In the High and Basic Scenarios, the additional capacity of this type amounts to 249 MW, while the corresponding value in the Low Scenario was of 182 MW.

The 1992-2010 expansion plans of the power system, including rehabilitation works, consist of 10179 MW in the Low Scenario, 13476 MW in the Basic Scenario and 17352 MW in the High Scenario. The biggest share is taken by the plants added within the period 2000-2010, as it is shown in Table 7.7.

Table 7.7 Structure of Electricity Generation Capacities in 2010

MW

Scenario	New Capacities			Total installed capacity
	1992-2000	2001-2010	1992-2010	
Low	2040	8139	10179	20646
Basic	2686	10790	13476	23943
High	3332	14029	17352	27819

7.6 Conclusions

Having in view the levels of the forecast electricity demand, the existing electricity generating capacities for the year 1992 cover the electricity demand under the assumed

reliability criterion, up to 1999 in the Low Scenario and 1998, 1997 in the Basic and High Scenario, respectively.

The first new capacities for generating electricity necessary to be installed in all reference expansion plans are the units 1 and 2 of Cernavodă NPP (of NUC1 type) which are in an advanced stage of construction. The rehabilitation of 7 condensation units of 200 MW based on natural gas and fuel oil, 4 units of 200 MW based on hard coal, and 6 units of 300 MW running on lignite was also selected in all reference expansion plans.

In these optimal plans the demand of new electricity generating capacities is covered by combined-cycle units based on natural gas, which at the price of 95$/1000 m^3 (1992 price level) prove to be more efficient than the NUC2 type units. The number of new combined cycle units was 8 for the Low Scenario, 13 for the Basic Scenario and 19 for the High Scenario.

The optimal expansion plans (including rehabilitation works) for the period 1992 - 2010 consist of 10179 MW in Low Scenario, 13476 MW in Basic Scenario and 17352 MW in High Scenario. Total costs in US$ 1992 for each scenario, broken down by major categories, are given in Table 7.8.

Table 7.8 Total Cost of the Optimal Expansion Plans

10^6 US$

Scenario	Capital Cost	Salvage Value	Operating Costs	Energy Not Served Cost	TOTAL
Low	2769.3	639.2	15970.6	5.6	18106.2
Basic	3844.3	901.5	17634.7	7.9	20585.4
High	4997.0	1190.4	19071.4	16.5	22894.5

The implementation of these programs would require 8790 millions m^3 of natural gas supply at the level of the year 2010 in the Low Scenario, and 14017 millions m^3 and 18940 millions m^3 in the Basic and High Scenarios, respectively. Both the amount of natural gas that should be provided and their price represent components that should be taken into consideration in the future analyses.

The sensitivity analyses regarding the evolution of natural gas price by 5% within 1992-1995, 23% between 1996-2000, and 45% within 2001-2010, showed that, under these terms, it would be preferable to promote nuclear power plants of NUC2 type. The same effect will be felt if the prices for all types of fuel escalate by 20%, over the study period.

The sensitivity analyses regarding the increase of the discount rate to 15% against the 10% considered in the reference cases will make the development of the nuclear program unfavourable.

The gradual increase of the price of natural gas over the study period (by 5% within 1992-1995 period, 23% within 1996-2000, and 45% between 2001-2010) and a discount rate of 8% will result in making the addition of nuclear power plants much competitive and the corresponding nuclear power programme very close to that of the combined cycle plants running on gas found for the reference solutions (at the discount rate 10%).

In order to make more sound decisions concerning future investments programmes, besides the factors regarding energy policy, it is necessary to make some studies on the following issues:

- Standard acceptable reliability criteria LOLP and minimum reserve margin;
- Energy not served cost;
- Electricity generation and distribution system losses.
- Financial capability of the electricity utility and the country to support the level of investments on the power sector arising from the optimal expansion programmes.

Chapter 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

8.1.1 The Study Implementation

The ENPP study for Romania was prepared in close cooperation between the IAEA and the Romanian team. The study has allowed the Romanian team to gain valuable experience in the use of the MAED model to determine the possible evolutions of the energy and electricity demand under different socioeconomic and technical development scenarios for the country, and of the WASP model to estimate economically optimal expansion plans to meet the demand for electricity with the required reliability.

In terms of the analyses carried out, the main objective was the economic optimization of the electric generating system expansion and the role that nuclear power might play in meeting the national future energy requirements.

In order to reach such goals, two types of analyses have been performed. The first was represented by the determination of the long term final energy requirements arising from different patterns of socioeconomic and technical development of the country and the role that electricity might play in meeting these requirements, by means of MAED model.

The electricity forecasts were dealt with in more detail to prepare the necessary data for the second type of analysis that consisted in the optimization of the expansion of the power generating system in order to meet the electricity projections within certain constraints related to system reliability and security of supply and other technical and economic constraints.

Thus, this second type of analysis, carried out by means of the WASP model, was to identify the future additions of power plants that would result in the optimal capacity mix for the system, taking into account the existing and committed plants and the different alternatives available to Romania, including nuclear power plants.

8.1.2 Scenarios

At the time of execution of the actual study no forecasting of future economic or technological evolution had been advanced by the Government. For this reason, proper attention was paid to the major objectives stated in the Government policies for the country. These were further analyzed in the light of the conclusions drawn out from the comparison between the past background of Romania's main macroeconomic and energy parameters and those of other countries, in order to establish possible patterns of development for Romania.

In order to select some outstanding scenarios that should indicate the evolution trends of the energy demand, a sensitivity study has been prepared to determine the influence of the GDP structure and energy intensities on the final energy demand.

From this analysis it can be concluded that the share of manufacturing sector within the total GDP, as well as the share of Basic Materials industries in the Manufacturing value added and the variation of their energy intensities, will have a decisive influence on the final energy demand is concerned,.

After performing these, three scenarios were set up, namely:

- Low Scenario (with slightly improved technologies);
- Basic Scenario (with moderately improved technologies);
- High Scenario (with high technologies).

Romania's economy was assumed to expand at an average annual growth rate of 3.4%, 4.2% and 5.0% for the Low, Basic and High Scenarios, respectively, over the period 1992-2010.

8.1.3 Energy Demand Projections

The evolution of the final energy demand (including non-commercial energy) through the 1989-2010 period, resulting from the analyses performed by means of Module 1 of the MAED model, is estimated at 77.02 Million ton of coal equivalent (Mtce) in the Low Scenario, 82.23 Mtce in the Basic Scenario and 86.67 Mtce in the High Scenario, against 78.17 Mtce in the base year (1989). It is interesting to notice that the annual average rates of growth of the total energy demand projections are lower than that of GDP.

Considering the distribution of final energy demand by sector, the Industry sector (including Manufacturing Construction, Mining and Agriculture) was and would remain the biggest final energy consumer of Romania, in all scenarios.

As to the distribution of the total energy demand by energy form, fossil fuels use and district heat would still have the largest contribution, of about 50% to the total demand, in 2010. On the other hand, electricity would have an increasing share in the total energy consumption during the study period, growing from about 11% in 1989 to about 15%, 16.5% and 18% in the year 2010 for the Low, Basic and High Scenarios, respectively.

8.1.4 Electricity Demand Projections

The final electricity demand is foreseen to grow until the year 2010, from 67.55 TWh as it was in 1989, to 90.41 TWh in the Low Scenario, 107.12 TWh in the Basic Scenario and 122.43 TWh in the High Scenario. The annual average growth rate of the final electricity demand over the whole period is 1.4%, 2.23% and 2.88%, respectively for the Low, Basic and High Scenarios.

Regarding the structure of electricity demand by categories of consumer, there are no essential differences between the three scenarios. Thus, at the level of the year 2010, the share of the Transport sector in the total consumption varies between 3-3.7% within the three scenarios, Industry between 71-74%, and Households and Services between 23-25%.

8.1.5 Electricity Generation Requirements

The electric power demand until the year 2010 would have similar trends in each scenario and are closely related to the share of each sub-sector in the electricity demand and the characteristics of the electric load curve imposed by the sector on the generating system.

In the Low Scenario, the decrease of electricity consumption during the 1989-1992 period would be followed by a slow growth of the system peak load requirements of about

0.65% per year during 1993-95, and a more emphasized growth of about 3.55% between 1995-2000, and then about 4.20% within the 2000-2010 period. The peak load is estimated at about 16000 MW in the year 2010.

In the Basic and High Scenario, the rates of growth of the system peak load are higher: 1.76% and 2.61%, respectively, until 1995, about 4.81% and 5.81% between 1995 and 2000 and about 5% and 5.5%, respectively, during the 2000-2010 period. According to this forecast, the peak load in the year 2010 is estimated at about 19.000 MW in the Basic Scenario and 21600 MW in the High Scenario.

8.1.6 Optimized Electricity Generation System Expansion Plans

The expansion analyses of the power generating system have been performed in order to cover the forecast electricity demand within the three scenarios. The optimal reference solutions have been obtained using a 10% annual discount rate, a reliability criterion limit of 1 day/year, and a price of unserved energy of 1 $/kWh.

Both the rehabilitation of some condensation thermal power units of over 200 MW and new candidate plants have been considered as options to expand the electricity generation system. In order to facilitate the optimization process and to reduce the number of alternatives subject to this analysis, an arrangement of the candidate plants by efficiency criterion has been performed outside the WASP model (see Chapter 6).

The optimal expansion plans resulting from the optimization achieved within the WASP model, foresees an addition of capacity of 10179 MW between 1992-2010 within the Low Scenario, and 13476 MW and 17352 MW in the Basic and High Scenarios, respectively.

In keeping with the forecast electricity demand, new capacities are requested for generating electricity starting with the year 1997 in the Low Scenario, 1998 in the Medium Scenario, and 1999 in High Scenario. The largest share within the reference expansion plans is represented by the plant additions within 2000-2010 period, namely of about 80% for the Low and Basic Scenarios and about 77% for the High Scenario.

The first additional capacities preferred in all reference (optimal) expansion plans are the nuclear units 1 and 2 (of NUC1 type) from Cernavodă NPP which are already in an advanced stage of construction. The commissioning dates of these units according to the scenario differ as shown in Table 8.1. These dates are much more remote than those necessary to complete the construction work of the respective units, which implies that the evolution of electricity demand in the coming years will require the re-evaluation of the commissioning dates of the first nuclear units.

Table 8.1 Year of Commissioning of Nuclear Units NUC1 Type

	Low Scenario	Basic Scenario	High Scenario
Unit 1	1999	1998	1997
Unit 2	2000	1999	1998

The rehabilitated condensation units are part of all reference expansion plans which confirms the economic expectations made for the corresponding rehabilitation work.

The optimal expansion plans are complemented by the addition of combined cycle units, operating on gas, that prove to be more efficient at the price of 95 US$/1000 m^3 (the 1992 price level) than the nuclear units of NUC 2 type. The commissioning of the first unit would be necessary in the year 2001 in the Low Scenario and in 1999 for the Basic and High Scenarios. For the peak and intermediate loads in the High and Basic Scenario an additional capacity of 249 MW in hydro power plants and 182 MW in the Low Scenario have been selected by the reference solutions.

Regarding the annual capital costs as compared to the annual GDP, they represent between 0.16% and 3.78% in the Low scenario; 0.25% - 3.39% in the Basic scenario and 0.24% - 4.56% in the High scenario.

The implementation of these programmes would require 8790 millions m^3 of gas supply at the level of the year 2010 in the Low Scenario, 14017 millions m^3 and 18940 millions m^3 in the Basic and High Scenario respectively. Both the required amount of natural gas and the associated price represent factors that should be taken into consideration in future analyses.

The sensitivity analyses performed on the optimal solutions in relation to fuels prices and the discount rate have important impacts on the schedule and type of new power plants.

In addition to these factors, it is worth noting that the above analysis is purely economic and should be complemented with some analysis of Romania's capability to support the high level of investments necessary for the development of the power generating system as determined by the study.

8.2 Recommendations

8.2.1 Plans for Future Use of the Package

In the frame of the ENPP study, the MAED model has been utilized to estimate the possible evolution of the electricity demand within the context of the overall requirements for final energy of the country for certain socioeconomic and technological development scenarios.

The resulting electricity demands were submitted to a detailed analysis to determine the economically optimal expansion schedule of power plants additions to meet the demand under certain constraints, including conditions for fuel supply and financial possibilities. This capacity expansion analysis was conducted by means of the WASP model.

It is recommended that both models, MAED and WASP, will be used to conduct future studies aiming at the determination of expansion strategies for the Romanian power system.

In addition, during the conduct of the study the Romanian working team has been exposed to several other computer methodologies and programs which are worth considering for application to Romania's conditions with the view of incorporating them into the planning procedure for energy and electricity matters in the country. As an example, it is envisaged to consider the combined application of the WASP and ICARUS models in order to conduct studies on long-range marginal cost of electricity generation that could serve as a basis for determining the electricity tariffs. The application of the ICARUS program is also foreseen with the objective of carrying out a detailed simulation of the generating system, whose results could be used to determine the fuel requirements of a given capacity mix of the power system.

On the other hand, taking into consideration that the available installed capacity of Romania in hydroelectric power plants (5500 MW) is about 25% of the total installed capacity of the system, a strong interest exists in the application of the VALORAGUA program in order to optimize the operating strategy of the hydro-thermal system with emphasis on the operation of the reservoirs associated to hydroelectric power plants. The optimized operating characteristics of hydro power plants should then be used for carrying out future WASP expansion planing studies.

Another aspect that needs proper consideration in the future, while determining expansion strategies for the power generating system, concerns the environmental impacts (emissions) imposed by different power generating technologies. This calls for the combined application of the WASP and IMPACTS models so as to try to minimize the environmental burden of electricity supply expansion programmes.

To enlarge the scope of the purely economic evaluation of electricity supply strategies, it would be necessary that such strategies are determined within the framework of the overall demand for total energy of the country with due account to environmental impacts of the proposed energy system development. For this purpose, it is necessary to consider the interactive application of the BALANCE, ELECTRIC and IMPACTS models.

The analyses above mentioned should be performed very carefully if it is necessary to use the corresponding results for decision making on energy and electricity planning matters in the country. In order to guarantee the adequate utilization of the programs for those purposes, it would be necessary that the IAEA maintains the technical assistance that was started within the conduct of the ENPP study.

8.2.2 Improvements to be Considered for Future Studies

The ENPP Study represented the first application of the MAED model in Romania, combined with the use of the WASP model, for which a certain experience was already available, particularly in its version for mainframe computers. During the conduct of the study, the Romanian working team faced several problems, especially due to the lack of some input information related to certain statistical data and the level of disaggregation of these data in the form required by the MAED model.

Consequently, the effective incorporation of MAED into the planning procedure in Romania would require to adapt the system in which statistics are gathered by the National Commission of Statistics to the requirements of the MAED model. For example, the statistics should include information at the level of demand for useful energy, a better disaggregation of the energy consumption by different economic sectors, the effect of different factors on the demand of energy and electricity by sector, etc.

It is also intended to use the MAED model in studies about the determination of the influence of economic structural changes on the demand of energy and electricity, as well as the impacts on these demands caused by other variations of the energy system such as energy policies by the Government, substitution among alternative energy carriers, etc.

8.2.3 Implications of the Results for Decision Making

It should be emphasized that the outcomes of the present study do not represent the forecast levels for electricity and energy demand of the country, nor the future evolution of the

power generating system of Romania. Several variants to cover evolution of the economy towards exceeding the current crises of the transition period towards the market economy have been considered in the study, but none has been officially approved by the Government as a viable strategy of economic re-launching and for the development of the energy sector.

Nevertheless, even under these conditions, the results obtained have shown that there is a strict dependence of the energy and electricity demand on the economic structure and on the technologies implementation in all sectors.

As to the contribution of nuclear power plants to cover the electricity demand it has been mentioned that within the performed analyses, the units 1 and 2 of Cernavodă NPP represent a common part of all optimal expansion programmes The development of new nuclear capacities will depend on the price evolution and supply possibilities of conventional fuels, mainly gas, and on Romania's capability to finance generating facilities requiring large capital investments.

The economic analyses performed within the ENPP study are recommended to be supplemented by additional studies, such as :

- standard acceptable reliability criteria, LOLP and minimum reserve margin;
- cost of unserved energy demands;
- electricity transmission and distribution system losses;
- fuels price forecast on the world market and fuel supplying capabilities;
- rehabilitating relations for the existing plants;
- environmental impact of alternative power system expansion programmes;
- financial analysis of the suggested programmes;
- the national participation in different power system expansion programmes;
- labour force development.

Appendix A

TREATMENT OF STATISTICAL DATA FOR THE ENPP STUDY

Prior to the application of MAED module 1 to carry out energy demand forecasting for Romania, it was compulsory to analyze first the evolution of certain of the most important parameters to be used in the study. These included, among others, the GDP formation by economic sector, the structure of final energy consumption by consumer sector and energy form, and the structure of the freight and passenger transportation.

Since in most cases, the input data for the MAED model could not be extracted directly from the available statistical data, it was necessary to reorganize and transform the statistics according to the requirements of the model.

A.1 GDP Formation by Economic Sector

Before 1989, the development of the Romanian economy was reflected by two macroeconomic parameters, specific to centrally planned economies, namely: the national income and the social product.

The concept of Gross Domestic Product (GDP) arose, for the first time, in the 1990 edition of the Romanian Statistical Yearbook, published by the National Commission for Statistics related to the economic activity in 1989. This publication also included GDP series for the 1980-1989 period.

The above publication provides the GDP structure in current prices for the following sectors: Agriculture and Forestry, Construction, Industry (Mining and Energy included), Transportation and Telecommunications, as well as a range of activities of the Service sector (see Table A.1).

In order to meet the input data requirements of the MAED model, the Industry sector had to be broken down into three sectors: Mining, Energy and Manufacturing industry, and the latter one into four sub-sectors: Basic Materials, Machinery and Equipment, Non-durable Goods and Miscellaneous. The correspondence between sectors and sub-sectors in the Romanian Statistical Yearbook and those in the MAED model is presented in Table A.2.

The Statistical Yearbook gives a very detailed breakdown of the industrial production by branches, out of which it is possible to derive the production of the Mining and Energy sectors and the four sub-sectors of the Manufacturing industry. Using this information, the GDP in Industry was distributed among these sectors and sub-sectors proportionally to their respective industrial production. The resulting GDP breakdown is listed in Table A.3.

A.2 Final Energy Consumption by Economic Sector and Energy Form

Statistical data concerning final energy consumption are published by the National Commission for Statistics in a yearly report, entitled: "The Energy Balance and the Structure of the Energetic Equipment". Although such reports have been issued since 1970 in a simplified form, the period 1981-1990 was selected for the analyses within the ENPP study since the statistical reports for this period have the same structure.

Table A.1 Statistics on Gross Domestic Product (1980-1990)

Unit: 10^9 lei (current prices)

Sector	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1. Agriculture & Forestry	78.0	91.6	125.7	107.9	110.7	114.3	106.8	103.4	115.6	110.9	152.0
(%)	12.6	14.7	17.3	14.0	13.6	14.0	12.7	12.2	13.5	13.9	18.0
2. Construction	47.4	44.7	47.2	52.2	53.5	57.9	59.5	60.8	60.4	50.6	47.9
(%)	7.7	7.2	6.5	6.8	6.6	7.1	7.1	7.2	7.0	6.3	5.7
3. Industry(1)	325.3	311.2	365.4	411.4	445.1	433.0	460.5	461.8	459.9	421.9	407.0
(%)	52.7	49.9	50.2	53.5	54.5	53.0	54.9	54.6	53.7	52.9	48.2
4. Transport & Telecomms	43.6	44.8	48.9	49.9	53.1	55.4	57.0	58.0	60.3	60.0	56.5
(%)	7.1	7.2	6.7	6.5	6.5	6.8	6.8	6.9	7.0	7.5	6.7
5. Services	122.6	131.4	140.2	147.3	153.7	156.8	154.8	161.1	160.8	154.6	180.6
(%)	19.9	21.0	19.3	19.2	18.8	19.1	18.5	19.1	18.8	19.5	21.4
Total GDP	616.9	623.7	727.4	768.7	816.1	817.4	838.6	845.1	857.0	798.0	844.0

Source : National Commission for Statistics

Note : (1) Manufacturing + Mining + Energy sectors

For the purposes of aggregation of different forms of energy, the ton of coal equivalent (tce) was chosen since this was the only common unit used in the reports for the various forms treated, i.e., electricity, thermal energy and fuels.

The annual statistical report gives the final consumption for several energy forms which, in a first stage, were aggregated as follows:

- solid fuels:
  - hard coal;
  - lignite and hard coal;
  - coke;
  - firewood and other solid fuels.
- liquid fuels:
  - gasoline;
  - diesel;
  - residual;
  - other liquid fuels.

Table A.2 Regrouping of Romanian Economic Sectors According to the Structure of GDP in the MAED Model

Economic sector in the MAED model	Economic sector of the Romanian statistics
1. Agriculture	1. Agriculture and forestry
2. Construction	2. Construction
3. Mining	3. Extractive industries: - coal, crude oil, natural gas - ferrous ore - non-ferrous ore
4. Manufacturing	4. Manufacturing industry
4.1 Basic Materials	4.1.1 Ferrous metallurgy 4.1.2 Non-ferrous metallurgy 4.1.3 Chemistry 4.1.4 Building materials 4.1.5 Wood working 4.1.6 Cellulose & paper
4.2 Machinery & Equipment	4.2 Engineering & metal working
4.3 Non-durable Goods	4.3.1 Glass, porcelain & ceramics 4.3.2 Light industry (textiles, clothes, leather, furs, footwear) 4.3.3 Food industry
4.4 Miscellaneous	4.4 Other branches of industry
5. Energy	5. Energy
6. Transportation	6. Transportation and Telecommunications
7. Services	7.1 Commerce 7.2 Services 7.3 Banking, financing 7.4 Public administration

Table A.3 GDP Formation by Economic Sector According to MAED Requirements

Unit 10^9lei (current prices)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1 Agriculture	78 0	91 6	125 7	107 9	110 7	114 3	106 8	103 4	115 6	110 9	152 0
(%)	12 6	14 7	17 3	14 0	13 6	14 0	12 7	12 2	13 5	13 9	18 0
2 Construction	47 4	44 7	47 2	52 2	53 5	57 9	59 5	60 8	60 4	50 6	47 9
(%)	7 7	7 2	6 5	6 8	6 6	7 1	7 1	7 2	7 0	6 3	5 7
3 Mining	12 0	13 7	16 4	19 3	20 9	20 8	21 2	27 7	27 6	26 2	35 8
(%)	1 9	2 2	2 3	2 5	2 6	2 5	2 5	3 3	3 2	3 3	4 2
4 Manufacturing	298 6	269 2	317 6	349 7	379 2	368 9	392 3	385 1	381 3	348 5	323 6
(%)	48 4	43 2	43 7	45 5	46 5	45 1	46 8	45 6	44 5	43 7	38 3
4 1 Basic Materials	90 8	92 6	111 0	121 8	133 5	127 6	136 8	131 1	129 8	118 6	106 6
(%)	14 7	14 8	15 2	15 8	16 3	15 6	16 3	15 5	15 1	14 9	12 6
4 2 Machinery& Equip	112 2	92 3	106 0	116 6	127 0	125 5	133 6	130 6	129 8	114 1	103 1
(%)	18 2	14 8	14 6	15 2	15 6	15 4	15 9	15 5	15 1	14 3	12 2
4 3 Non-durable Goods	88 9	78 3	93 5	103 7	110 0	106 5	111 6	112 6	110 9	106 3	101 9
(%)	14 4	12 6	12 9	13 5	13 5	13 0	13 3	13 3	12 9	13 3	12 1
4 4 Miscellaneous	6 7	6 0	7 1	7 6	8 7	9 3	10 3	10 8	10 8	9 5	12 0
(%)	1 1	1 0	1 0	1 0	1 1	1 1	1 2	1 3	1 3	1 2	1 4
5 Energy	14 6	28 3	31 4	42 4	45 0	43 3	47 0	49 0	51 0	47 2	47 6
(%)	2 4	4 5	4 3	5 5	5 5	5 3	5 6	5 8	6 0	5 9	5 6
6 Transportation	43 6	44 8	48 9	49 9	53 1	55 4	57 0	58 0	60 3	60 0	56 5
(%)	7 1	7 2	6 7	6 5	6 5	6 8	6 8	6 9	7 0	7 5	6 7
7 Service	122 6	131 4	140 2	147 3	153 7	156 8	154 8	161 1	160 8	154 6	180 6
(%)	19 9	21 0	19 3	19 2	18 8	19 1	18 5	19 1	18 8	19 4	21 4
TOTAL GDP	616 9	623 7	727 4	768 7	816 1	817 4	838 6	845 1	857 0	798 0	844 0

Source National Commission for Statistics

- gaseous fuels
  - natural gas,
  - other gaseous fuels
- electricity,
- centralized thermal energy,

For each energy form the final energy consumption is listed for the following sectors

- Agriculture and forestry,
- Construction,
- Industry
  - Extractive industry (coal, crude oil, natural gas)
  - Ferrous metallurgy (including mining of ferrous ore),
  - Non-ferrous metallurgy (including mining of non-ferrous ore),
  - Chemistry,
  - Building materials,
  - Wood working,
  - Cellulose and paper,
  - Engineering and metal working,
  - Glass, porcelain and ceramics,
  - Light industry (textiles, clothes, leather, furs and footwear),

- Food industry;
- Other branches of industry.

- Transportation and Telecommunications;
- Public administration;
- Other sectors: commerce, services, banking, etc.
- Residential;

The final energy consumptions through the 1981-1990 period resulting from the above aggregation are presented in Tables A.4-A.13. These statistical data had to be reorganized according to the sectors and sub-sectors (see Table A.14), as well as the forms of energy allowed in the MAED model, for which certain hypotheses and intermediate calculations were necessary, namely:

- estimating the final energy consumption of the Mining sector from the actual consumption of some Industry sub-sectors that were considered to represent mining activities;
- dividing the energy consumption of the Manufacturing industry into its four sub-sectors: Basic Materials, Machinery and Equipment, Non-durable Goods and Miscellaneous;
- regrouping the energy forms from Tables A.4-A.13 into: motor fuels, specific uses of electricity, thermal purposes, special utilizations (coke for steel production, feedstock for the petrochemical industry) and non-commercial fuels (vegetable residues, etc.).
- displacing the motor fuels consumption recorded in the statistics within the Service and Household sectors to the Transportation sector;
- displacing the energy consumption for thermal uses recorded into the Transportation sector (space heating and hot water in railway stations, airports, travel agencies, etc.) to the Service sector.

Based on the above, the final energy consumption of the Mining sector includes the consumptions of the following sub-sectors:

- coal, oil and gas extraction;
- ferrous ores extraction and treatment;
- non-ferrous ores extraction and treatment.

While the first entry is directly found in the statistical report, the last two had to be estimated out of the total consumption of both ferrous and non-ferrous metallurgy after some consultations with experts of the respective sub-sectors.

The breakdown of the Manufacturing industry into the sub-sectors allowed by the MAED model was made in a similar fashion as for the GDP breakdown (see Table A.14) in order to determine in a consistent manner the energy intensities of these sub-sectors.

Text cont. on p. 187.

Table A.4 Commercial Final Energy Consumption in Year 1981

	Sector	Solid fuels (ktce)					Liquid fuels (ktce)					Gaseous fuels (ktce)			Total fossil fuels (ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(ktce)	(Tcal)	(ktce)	(ktce)
1.	Agriculture and forestry	8.5	21.2	-	41.9	71.6	143.1	1690.0	2.7	44.5	1880.3	38.4	0.5	38.9	1990.7	3181	391	8810	1259	3640.7
2.	Construction	3.9	9.0	0.3	13.0	26.2	118.2	1049.6	7.0	76.9	1251.7	50.0	-	50.0	1327.9	1507	185	2843	406	1918.9
3.	Industry	292.5	126.9	4095.5	505.2	5020.0	1395.0	1040.8	1397.1	393.9	4226.8	15206.8	2375.9	17582.7	26829.6	43123	5304	103191	14742	46875.6
3.1	Extractive industry	201.6	42.8	-	0.3	244.7	9.3	101.5	0.3	7.9	119.0	409.5	-	409.5	773.1	3729	459	15135	2162	3394.2
3.2	Ferrous metallurgy***	6.1	0.1	3500.3	96.4	3602.9	2.1	52.0	211.4	3.5	269.0	3327.9	1170.3	4498.2	8370.2	6864	844	5737	820	10034.2
3.3	Non-ferrous metallurgy***	7.3	0.2	57.6	5.1	70.2	7.5	36.8	304.8	5.2	354.3	252.9	22.9	275.8	700.3	5574	686	2956	422	1808.3
3.4	Chemistry	0.5	0.2	296.4	44.6	341.7	1275.4	199.8	139.5	170.0	1784.7	6573.6	1157.5	7731.1	9857.5	11121	1368	36250	5179	16404.5
3.5	Building materials	47.8	49.7	25.5	40.8	163.8	10.6	99.8	615.5	18.5	744.4	2024.2	17.3	2041.5	2949.7	2532	311	3342	477	3737.7
3.6	Wood working	0.4	0.8	1.4	51.7	54.3	15.6	77.2	42.1	10.4	145.3	56.8	-	56.8	256.4	1175	144	5757	822	1222.4
3.7	Cellulose and paper	0.3	-	-	-	0.3	0.3	5.6	7.9	0.2	14.0	53.4	-	53.4	67.7	1581	195	5744	821	1083.7
3.8	Engineering and metal working	11.8	4.8	152.7	6.5	175.8	29.0	146.7	34.7	86.9	297.3	1363.7	5.5	1369.2	1842.3	6431	791	11807	1687	4320.3
3.9	Glass, porcelain and ceramics	8.2	0.3	0.4	1.0	9.9	1.1	3.4	0.1	18.0	22.6	799.3	-	799.3	831.8	335	41	421	60	932.8
3.10	Light industry	0.4	1.6	0.1	3.7	5.8	14.4	10.2	10.6	14.5	49.7	56.3	-	56.3	111.8	1912	235	6956	994	1340.8
3.11	Food industry	1.1	16.1	25.6	13.1	55.9	18.9	250.7	20.3	44.3	334.2	174.9	0.1	175.0	565.1	1437	177	8613	1230	1972.1
3.12	Other branches of industry	7.0	10.3	35.5	242.0	294.8	10.8	57.1	9.9	14.5	92.3	114.3	2.3	116.6	503.7	432	53	473	68	624.7
4.	Transportation and telecomms.	13.8	19.6	0.3	101.0	134.7	459.6	2386.4	452.9	273.2	3572.1	7.8	-	7.8	3714.6	1997	246	1317	188	4148.6
5.	Services	6.8	109.9	0.1	185.1	301.9	163.4	406.5	0.7	137.0	707.6	307.4	1.9	309.3	1318.8	2795	344	8117	1159	2821.8
6.	Households	116.7	499.5	-	1216.1	1832.3	706.3	2.5	-	386.8	1095.6	1776.5	413.3	2189.8	5117.7	5132	631	20866	2981	8729.7
	Grand Total	442.2	786.1	4096.2	2062.3	7386.8	2985.6	6575.8	1860.4	1312.3	12734.1	17386.9	2791.6	20178.5	40299.3	57735	7101	145144	20735	68135.3

Source : National Commission for Statistics

Note : *** Including mining of ferrous ores
*** Including mining of non-ferrous ores

Table A.5 Commercial Final Energy Consumption in Year 1982

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	6.8	15.7	-	40.6	63.1	67.9	1537.9	2.0	37.6	1645.4	25.5	1.5	27.0	1735.5	3457	425	7332	1047	3207.5
2.	Construction	7.1	5.8	0.2	21.6	34.7	90.4	1032.4	6.1	41.3	1170.2	60.9	-	60.9	1265.8	1157	142	2641	377	1784.8
3.	Industry	136.3	116.9	4038.9	1106.4	5398.5	1424.7	1118.4	1361.8	500.0	4404.9	15875.6	3002.3	18877.9	28681.3	44167	5432	103347	14764	48877.3
3.1	Extractive industry	56.8	19.9	-	1.6	78.3	14.2	153.5	1.2	17.5	186.4	350.2	-	350.2	614.9	4008	493	14624	2089	3196.9
3.2	Ferrous metallurgy***	6.3	0.1	3384.3	83.9	3474.6	1.9	53.5	250.2	6.5	312.1	3388.5	1116.0	4504.5	8291.2	7164	881	5871	839	10011.2
3.3	Non-ferrous metallurgy***	2.1	0.1	61.7	106.9	170.8	5.5	37.4	273.0	3.0	318.9	253.6	17.8	271.4	761.1	4980	612	2781	397	1770.1
3.4	Chemistry	1.3	0.4	295.1	120.3	417.1	1302.8	176.3	134.8	221.0	1834.9	6901.0	738.5	7639.5	9891.5	11302	1391	36964	5281	16563.5
3.5	Building materials	51.7	45.7	28.5	51.4	177.3	6.2	102.4	571.7	26.3	706.6	2085.4	6.4	2091.8	2975.7	2654	326	3077	440	3741.7
3.6	Wood working	1.4	3.8	1.2	38.0	44.4	17.8	65.4	41.1	8.8	133.1	49.3	-	49.3	226.8	1157	142	5588	798	1166.8
3.7	Cellulose and paper	0.1	-	-	-	0.1	0.3	6.2	8.3	0.2	15.0	51.4	-	51.4	66.5	1536	189	5648	807	1062.5
3.8	Engineering and metal working	7.8	4.3	174.5	4.7	191.3	35.5	167.6	25.6	93.7	322.4	1235.4	19.7	1255.1	1768.8	6427	790	11916	1702	4260.8
3.9	Glass, porcelain and ceramics	3.7	-	0.4	0.6	4.7	1.5	4.6	-	15.7	21.8	791.8	-	791.8	818.3	343	42	432	62	922.3
3.10	Light industry	0.2	1.4	0.1	2.3	4.0	8.9	9.3	0.7	12.1	31.0	51.2	-	51.2	86.2	1938	239	6639	948	1273.2
3.11	Food industry	4.1	21.1	29.7	20.5	75.4	14.0	284.4	14.5	44.3	357.2	161.4	1.3	162.7	595.3	1448	178	8917	1274	2047.3
3.12	Other branches of industry	0.8	20.1	63.4	676.2	760.5	16.1	57.8	40.7	50.9	165.5	556.4	1102.6	1659.0	2585.0	1210	149	890	127	2861.0
4.	Transportation and telecomms	56.9	13.2	-	14.6	84.7	334.1	2191.5	448.7	219.9	3194.2	9.1	0.1	9.2	3288.1	1952	240	1272	182	3710.1
5.	Services	10.1	116.0	0.1	216.4	342.6	144.2	424.7	0.9	62.2	632.0	303.5	4.8	308.3	1282.9	2655	327	7972	1139	2748.9
6.	Households	98.7	474.1	-	1398.4	1971.2	737.0	75.8	-	248.5	1061.3	1818.2	360.2	2178.4	5210.9	5050	621	22059	3151	8982.9
	Grand Total	315.9	741.7	4039.2	2798.0	7894.8	2798.3	6380.7	1819.5	1109.5	12108.0	18092.8	3368.9	21461.7	41464.5	58438	7187	144623	20660	69311.5

Source : National Commission for Statistics

Note : *** Including mining of ferrous ores
*** Including mining of non-ferrous ores

Table A.6 Commercial Final Energy Consumption in Year 1983

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	5.5	19.8	-	43.4	68.7	52.5	1500.7	-	27.3	1580.5	27.4	0.1	27.5	1676.7	4163	512	6390	913	3101.7
2.	Construction	0.2	8.0	-	30.0	38.2	53.3	974.3	2.8	17.0	1047.4	386.2	0.2	386.4	1472.0	1112	137	1896	271	1880.0
3.	Industry	193.6	142.5	3611.9	701.0	4649.0	1284.7	1067.4	1010.8	524.8	3887.7	15073.0	2402.3	17475.3	26012.0	44317	5451	102277	14611	46074.0
3.1	Extractive industry	112.3	49.7	-	0.1	162.1	9.9	163.6	0.7	66.6	240.8	331.9	-	331.9	734.8	4267	525	15421	2203	3462.8
3.2	Ferrous metallurgy(1)	4.4	0.6	2995.0	108.1	3108.1	1.4	51.0	234.3	4.3	291.0	3219.0	1158.6	4377.6	7776.7	7315	900	6298	900	9576.7
3.3	Non-ferrous metallurgy(2)	3.0	0.2	67.3	127.0	197.5	3.1	36.3	97.8	2.9	140.1	248.1	18.0	266.1	603.7	5315	654	2807	401	1658.7
3.4	Chemistry	1.8	0.2	314.7	154.3	471.0	1189.7	189.2	128.9	288.1	1795.9	7013.0	1204.0	8217.0	10483.9	11584	1425	37740	5391	17299.9
3.5	Building materials	56.4	53.1	24.1	42.0	175.6	3.6	82.9	447.0	8.9	542.4	2030.6	5.0	2035.6	2753.6	2536	312	2806	401	3466.6
3.6	Wood working	0.1	0.7	1.0	25.5	27.3	15.1	66.5	38.5	8.1	128.2	59.8	-	59.8	215.3	1159	142	5682	812	1169.3
3.7	Cellulose and paper	0.3	-	-	-	0.3	0.3	5.4	6.1	0.1	11.9	47.7	-	47.7	59.9	1554	191	5614	802	1052.9
3.8	Engineering and metal working	9.4	4.1	153.7	7.4	174.6	26.6	136.4	30.9	65.9	259.8	872.4	16.5	888.9	1323.3	6431	791	10643	1520	3634.3
3.9	Glass, porcelain and ceramics	0.9	-	0.2	0.8	1.9	1.0	4.0	0.1	13.4	18.5	827.8	0.1	827.9	848.3	347	43	416	59	950.3
3.10	Light industry	0.1	1.2	0.1	2.0	3.4	8.2	8.0	5.3	13.0	34.5	61.0	-	61.0	98.9	1921	236	6460	923	1257.9
3.11	Food industry	3.6	18.9	25.1	24.2	71.8	14.5	270.4	11.6	48.5	345.0	179.6	0.1	179.7	596.5	1490	183	7963	1138	1917.5
3.12	Other branches of industry	1.3	13.8	30.7	209.6	255.4	11.3	53.7	9.6	5.0	79.6	182.1	-	182.1	517.1	398	49	427	61	627.1
4.	Transportation and telecomms.	44.0	9.3	-	15.6	68.9	177.6	2049.5	422.1	212.2	2861.4	8.5	0.1	8.6	2938.9	2143	264	926	132	3334.9
5.	Services	7.3	140.9	0.3	214.4	362.9	87.0	326.2	6.9	45.2	465.3	270.4	1.3	271.7	1099.9	2958	364	8166	1167	2630.9
6.	Households	70.3	403.0	-	1357.4	1830.7	727.4	36.7	-	125.1	889.2	1607.1	346.9	1954.0	4673.9	4994	614	20169	2881	8168.9
	Grand Total	320.9	723.5	3612.2	2361.8	7018.4	2382.5	5954.8	1442.6	951.6	10731.5	17372.6	2750.9	20123.5	37873.4	59687	7342	139824	19975	65190.4

Source : National Commission for Statistics

Note : (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.7 Commercial Final Energy Consumption in Year 1984

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	3.9	0.9	-	37.8	42.6	38.0	1551.2	2.2	2.9	1594.3	44.5	0.5	45.0	1681.9	3532	435	5250	750	2866.9
2.	Construction	6.6	9.1	0.2	18.8	34.7	39.9	904.6	1.4	16.6	962.5	29.1	-	29.1	1026.3	1378	169	1563	223	1418.3
3.	Industry	116.5	106.2	4405.0	663.4	5291.1	1219.8	1107.4	949.9	457.0	3734.1	15950.8	2156.0	18106.8	27132.0	46219	5685	99056	14151	46968.0
3.1	Extractive industry	40.6	6.7	-	5.5	52.8	9.0	173.0	-	58.6	240.6	608.5	-	608.5	901.9	3027	373	5876	839	2113.9
3.2	Ferrous metallurgy[1]	2.9	0.7	3800.3	74.0	3877.9	1.4	51.0	232.8	1.7	286.9	3282.9	1365.3	4648.2	8813.0	7923	974	6129	875	10662.0
3.3	Non-ferrous metallurgy[2]	1.7	0.7	77.6	170.4	250.4	2.5	34.5	114.1	1.1	152.2	276.8	13.0	289.8	692.4	5619	691	2836	405	1788.4
3.4	Chemistry	1.6	0.3	297.7	142.8	442.4	1126.5	219.7	124.0	255.5	1725.7	7167.9	758.3	7926.2	10094.3	11939	1468	40949	5850	17412.3
3.5	Building materials	57.1	49.9	26.9	38.7	172.6	3.8	96.2	374.3	6.3	480.6	2083.3	4.7	2088.0	2741.2	2589	318	2706	387	3446.2
3.6	Wood working	0.4	0.7	0.7	17.8	19.6	17.0	70.0	26.7	5.6	119.3	65.0	-	65.0	203.9	1175	144	5842	835	1182.9
3.7	Cellulose and paper	0.1	0.1	-	0.1	0.3	0.3	6.3	2.1	0.2	8.9	52.3	-	52.3	61.5	1615	199	5920	846	1106.5
3.8	Engineering and metal working	5.2	9.1	126.0	8.1	148.4	24.6	155.9	32.4	60.6	273.5	1287.2	14.5	1301.7	1723.6	6982	859	11428	1633	4215.6
3.9	Glass, porcelain and ceramics	0.9	0.4	0.4	0.9	2.6	0.9	4.9	-	12.9	18.7	851.5	0.1	851.6	872.9	371	46	422	60	978.9
3.10	Light industry	-	1.4	0.1	2.0	3.5	7.4	8.9	6.4	12.4	35.1	50.2	-	50.2	88.8	1887	232	6322	903	1223.8
3.11	Food industry	4.2	25.8	35.5	21.9	87.4	15.2	243.3	24.1	29.1	311.7	116.8	0.1	116.9	516.0	1643	203	9389	1341	2060.0
3.12	Other branches of industry	1.8	10.4	39.8	181.2	233.2	11.2	43.7	13.0	13.0	80.6	108.4	-	108.4	422.5	1449	178	1237	177	777.5
4.	Transportation and telecomms	54.5	8.4	-	38.1	101.0	157.2	1945.4	480.2	272.8	2855.6	15.7	-	15.7	2972.3	2315	285	816	117	3374.3
5.	Services	5.1	105.3	0.2	201.3	311.9	83.0	276.2	24.6	45.1	428.9	268.8	1.9	270.7	1011.5	4936	607	5834	833	2451.5
6.	Households	51.2	393.8	-	1369.4	1814.4	653.7	33.3	-	99.7	786.7	1741.5	342.3	2083.8	4684.9	4784	588	20985	2998	8270.9
	Grand Total	237.8	623.7	4405.4	2328.8	7595.7	2191.6	5818.1	1458.3	894.1	10362.1	18050.4	2500.7	20551.1	38508.9	63164	7769	133504	19072	65349.9

Source : National Commission for Statistics

Note : (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.8 Commercial Final Energy Consumption in Year 1985

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	5.5	29.4	-	54.4	89.3	33.5	1589.2	4.5	14.0	1641.2	22.5	0.7	23.2	1753.7	3948	486	6481	926	3165.7
2.	Construction	6.0	10.1	-	21.6	37.7	22.1	808.7	1.3	10.3	842.4	29.1	0.1	29.2	909.3	1308	161	1476	211	1281.3
3.	Industry	92.0	107.9	4826.2	653.4	5679.5	1286.3	1161.0	829.5	485.2	3762.0	16367.9	1706.6	18074.5	27516.0	46654	5738	99717	14245	47499.0
3.1	Extractive industry	18.3	4.0	-	0.3	22.6	6.3	258.2	-	83.0	347.5	626.9	-	626.9	997.0	3310	407	5828	832	2236.0
3.2	Ferrous metallurgy***	1.6	1.1	4226.8	95.5	4325.0	0.5	51.6	216.7	1.7	270.5	3252.2	1413.7	4665.9	9261.4	8071	993	6815	974	11228.4
3.3	Non-ferrous metallurgy***	1.6	-	76.5	117.6	195.7	3.0	47.1	101.9	1.2	153.2	246.3	15.1	261.4	610.3	5667	697	2910	416	1723.3
3.4	Chemistry	1.5	0.2	281.6	116.9	400.2	1213.0	181.0	73.9	262.2	1730.1	7535.8	255.8	7791.6	9921.9	11808	1452	41192	5884	17257.9
3.5	Building materials	46.0	55.7	27.0	38.2	166.9	2.5	86.3	329.5	6.7	425.0	1921.1	4.2	1925.3	2517.2	2413	297	2482	355	3169.2
3.6	Wood working	0.2	0.7	0.5	17.0	18.4	13.0	69.8	21.0	5.0	108.8	74.7	-	74.7	201.9	1144	141	5870	839	1181.9
3.7	Cellulose and paper	-	-	-	0.4	0.4	0.3	4.7	7.2	0.2	12.4	44.3	-	44.3	57.1	1500	184	6291	898	1139.1
3.8	Engineering and metal working	5.5	7.2	125.6	9.5	147.8	21.3	155.3	42.7	46.5	265.8	1371.2	17.0	1388.2	1801.8	7393	909	11023	1575	4285.8
3.9	Glass, porcelain and ceramics	1.0	0.4	0.4	0.7	2.5	0.6	2.7	-	11.5	14.8	838.7	-	838.7	855.9	373	46	466	67	968.9
3.10	Light industry	0.2	1.1	-	2.0	3.3	8.0	9.4	10.8	12.1	40.3	52.3	-	52.3	95.9	1859	229	6300	900	1224.9
3.11	Food industry	5.5	19.6	31.0	38.0	94.1	14.1	240.0	16.0	47.3	317.4	179.4	0.6	180.0	591.5	1601	197	9311	1330	2118.5
3.12	Other branches of industry	10.6	17.9	56.8	217.3	302.6	3.7	54.9	9.8	7.8	76.1	225.0	0.2	225.2	604.0	1515	186	1229	175	965.0
4.	Transportation and telecomms.	58.2	9.7	-	58.8	126.7	116.6	1922.2	509.8	325.5	2874.1	17.1	-	17.1	3017.9	2430	299	866	124	3440.9
5.	Services	3.9	89.0	-	198.3	291.2	65.9	253.2	0.2	39.2	358.5	740.6	1.6	742.2	1391.9	2567	316	7599	1086	2793.9
6.	Households	34.8	446.2	-	1451.7	1932.7	509.5	29.8	-	79.6	618.9	1886.1	313.7	2199.8	4751.4	4814	522	18662	2666	8009.4
	Grand Total	200.4	692.3	4826.0	2438.2	8157.1	2033.9	5764.1	1345.3	953.8	10097.1	19063.3	2022.7	21086.0	39340.2	61721	7592	134801	19258	66190.2

Source : National Commission for Statistics

Note : (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.9 Commercial Final Energy Consumption in Year 1986

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	7.3	23.2	-	43.3	73.8	25.2	1567.4	2.1	5.2	1599.9	32.3	7.9	40.2	1713.9	4135	509	5836	834	3056.9
2.	Construction	5.3	7.3	0.2	29.3	42.1	21.0	810.7	1.8	9.9	843.4	36.0	0.1	36.1	921.6	1354	166	1499	214	1301.6
3.	Industry	108.4	99.8	4682.9	672.9	5564.0	1254.2	1086.2	987.6	492.9	3820.9	17570.4	2956.6	20527.0	29911.9	50094	6162	104603	14943	51016.9
3.1	Extractive industry	43.3	0.6	0.1	6.2	50.2	5.7	277.8	-	57.7	341.2	1045.5	-	1045.5	1436.9	3503	431	5898	842	2709.9
3.2	Ferrous metallurgy***	2.3	0.2	4094.6	122.9	4220.0	0.9	46.7	237.5	1.1	286.2	3388.2	1413.8	4802.1	9308.2	8584	1056	6939	991	11355.2
3.3	Non-ferrous metallurgy***	0.6	0.1	91.4	126.0	218.1	2.5	44.2	105.0	1.7	153.4	270.1	30.9	301.0	672.5	6077	747	3074	439	1858.5
3.4	Chemistry	3.0	0.5	273.5	96.6	373.6	1164.6	135.4	74.6	289.3	1663.9	8061.9	1392.9	9454.8	11492.3	12762	1570	44711	6387	19449.3
3.5	Building materials	46.4	26.8	26.9	76.3	176.4	2.9	91.4	471.0	6.9	572.2	2046.0	-	2046.0	2794.6	2804	345	2587	370	3509.6
3.6	Wood working	0.6	1.3	2.5	22.1	26.5	15.4	68.5	19.6	4.5	108.0	69.5	-	69.5	204.0	1219	150	5739	820	1174.0
3.7	Cellulose and paper	0.3	-	0.1	5.3	5.7	0.3	7.1	7.9	0.2	15.5	47.2	-	47.2	68.4	1641	202	6782	969	1239.4
3.8	Engineering and metal working	6.5	20.0	115.6	7.5	149.6	20.8	155.8	44.3	47.0	267.9	1436.8	28.6	1465.4	1882.9	7886	970	11347	1621	4473.9
3.9	Glass, porcelain and ceramics	0.3	-	0.3	0.7	1.3	0.7	3.6	-	10.9	15.2	849.6	-	849.6	866.1	352	43	442	63	972.1
3.10	Light industry	0.1	1.1	0.1	2.3	3.6	2.7	9.0	1.4	18.2	31.3	48.4	-	48.4	83.3	1975	243	6658	951	1277.3
3.11	Food industry	4.8	41.4	32.0	40.1	118.3	27.7	213.9	19.1	50.2	310.9	211.2	0.1	211.3	640.5	1788	220	9567	1367	2227.5
3.12	Other branches of industry	0.2	7.8	45.8	166.9	220.7	10.0	32.8	7.2	5.2	55.2	96.0	90.3	186.3	462.2	1503	185	859	123	770.2
4.	Transportation and telecomms.	36.6	9.3	-	27.6	73.5	88.2	1837.7	486.7	315.8	2728.4	0.7	-	0.7	2802.6	2580	317	850	121	3240.6
5.	Services	2.3	83.6	0.4	204.9	291.2	59.6	260.8	2.7	29.0	352.1	208.4	1.6	210.0	853.3	2633	324	7384	1055	2232.3
6.	Households	24.0	747.4	-	1122.4	1893.8	553.9	26.5	0.3	98.7	679.4	1768.6	343.5	2112.1	4685.3	4992	614	20468	2924	8223.3
	Grand Total	183.9	970.6	4683.5	2100.4	7938.4	2002.1	5589.3	1481.2	951.5	10024.1	19616.4	3309.7	22926.1	40888.6	65788	8092	140640	20091	69071.6

Source : National Commission for Statistics

Note : (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.10 Commercial Final Energy Consumption in Year 1987

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	5.8	24.2	-	42.8	72.8	23.9	1508.2	4.7	13.9	1550.7	35.7	0.1	35.8	1659.3	3904	480	6050	864	3003.3
2.	Construction	3.4	5.3	0.3	30.6	39.6	32.9	1329.4	2.3	10.5	1375.1	32.6	-	32.6	1447.3	1512	186	1546	221	1854.3
3.	Industry	134.7	107.6	4587.3	687.7	5517.3	1385.3	1200.0	923.5	237.0	3745.8	16380.8	5.8	16386.6	25649.7	49505	6089	104341	14905	46643.7
3.1	Extractive industry	46.8	12.1	-	3.9	62.8	3.6	300.6	-	46.9	351.1	703.3	-	703.3	1117.2	3599	443	6206	887	2447.2
3.2	Ferrous metallurgy***	6.9	0.4	3930.7	149.4	4087.4	0.6	48.4	190.8	1.4	241.2	3212.1	-	3212.1	7540.7	8449	1039	7347	1050	9629.7
3.3	Non-ferrous metallurgy***	0.7	-	80.4	5.7	86.8	2.2	58.4	136.8	1.8	199.2	266.6	-	266.6	552.6	6215	764	3270	467	1783.6
3.4	Chemistry	0.7	0.2	311.2	52.9	365.0	1298.6	62.9	65.7	53.8	1481.0	7435.8	2.3	7438.1	9284.1	11983	1474	43143	6163	16921.1
3.5	Building materials	66.5	29.3	30.4	72.1	198.3	2.4	113.5	433.7	7.8	557.4	1988.1	-	1988.1	2743.8	2723	335	2642	377	3455.8
3.6	Wood working	0.3	1.5	0.6	7.0	9.4	13.3	69.6	21.5	4.2	108.6	67.3	0.2	67.5	185.5	1189	146	5708	815	1146.5
3.7	Cellulose and paper	0.1	-	-	0.1	0.2	0.4	8.5	7.7	0.2	16.8	52.9	-	52.9	69.9	1616	199	6673	953	1221.9
3.8	Engineering and metal working	6.7	14.4	139.0	9.5	169.6	18.6	172.9	41.2	42.3	275.0	1380.6	2.7	1383.3	1827.9	8035	988	11239	1606	4421.9
3.9	Glass, porcelain and ceramics	0.5	-	0.4	0.2	1.1	0.7	4.7	-	10.5	15.9	896.0	0.1	896.1	913.1	366	45	492	70	1028.1
3.10	Light industry	0.2	1.3	0.7	2.1	4.3	14.3	11.0	0.7	12.6	38.6	52.6	-	52.6	95.5	1948	240	6745	964	1299.5
3.11	Food industry	4.6	37.3	35.3	35.7	112.9	28.4	297.1	16.4	50.0	391.9	218.3	0.5	218.8	723.6	1734	213	10005	1429	2365.6
3.12	Other branches of industry	0.7	11.1	58.6	349.1	419.5	2.2	52.4	9.0	5.5	69.1	107.2	-	107.2	595.8	1648	203	871	124	922.8
4.	Transportation and telecomms.	35.7	7.9	-	18.9	62.5	66.4	1548.3	505.7	357.0	2477.4	12.5	-	12.5	2552.4	2583	318	642	92	2962.4
5.	Services	2.9	75.4	0.1	189.0	267.4	51.8	271.3	1.8	24.6	349.5	196.9	1.0	197.9	814.8	1637	201	7900	1129	2144.8
6.	Households	24.0	416.3	-	793.8	1234.1	572.1	26.2	-	82.0	680.3	1970.5	363.4	2333.9	4248.3	4807	591	20747	2964	7803.3
	Grand Total	206.5	636.7	4587.7	1762.8	7193.7	2132.4	5883.4	1438.0	725.0	10178.8	18629.0	370.3	18999.3	36371.8	63948	7865	141226	20175	64411.8

Source : National Commission for Statistics

Note : (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.11 Commercial Final Energy Consumption in Year 1988

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	8.3	26.9	-	42.9	78.1	21.0	1704.2	4.2	19.7	1749.1	36.3	0.1	36.4	1863.6	3666	451	6165	881	3195.6
2.	Construction	1.0	6.8	0.3	20.0	28.1	22.2	871.6	1.7	9.0	904.5	77.5	-	77.5	1010.1	1568	193	1672	239	1442.1
3.	Industry	115.0	126.3	4479.5	731.3	5452.1	1843.4	1170.8	1088.9	524.8	4627.9	16842.1	3.2	16845.3	26925.3	51256	6304	107639	15377	48606.3
3.1	Extractive industry	54.4	10.0	-	-	64.4	3.1	273.9	1.4	65.5	343.9	717.7	-	717.7	1126.0	3796	467	5510	787	2380.0
3.2	Ferrous metallurgy[1]	6.0	0.3	3810.7	115.6	3932.6	0.6	45.3	199.4	1.4	246.7	3168.2	-	3168.2	7347.5	8729	1074	7854	1122	9543.5
3.3	Non-ferrous metallurgy[2]	0.5	0.1	91.0	1.9	93.5	2.3	57.2	131.4	1.3	192.2	259.1	-	259.1	544.8	6374	784	3210	459	1787.8
3.4	Chemistry	0.2	0.3	322.0	67.2	389.7	1760.7	94.7	217.5	317.2	2390.1	7863.2	0.3	7863.5	10643.3	12259	1508	45327	6475	18626.3
3.5	Building materials	41.7	25.6	30.4	114.1	211.8	1.7	93.4	436.8	7.6	539.5	2013.1	-	2013.1	2764.4	2723	335	2372	339	3438.4
3.6	Wood working	0.2	1.9	0.5	4.4	7.0	12.5	71.3	21.4	4.3	109.5	65.9	-	65.9	182.4	1188	146	5638	805	1133.4
3.7	Cellulose and paper	-	-	0.1	0.1	0.2	0.3	6.3	6.4	0.3	13.3	56.0	-	56.0	69.5	1791	220	7582	1083	1372.5
3.8	Engineering and metal working	2.7	47.8	129.8	27.8	208.1	23.1	174.9	47.5	38.6	284.1	1359.9	2.3	1362.2	1854.4	8410	1034	11907	1701	4589.4
3.9	Glass, porcelain and ceramics	-	0.1	0.3	0.3	0.7	0.7	5.7	-	11.1	17.5	909.0	-	909.0	927.2	389	48	474	68	1043.2
3.10	Light industry	0.1	1.6	0.1	2.1	3.9	9.6	13.9	0.2	14.9	38.6	51.5	-	51.5	94.0	1938	238	6732	962	1294.0
3.11	Food industry	3.0	25.9	34.4	19.9	83.2	27.0	286.8	18.3	51.0	383.1	206.1	0.5	206.6	672.9	1796	221	9863	1409	2302.9
3.12	Other branches of industry	6.2	12.7	60.2	377.9	457.0	1.8	47.4	8.6	11.6	69.4	172.4	0.1	172.5	698.9	1863	229	1170	167	1094.9
4.	Transportation and telecomms.	20.7	11.8	-	16.6	49.1	69.3	2069.2	556.7	387.8	3083.0	12.7	-	12.7	3144.8	2824	347	786	112	3603.8
5.	Services	2.8	96.9	-	242.6	342.3	56.5	273.0	7.6	24.9	362.0	193.5	1.0	194.5	898.8	2861	352	8013	1145	2395.8
6.	Households	20.0	371.6	-	638.0	1029.6	632.7	25.3	-	106.6	764.6	1741.0	364.3	2105.3	3899.5	4482	551	21690	3099	7549.5
	Grand Total	167.8	640.3	4479.8	1691.4	6979.3	2645.1	6114.1	1659.1	1072.8	11491.1	18903.1	368.6	19271.7	37742.1	66657	8198	145965	20853	66793.1

Source: National Commission for Statistics

Note: (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.12 Commercial Final Energy Consumption in Year 1989

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	4.9	26.5	-	98.8	130.2	19.4	1622.2	1.4	1.4	1644.4	41.8	0.7	42.5	1817.1	4169	513	5462	780	3110.1
2.	Construction	1.0	3.6	0.3	74.2	79.1	18.6	787.7	6.5	0.3	813.1	74.3	0.1	74.4	966.6	1511	186	1383	198	1350.6
3.	Industry	70.7	186.1	6340.2	1745.8	8342.8	1371.0	1122.1	918.6	469.6	3881.3	16627.6	2239.5	18867.1	31091.2	51717	6361	108712	15530	52982.2
3.1	Extractive industry	-	8.7	-	0.6	9.3	2.7	205.5	0.7	66.4	275.3	410.3	270.0	680.3	964.9	4217	519	5237	748	2231.9
3.2	Ferrous metallurgy[1]	4.5	0.2	5699.6	165.8	5870.1	0.6	46.4	188.9	1.3	237.2	3397.8	464.8	3862.6	9969.9	9018	1109	8732	1247	12325.9
3.3	Non-ferrous metallurgy[1]	0.4	0.3	72.8	6.2	79.7	2.2	60.1	136.1	1.4	199.8	289.7	0.1	289.8	569.3	6297	775	3390	484	1828.3
3.4	Chemistry	0.3	4.3	270.9	705.3	980.8	1302.6	128.3	99.3	273.3	1803.5	7761.4	1001.6	8763.0	11547.3	12267	1509	46858	6694	19750.3
3.5	Building materials	56.1	23.5	27.1	230.4	337.1	1.9	112.5	373.6	6.3	494.3	1827.5	-	1827.5	2658.9	2676	329	2517	359	3346.9
3.6	Wood working	0.6	2.7	0.3	21.2	24.8	12.2	63.9	17.1	4.4	97.6	66.0	-	66.0	188.4	1154	142	5409	773	1103.4
3.7	Cellulose and paper	-	0.1	-	2.5	2.6	0.3	6.3	2.0	0.3	8.9	44.5	-	44.5	56.0	1709	210	7754	1108	1374.0
3.8	Engineering and metal working	5.3	98.7	143.0	110.7	357.7	19.7	151.0	35.6	37.6	243.9	1339.7	502.5	1842.2	2443.8	8808	1083	11240	1606	5132.8
3.9	Glass, porcelain and ceramics	0.5	1.1	0.5	2.3	4.4	0.8	6.0	-	10.8	17.6	903.6	0.1	903.7	925.7	360	44	393	56	1025.7
3.10	Light industry	0.1	6.1	0.1	5.9	12.2	8.3	15.6	1.8	13.0	38.7	52.2	-	52.2	103.1	1863	229	6340	906	1238.1
3.11	Food industry	0.7	30.3	65.9	47.9	144.8	17.5	271.3	56.2	48.4	393.4	261.9	0.4	262.3	800.5	1743	214	9934	1419	2433.5
3.12	Other branches of industry	2.2	10.1	60.0	447.0	519.3	2.2	55.2	7.3	6.4	71.1	273.0	-	273.0	863.4	1605	198	908	130	1191.4
4.	Transportation and telecomms.	14.9	9.8	-	23.7	48.4	63.4	1188.4	624.6	361.7	2238.1	12.2	294.0	306.2	2592.7	2921	359	767	110	3061.7
5.	Services	2.9	85.8	0.2	215.4	304.3	62.3	272.4	5.2	28.0	367.9	217.8	328.8	546.6	1218.8	2932	361	7751	1107	2686.8
6.	Households	25.0	419.4	-	819.3	1263.7	645.6	22.8	-	98.5	766.9	1725.6	417.2	2142.8	4173.4	4296	528	23097	3300	8001.4
	Grand Total	119.4	731.2	6340.7	2977.2	10168.5	2180.3	5015.6	1556.3	959.5	9711.7	18699.3	3280.3	21979.6	41859.8	67546	8308	147172	21025	71192.8

Source: National Commission for Statistics

Note: (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.13 Commercial Final Energy Consumption in Year 1990

	Sector	Solid fuels (Ktce)					Liquid fuels (Ktce)					Gaseous fuels (Ktce)			Total fossil fuels (Ktce)	Electricity		Thermal energy		Grand Total
		Hard coal	Lignite & brown coal	Coke	Fire-wood & other	Total	Gasoline	Diesel	Residual	Other	Total	Natural gas	Other	Total		(GWh)	(Ktce)	(Tcal)	(Ktce)	(Ktce)
1.	Agriculture and forestry	3.1	18.1	-	47.1	68.3	39.5	1607.4	2.8	8.9	1658.6	44.4	0.3	44.7	1771.6	3180	391	4835	691	2853.6
2.	Construction	1.8	2.8	0.4	86.1	91.1	17.9	651.5	6.7	17.8	693.9	30.2	0.1	30.3	815.3	1382	170	1291	184	1169.3
3.	Industry	47.6	87.0	3279.3	1480.8	4894.7	982.4	1058.1	980.5	386.5	3407.5	14395.1	4.1	14399.2	22701.4	41189	5066	92378	13197	40964.4
3.1	Extractive industry	-	1.8	-	2.2	4.0	3.8	223.3	0.6	68.5	296.2	418.5	0.1	418.6	718.8	3868	476	5218	746	1940.8
3.2	Ferrous metallurgy[1]	3.5	0.1	2848.0	56.8	2908.4	0.5	44.9	164.9	0.8	211.1	2647.3	-	2647.3	5766.8	7180	883	7015	1002	7651.8
3.3	Non-ferrous metallurgy[2]	0.1	0.1	27.5	81.4	109.1	1.7	48.7	84.5	1.1	136.0	265.7	-	265.7	510.8	4057	499	2525	361	1370.8
3.4	Chemistry	5.5	0.7	201.2	581.6	789.0	919.1	122.5	95.2	198.1	1334.9	6693.9	1.7	6695.6	8819.5	9318	1146	37389	5341	15306.5
3.5	Building materials	30.6	11.7	21.9	246.7	310.9	2.5	110.3	545.1	7.4	665.3	1287.2	-	1287.2	2263.4	2539	312	2354	336	2911.4
3.6	Wood working	-	0.3	0.5	7.1	7.9	9.0	52.5	22.2	6.2	89.9	53.9	-	53.9	151.7	931	114	4825	689	954.7
3.7	Cellulose and paper	-	-	0.1	28.0	28.1	0.3	6.5	9.3	0.2	16.3	118.5	-	118.5	162.9	1470	181	5370	767	1110.9
3.8	Engineering and metal working	3.2	51.7	107.4	90.4	252.7	13.8	145.8	45.7	23.0	228.3	1363.4	2.1	1365.5	1846.5	6663	819	11194	1599	4264.5
3.9	Glass, porcelain and ceramics	-	0.6	0.3	0.8	1.7	0.9	7.9	-	6.0	14.8	899.5	-	899.5	916.0	388	48	375	54	1018.0
3.10	Light industry	-	1.4	-	3.7	5.1	7.1	17.5	1.9	12.9	39.4	35.6	-	35.6	80.1	1575	194	4896	712	986.1
3.11	Food industry	0.8	9.0	33.1	69.9	112.8	21.9	229.4	3.6	50.7	305.6	304.0	0.2	304.2	722.6	1861	229	10582	1512	2463.6
3.12	Other branches of industry	3.9	9.6	39.3	312.2	365.0	1.8	48.8	7.5	11.6	69.7	307.6	-	307.6	742.3	1339	165	545	78	985.3
4.	Transportation and telecomms.	7.4	6.5	-	62.1	76.0	52.0	1935.1	371.9	333.8	2692.8	11.8	-	11.8	2780.6	2614	321	795	113	3214.6
5.	Services	2.1	63.2	0.1	251.9	317.3	75.1	281.1	8.7	67.4	432.3	229.1	1.4	230.5	980.1	3193	393	9553	1365	2738.1
6.	Households	46.0	420.2	-	1098.4	1564.6	1454.6	59.9	0.1	224.3	1738.9	1702.9	356.8	2059.7	5363.2	5353	658	26195	3742	9763.2
	Grand Total	108.0	597.8	3279.8	3026.4	7012.0	2621.5	5593.1	1370.7	1038.7	10624.0	16413.5	362.7	16776.2	34412.2	56911	6999	135047	19292	60703.2

Source: National Commission for Statistics

Note: (1) Including mining of ferrous ores
(2) Including mining of non-ferrous ores

Table A.14 Regrouping of Romanian Economic Sectors According to the Structure of Energy Consumption in the MAED Model

	Economic sector in the MAED model		Economic sector of the Romanian statistics
1.	Agriculture	1.	Agriculture and forestry
2.	Construction	2.	Construction
3.	Mining	3.	Extractive industries - coal, crude oil, natural gas - ferrous ore[1] - non-ferrous ore[2]
4.	Manufacturing	4.	Manufacturing industry
4.1	Basic Materials	4.1.1	Ferrous metallurgy[1]
		4.1.2	Non-ferrous metallurgy[2]
		4.1.3	Chemistry
		4.1.4	Building materials
		4.1.5	Wood working
		4.1.6	Cellulose & paper
4.2	Machinery & Equipment	4.2	Engineering & metal working
4.3	Non-durable Goods	4.3.1	Glass, porcelain & ceramics
		4.3.2	Light industry (textiles, clothes, leather, furs, footwear)
		4.3.3	Food industry
4.4	Miscellaneous	4.4	Other branches of industry
5.	Transportation	5.	Transportation and Telecommunications
6.	Services	6.1	Public administration
		6.2	Other sectors: Commerce, Services, Banking, Financing, etc.
7.	Households	7.	Residential

Note: (1) The consumption for ferrous ore extraction was estimated and deducted from the total consumption in ferrous metallurgy

(2) The consumption for non-ferrous ore extraction was estimated and deducted from the total consumption in non-ferrous metallurgy

The regrouping of the original energy form, from Tables A.4-A.13, according to the classification used in the MAED model was done based on the following assumptions:

- the gasoline and diesel consumption of all sectors were grouped as motor fuels and assumed to be utilized for motive power in Agriculture, Construction and Industry and for freight or passenger transportation in the following sectors: Transportation, Services and Household.

- the rest of fossil fuels was assumed to be used for thermal purposes: direct use, steam and hot water, etc. Furthermore, the part of fossil fuels regcorded in the Transportation sector for certain uses (heating of airports, railway stations, travel agencies, etc.) was considered within the Service sector for the MAED analysis.

- the coke consumption was assumed to be fully used for the production of steel;

- the division of electricity consumption of each sector into specific uses (lighting, electric motors, electrolysis, computers, etc.) and thermal uses (space heating, hot water, steam, etc.) was estimated after consultations with experts from the respective sectors since the existing statistics do not include this piece of information.

The form of energy that raised special problems, in the case of Romania, was the centralized thermal energy generated in cogeneration and thermal plants (district heating). The difficulty consists in the fact that the MAED model allows this energy form only in the Manufacturing industry, Service and Household, and in the last two sectors only for large cities, while in Romania, this energy form is also consumed in other sectors such as Agriculture, Construction, Mining and Transportation.

There are two ways of solving this matter.

- The *first solution* consists in displacing the consumption of district heating from Agriculture, Construction, Mining and Transportation to one of the MAED sectors allowing this energy form (i.e. Manufacturing industry). With this solution, the consumption of district heating remains unchanged at the country level, but the energy consumption of the respective sectors is altered.

- The *second solution* is to change the district heat consumption in Agriculture, Construction, Mining and Transportation into an equivalent consumption of fossil fuels within the same sector. Thus, the energy consumption of the respective sectors do not change, but the centralized thermal energy and the direct use of fossil fuels at the level of the country are altered.

Finally, a combination of the above solutions was adopted, namely in Agriculture, Construction and Mining sectors the district heat consumption was changed into an equivalent consumption of fossil fuels, while the respective consumption of the Transportation sector was taken into consideration within the Service sector (heating of airports, railway stations, travel agencies).

Romania's final energy consumptions in the base year (1989), before and after the above mentioned changes, are shown in Table A.15 and Table A.16, respectively. Table A.17 gives the evolution of the final energy consumption during the 1981-1990 period, according to the sectors and energy forms allowed by the MAED model.

Table A.15 Final Energy Consumption in the Base Year (1989); Intermediate Reorganization of Sectors and Energy Forms

Sectors	Motor fuels		Electricity, specific uses	Thermal uses						Coal, specific uses		Feed-stock	TOTAL commercial final energy		Non-commercial fuels	Non-supplied energy	GRAND TOTAL[1]
				Fossil, direct use		District heating	Electricity		Total	Trains	Coke						
	Mtce	Pcal	TWh	Mtce	Pcal	Pcal	TWh	Pcal	Pcal	Mtce	Mtce	Mtce	Mtce	%	Mtce	Mtce	Mtce
Agriculture	1 694	11 858	4 169	0 123	0 861	5 462	-	-	6 323	-	-	-	3 110	4 4	-	-	3 110
Construction	0 813	5 691	1 511	0 154	1 078	1 383	-	-	2 461	-	-	-	1 351	1 9	-	-	1 351
Mining	0 187	1 309	5 512	0 565	3 955	5 617	-	-	9 572	-	-	0 145	2 377	3 3	-	-	2 377
Manufacturing	0 838	5 866	37 505	13 422	93 954	103 095	8 700	7 482	204 531	-	5 702	10 232	50 605	71 1	-	-	50 605
-Basic Materials	0 292	2 044	25 826	9 914	69 398	74 280	6 000	5 160	148 838	-	5 642	9 841	40 215	56 5	-	-	40 215
-Machinery& Equip	0 171	1 197	7 208	1 720	12 040	11 240	1 600	1 376	24 656	-	0 050	0 015	4 645	6 5	-	-	4 645
-Non-durable Goods	0 319	2 233	3 166	1 528	10 696	16 667	0 800	0 688	28 051	-	-	-	4 715	6 6	-	-	4 715
-Miscellaneous	0 056	0 392	1 305	0 260	1 820	0 908	0 300	0 258	2 986	-	0 010	0 376	1 030	1 4	-	-	1 030
Transportation	2 225	15 575	2 921	0 647	4 529	0 767	-	-	5 296	0 035	-	-	3 376	4 8	-	-	3 376
Service	0 334	2 338	2 844	0 570	3 990	7 751	0 088	0 076	11 817	-	-	-	2 372	3 3	-	0 700	3 072
Household	0 669	4 683	3 928	3 505	24 535	23 097	0 368	0 316	47 948	-	-	-	8 002	11 2	2 550	3 700	14 252
TOTAL	6 760	47 320	58 390	18 986	132 902	147 172	9 156	7 874	287 948	0 035	5 702	10 377	71 193	100 0	2 550	4 400	78 143

Note (1) Unit conversion 1 Mtce = 7 0 Pcal
1 TWh = 0 86 Pcal
1 TWh = 0 123 Mtce

Table A.16 Final Energy Consumption in the Base Year (1989) According to the MAED Model Requirements

Sectors	Motor fuels		Electricity, specific uses	Thermal uses						Coal, specific uses		Feed-stock	TOTAL commercial final energy		Non-commercial fuels	Non-supplied Energy	GRAND TOTAL (1)
				Fossil, direct use		District heating	Electricity		Total	Trains	Coke						
	Mtce	Pcal	TWh	Mtce	Pcal	Pcal	TWh	Pcal	Pcal	Mtce	Mtce	Mtce	Mtce	%	Mtce	Mtce	Mtce
Agriculture	1.694	11.858	4.169	0.903	6.323	-	-	-	6.323	-	-	-	3.110	4.4	-	-	3.110
Construction	0.813	5.691	1.511	0.352	2.461	-	-	-	2.461	-	-	-	1.351	1.9	-	-	1.351
Mining	0.187	1.309	5.512	1.367	9.572	-	-	-	9.572	-	-	-	2.232	3.1	-	-	2.232
Manufacturing	0.838	5.866	37.505	13.422	93.954	103.095	8.700	7.482	204.531	-	5.702	10.377	50.75	71.3	-	-	50.750
-Basic Materials	0.292	2.044	25.826	9.914	69.398	74.280	6.000	5.160	148.838	-	5.702	9.986	40.42	56.8	-	-	40.420
-Machinery&Equip.	0.171	1.197	7.208	1.720	12.040	11.240	1.600	1.376	24.656	-	-	0.015	4.595	6.5	-	-	4.595
-Non-durable Goods	0.319	2.233	3.166	1.528	10.696	16.667	0.800	0.688	28.051	-	-	-	4.715	6.6	-	-	4.715
-Miscellaneous	0.056	0.392	1.305	0.260	1.820	0.908	0.300	0.258	2.986	-	-	0.376	1.020	1.4	-	-	1.020
Transportation	3.228	22.596	2.921	-	-	-	-	-	-	0.035	-	-	3.622	5.1	-	-	3.622
Service	-	-	2.844	1.217	8.519	8.518	0.088	0.076	17.113	-	-	-	2.795	3.9	-	0.700	3.495
Household	-	-	3.928	3.505	24.535	23.097	0.368	0.316	47.948	-	-	-	7.333	10.3	2.550	3.700	13.583
TOTAL	6.760	47.320	58.390	20.766	145.364	134.710	9.156	7.874	287.948	0.035	5.702	10.377	71.193	100.0	2.550	4.400	78.143

Note: (1) Unit conversion : 1 Mtce = 7.0 Pcal
1 TWh = 0.86 Pcal
1 TWh = 0.123 Mtce

Table A.17 Commercial Final Energy Consumption According to the MAED Requirements (1981-1990)

Unit Mtce

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture										
- Motor fuels	1 833	1 606	1 553	1 589	1 623	1 593	1 532	1 725	1 694	1 647
- Electricity	0 391	0 425	0 512	0 435	0 486	0 509	0 480	0 451	0 513	0 391
- Fossil fuels(1)	1 417	1 177	1 037	0 843	1 057	0 955	0 991	1 020	0 903	0 816
Subtotal	3 641	3 208	3 102	2 867	3 166	3 057	3 003	3 196	3 110	2 854
Construction										
- Motor fuels	1 168	1 123	1 028	0 944	0 831	0 832	1 362	0 894	0 813	0 669
- Electricity	0 185	0 142	0 137	0 169	0 161	0 166	0 186	0 193	0 186	0 170
- Fossil fuels(1)	0 566	0 520	0 715	0 305	0 289	0 303	0 306	0 355	0 352	0 330
Subtotal	1 919	1 785	1 880	1 418	1 281	1 301	1 854	1 442	1 351	1 169
Mining										
- Motor fuels	0 111	0 168	0 173	0 182	0 264	0 284	0 304	0 277	0 187	0 227
- Electricity	0 459	0 493	0 525	0 373	0 407	0 431	0 443	0 467	0 678	0 476
- Fossil fuels(1)	2 824	2 536	2 765	1 559	1 565	1 995	1 700	1 636	1 367	1 238
Subtotal	3 394	3 197	3 463	2 114	2 236	2 710	2 447	2 380	2 232	1 941
Manufacturing										
- Motor fuels	0 939	0 965	0 904	0 934	0 903	0 809	0 899	0 897	0 917	0 835
- Electricity	4 845	4 939	4 926	5 312	5 331	5 731	5 646	5 837	5 842	4 590
- Fossil fuels	11 097	14 382	11 453	11 879	12 039	12 393	10 500	11 120	12 492	9 740
- Centralized heat	12 580	12 675	12 408	13 312	13 540	14 101	14 018	14 590	14 782	12 451
- Coke	4 095	4 039	3 612	4 405	4 826	4 683	4 587	4 480	6 340	3 279
- Feedstock	9 925	8 680	9 308	9 011	8 625	10 591	8 547	9 302	10 377	8 128
Subtotal	43 481	45 680	42 611	44 854	45 264	48 308	44 197	46 226	50 750	39 023
Transportation										
- Motor fuels	3 879	4 127	3 617	3 422	3 223	3 142	2 893	3 514	3 223	4 192
- Electricity	0 246	0 240	0 364	0 285	0 299	0 317	0 318	0 347	0 359	0 321
- Fossil fuels(2)	0 050	0 045	0 040	0 045	0 050	0 055	0 045	0 040	0 040	0 035
Subtotal	4 175	4 412	4 021	3 752	3 572	3 514	3 256	3 901	3 622	4 548
Service										
- Electricity	0 344	0 327	0 364	0 607	0 316	0 324	0 201	0 352	0 361	0 393
- Fossil fuels	1 813	1 212	1 046	1 204	1 676	1 039	1 028	1 147	1 217	1 048
- District heat	1 347	1 321	1 299	0 950	1 210	1 176	1 221	1 257	1 217	1 478
Subtotal	3 504	2 860	2 709	2 761	3 202	2 539	2 450	2 756	2 795	2 919
Household										
- Electricity	0 631	0 621	0 614	0 588	0 592	0 614	0 591	0 551	0 528	0 658
- Fossil fuels	4 409	4 398	3 910	3 998	4 212	4 105	3 650	3 242	3 505	3 849
- District heat	2 981	3 151	2 881	2 998	2 666	2 924	2 964	3 099	3 300	3 742
Subtotal	8 021	8 170	7 405	7 584	7 470	7 643	7 205	6 892	7 333	8 249
TOTAL	68 135	69 312	65 191	65 349	66 191	69 072	64 412	66 793	71 193	60 703

Source National Commission for Statistics

Notes (1) Including Centralized heat
(2) Coal, specific uses

A.3 Final Energy Intensity by Economic Sector and Energy Form

In the MAED model energy demand of the Agriculture, Construction, Mining and Manufacturing sectors is calculated as a function of the sector's value added and the energy intensity by energy form: motor fuels, electricity, thermal uses

The information in Table A.3 and Table A 17 related to GDP formation and the energy consumption by sectors, respectively, allows to determine the energy intensities of the above-mentioned sectors and the average energy intensity at the country level for the 1981-1990 period In order to obtain consistent energy intensities, the GDP values listed in Table A.3 were changed into 1989 constant prices using an average inflation index for all the economic sectors (see Table A 18). The energy intensities thus obtained, are shown in Table A.19.

A.4 Freight and Passenger Transportation

A.4.1 Freight Transportation

The Statistical Yearbook gives a detailed breakdown of the freight transportation by modes of transport. The evolution of the freight transportation in some selected years within the 1980-1989 period is listed in Table A 20.

It should be noted the large share of the sea transport in the total freight transportation. In addition, the ships performing this volume of transport are not supplied with the whole amount of fuel from domestic sources, but they purchase fuel from harbours abroad, this consumption being not emphasized by any national statistics For this reason, in the MAED study the assumption was made that only a quarter of the volume of sea freight transportation and the whole river transportation are carried out with domestic fuel

Table A.18 GDP Formation by Selected Economic Sectors

Unit 10^9 lei (1989 constant prices)

Year	Agriculture & Forestry	Construction	Mining	Manufacturing	TOTAL GDP
1980	88.985	54.380	13.418	341 181	706 230
1981	103 933	50.906	15 555	305 436	707 028
1982	127 148	47.772	16 904	321 177	734 958
1983	109.150	53 016	19 491	354 739	779 646
1984	112 218	54.459	21 453	383 686	825 132
1985	115 518	58.584	20 628	372 135	824 835
1986	107 224	59 944	21 107	395 125	844 284
1987	103 879	61 306	28 098	388 269	851 466
1988	114 409	59 323	27 119	377 127	847 476
1989	110 90	50 60	26 20	348 50	798 00
1990	133 011	42 120	31 036	283 017	738 948

Source: National Commission for Statistics

Table A.19 Final Energy Intensities by Selected Economic Sector and Energy End-use

Unit kg c e /10^3 lei (1989 constant prices)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture	35 0	25 2	28 4	25 6	27 4	28 5	28 9	27 9	28 0	21 4
- motor fuels	17 6	12 6	14 2	14 2	14 0	14 9	14 8	15 1	15 3	12 4
- electricity	3 8	3 3	4 7	3 9	4 2	4 7	4 6	3 9	4 6	2 9
- fossil fuels(1)	13 6	9 3	9 5	7 5	9 2	8 9	9 5	8 9	8 1	6 1
Construction	37 6	37 4	35 5	26 0	21 8	21 7	30 2	24 3	26 7	27 7
- motor fuels	22 9	23 5	19 4	17 3	14 2	13 9	22 2	15 1	16 0	15 9
- electricity	3 6	3 0	2 6	3 1	2 7	2 8	3 0	3 2	3 7	4 0
- fossil fuels	11 1	10 9	13 5	5 6	4 9	5 0	5 0	6 0	7 0	7 8
Mining	218 1	189 1	177 7	98 6	108 4	128 4	87 1	87 7	85 2	62 5
- motor fuels	7 1	9 9	8 9	8 5	12 8	13 5	10 8	10 2	7 1	7 3
- electricity	29 5	29 2	26 9	17 4	19 7	20 4	15 8	17 2	25 9	15 3
- fossil fuels	181 5	150 0	141 9	72 7	75 9	94 5	60 5	60 3	52 2	39 9
Manufacturing	142 4	142 2	120 1	116 9	121 6	122 3	113 8	123 1	145 6	137 9
- motor fuels	3 1	3 0	2 5	2 4	2 4	2 0	2 3	2 4	2 4	3 0
- electricity	15 9	15 4	13 9	13 8	14 3	14 5	14 5	15 5	16 3	16 2
- fossil fuels&district heat	96 0	84 2	67 3	65 7	68 7	67 1	63 1	69 2	80 8	78 4
Country Average Final Energy Intensity	96 4	94 3	83 6	79 2	80 2	81 8	75 6	79 1	89 2	82 1

Note (1) Including Centralized heat supply

Table A.20 Statistics on Freight Transportation

Unit 10^9 t-km

Type of transportation	1980	1985	1986	1987	1988	1989
Railway	75 535	74 215	79 092	78 070	80 607	81 131
Truck	27 727	27 870	30 399	29 635	29 785	30 028
- long distance	11 756	5 957	5 522	5 511	5 649	5 813
- local	15 971	21 913	24 877	24 124	24 136	24 215
River	2 350	2 417	2 598	2 656	3 318	3 666
Sea	80 264	103 417	116 042	116 063	138 093	149 372
Air	0 075	0 073	0 073	0 063	0 061	0 078
Pipelines	5 188	4 771	5 419	6 458	6 356	6 654
Total	191 139	212 763	233 623	232 945	258 220	270 929

Due to the fact that the air transportation has a very small share in the total freight transportation and that each town provided with airport is also provided by rail transportation, the air freight transportation has been cumulated with the railway one

Based on the above consumptions the data for Freight transportation for Module 1 of MAED was determined as illustrated in Table A 21

Table A.21 Statistics on Freight Transportation for the MAED Model

Unit 10^9 t-km

Mode of transportation	1980	1985	1986	1987	1988	1989
Train	75 610	74 288	79 164	78 133	80 668	81 209
Truck - long distance - local	27 727 11 756 15 971	27 870 5 957 21 913	30 399 5 522 24 877	29 635 5 511 24 124	29 785 5 649 24 136	30 028 5 813 24 215
Barge	22 416	28.271	31 609	31 672	37 841	41 009
Pipelines	5 188	4 771	5 419	6 458	6 356	6 654
Total	130 941	135 200	146 592	145 898	154 650	158 900

A.4.2 Passenger Transportation

The Statistical Yearbook also gives the volume of the intercity public transportation but without any reference to the volume of transportation with private cars. Table A 22 presents the evolution of the volume of intercity public mass transportation in certain years of the period 1980-1989

Due to the small share of the river transportation in the total passenger intercity transportation and to the fact that each town provided with harbour is served by the railway transportation, too, the river passenger transportation has been cumulated with the railway one in the MAED study.

As to the urban passenger transportation, the statistics do not explicitly provide any data concerning the volume of transportation (passenger-kilometres) but only a series of other data: the length of urban transport line routes, the number of vehicles per modes of transportation, etc that are useful in processing input data for MAED model.

A.5 Electric Power Balance

The electric power balance listed in the Romanian Statistical Yearbook includes the following items: *Resources* (provided from the domestic production and from import), and

Table A.22 Statistics on Intercity Passenger Transportation (public modes)

Unit: 10^9 p-km

Type of transportation	1980	1985	1986	1987	1988	1989
Railway	23 220	31 082	32 304	33 520	34 643	35 456
Buses	24 016	21 682	22 263	22 438	22 989	23 077
River	0 079	0 078	0 084	0 073	0 078	0 072
Air	2 790	3 403	3 301	3 851	4 019	3 842
Total	50 105	56 245	57 882	59 882	61 729	62 447

Table A.23 Electric Power Balance

Unit GWh

	1970	1980	1985	1986	1987	1988	1989	1990
A RESOURCES	35116	67958	75078	79908	79229	82521	83662	73785
1 Production	35088	67486	71819	75478	74079	75322	75851	64309
2 Import	28	472	3259	4430	5150	7199	7811	9476
B DESTINATIONS	35116	67958	75078	79908	79229	82521	83661	73785
1 Consumption	29387	63883	71223	75795	75177	78226	79027	67856
of which								
- Industry	19596	43692	49311	52861	52707	55056	55574	44533
- Construction	662	1501	1308	1354	1512	1568	1511	1342
- Transportation&telecomms	500	1924	2430	2580	2583	2824	2921	2614
- Agriculture & forestry	710	2821	3948	4135	3904	3666	4169	3180
- Municipal services	655	1116	1298	1363	1361	1460	1544	1609
- Public lighting	345	176	73	75	57	69	84	160
- Domestic use	2239	4889	4814	4992	4807	4482	4296	5353
- Consumption in electric power stations	3317	5954	6585	7044	7026	7294	7626	7640
of which for producing electric power	2501	4457	4770	5125	5019	5095	5298	4984
2 Exports	2413	49	-	-	-	-	-	-
3 Losses in the electric transmission and distribution network	331	4026	3855	4113	4052	4295	4635	5929

Source Romanian Statistical Yearbook, 1991

Destinations (consumption, exports and losses in both transmission and distribution electric networks)

The electricity consumption is divided into several categories of consumers (see Table A 23) It should be mentioned that the internal consumption of power plants is included in this table as a category of consumption

Appendix B

INPUT DATA FOR MAED ANALYSIS
MODULE 1

The data input requirements of the MAED model includes a variety of information regarding the economy, technological status of the productive sectors, demographic information, habitat and standards of living of the population, etc. These data should be provided not only for the base year of study, but also for every year considered in the scenario of development describing the future evolution of these parameters. This appendix describes how the statistical data and other available information was processed in order to meet the input data requirements of the MAED model.

B.1 Derivation of Constant Parameters

Constant Parameters refer to the information for the base year of study (1989) and their description is presented in Table B.1.

B.1.1 Specific Energy Intensity in Industry (EI(I,J))

The specific energy intensities, defined in terms of energy consumption per monetary unit, were calculated from the 1989 final energy consumption in the Industry sector divided by the value added of the corresponding sector. However, the thermal uses in Manufacturing were calculated in terms of useful energy in order to satisfy the requirements of the MAED model so as to facilitate the analysis of the substitution process among alternative energy carriers. The results of specific energy intensities in Industry are summarized in Tables B.2 and B.3.

B.1.2 Share of Useful Thermal Energy Demand of Manufacturing Sector (PUSIND (I,J))

The energy consumption for thermal purposes in Manufacturing was broken down into utilization categories by temperature range, namely: furnace and direct heat (high temperature), steam generation (medium temperature), and space heating and hot water (low temperature) as follows:

- district heat is used to cover medium temperature (steam) and low temperature (space heating and hot water) consumption;

- fossil fuels and electricity are used for high temperature consumption (furnace and direct heat).

Tables B.4 and B.5 show the thermal uses and average efficiency of thermal processes in Manufacturing assumed in the study.

B.1.3 Constants for Steel Production (CPST (1), CPST(2))

Romania's steel production was about 14 million tons yearly through 1984-1988 and 14.416 million tons in 1989.

Table B.1 Description of Constant Parameters (Base Year)

Description	Variable	Value
INDUSTRY		
1 Specific energy consumption per monetary unit of value added by sector and energy form	EI(I J)	
Agriculture		
- Motor fuel (final, Mcal/US$ of value added)	EI AGR MF	1 871
- Electricity (final, kWh/US$ of value added)	EI AGR EL	0 658
- Thermal uses (final, Mcal/US$ of value added)	EI AGR TH	0 998
Construction		
- Motor fuel (final, Mcal/US$ of value added)	EI CON MF	1 968
- Electricity (final, kWh/US$ of value added)	EI CON EL	0 523
- Thermal uses (final, Mcal/US$ of value added)	EI CON TH	0 851
Mining		
- Motor fuel (final, Mcal/US$ of value added)	EI MIN MF	0 875
- Electricity (final, kWh/US$ of value added)	EI MIN EL	3 682
- Thermal (final, Mcal/US$ of value added)	EI MIN TH	6 398
Manufacturing		
* Basic Materials		
- Motor fuel (final, Mcal/US$ of value added)	EI BM MF	0 3016
- Electricity (final, kWh/US$ of value added)	EI BM EL	3 8108
- Thermal (useful, Mcal/US$ of value added)	EI BM US	17 3541
* Machinery and Equipment		
- Motor fuel (final, Mcal/US$ of value added)	EI ME MF	0 1836
- Electricity (final, kWh/US$ of value added)	EI ME EL	1 1055
- Thermal (useful, Mcal/US$ of value added)	EI ME US	2 9506
* Non-durable Goods		
- Motor fuel (final, Mcal/US$ of value added)	EI ND MF	0 3676
- Electricity (final, kWh/US$ of value added)	EI ND EL	0 5212
- Thermal (useful, Mcal/US$ of value added)	EI ND US	3 8258
* Miscellaneous industries		
- Motor fuel (final, Mcal/US$ of value added)	EI MI MF	0 7219
- Electricity (final, kWh/US$ of value added)	EI MI EL	2 4033
- Thermal (useful, Mcal/US$ of value added)	EI MI US	3 9890
2 Share of useful thermal energy demand of manufacturing by process category	PUSIND(I J)	
* Basic Materials		
- Steam generation	PUSIND(1,1)	0 5597
- Furnace/direct heat	PUSIND(1,2)	0 3684
- Space/water heating	PUSIND(1,3)	0 0719
* Machinery and Equipment		
- Steam generation	PUSIND(2,1)	0 5258
- Furnace/direct heat	PUSIND(2,2)	0 4158
- Space/water heating	PUSIND(2,3)	0 0584
* Non-durable Goods		
- Steam generation	PUSIND(3,1)	0 6303
- Furnace/direct heat	PUSIND(3,2)	0 2828
- Space/water heating	PUSIND(3,3)	0 0869
* Miscellaneous industries		
- Steam generation	PUSIND(4,1)	0 0000
- Furnace/direct heat	PUSIND(4,2)	0 5808
- Space/water heating	PUSIND(4,3)	0 4192
3 Steel production Constants used to project the amount of steel produced		
- (million tons)	CPST(1)	14 416
- (tons/1000 US$ value added)	CPST(2)	0 000
4 Feedstock requirements Constants used to project feedstock requirements of the petrochemical industry		
- (million toe)	CFEED(1)	7 264
- (toe/US$ of value added)	CFEED(2)	0 000

Table B.1 Continuation

Description	Variable	Value
TRANSPORTATION		
5 Constants used to project the total demand for freight transportation		
- (10^9 ton-km)	CTKFRT(1)	101 5180
- (ton-km/US$ of value added)	CTKFRT(2)	1 8835
6. Constants used to project the total motor fuel demand for international, military and miscellaneous transport		
- (Pcal)	CMISMF(1)	0 00
- (Pcal/ US$)	CMISMF(2)	0 00
HOUSEHOLD/SERVICE		
7 Degree-day	DD	3100 00
8 Fraction of dwellings in areas where space heating is required	DWSH	1 00
9 Total stock of dwellings in the base year (million dwellings)	DW	7 96
10 Specific space heat requirements of "Old" dwellings by type		
(1) Single family house with central heating (Mcal/dw/yr)	SHDWO(1)	5040 00
(2) Apartment with central heating (Mcal/dw/yr)	SHDWO(2)	4670 00
(3) Dwelling with room heating only (Mcal/dw/yr)	SHDWO(3)	4030 00
11 Share of floor area heated in Service sector	ARSH	1 00
12 Total floor area of Service sector buildings in base year (million square meters)	TAREA	75 00
13 Constant used to project the Service sector share in the total labour force	CPLSER	1 22
14 Specific heat requirements (useful energy) of "Old" Service sector buildings (Mcal/sqm/yr)	HAREAO	220 00
15 Amount of Non-commercial fuels used in the base year (million tce)	BYRNCF	2 55

Table B.2 Energy Intensity in Agriculture, Construction and Mining Sectors for the Base Year (1989) [Final Energy/Monetary Unit of Value Added]

	Value added 10^9 US$	Motor fuels 10^3 kcal/US$	Specific uses of electricity kWh/US$	Thermal uses 10^3 kcal/US$
Agriculture	6 338	1 871	0 658	0 998
Construction	2 891	1 968	0 523	0 851
Mining	1 496	0 875	3 682	6 398
Manufacturing	19 914	0 294	1 883	8 148 [useful energy] 10 270 [final energy]

Table B.3 Energy Intensity in Manufacturing for the Base Year (1989) [Final (Useful) Energy/M.U. of Value Added]

	Value added 10^9 US$	Motor fuels [Final energy] 10^3 kcal/US$	Specific uses of electricity [Final energy] kWh/US$	Thermal uses [Useful energy] 10^3 kcal/US$
Basic Materials	6 777	0 3016	3 8108	17 3541
Machinery and Equipment	6 520	0 1836	1 1055	2 9506
Non-durable Goods	6 074	0 3676	0 5212	3 8258
Miscellaneous	0 543	0 7219	2 4033	3 9890

Table B.4 Thermal Energy Demand (Final) in Manufacturing for the Base Year (1989)

(a) Totals

Unit 10^6 Gcal

	Thermal uses (Final)			
	Direct heat	District heat and cogeneration	Electricity	All forms
Basic Materials	69 398	74 280	5 160	148 838
Machinery and Equipment	12 040	11 240	1 376	24 656
Non-durable Goods	10 696	16 667	0 688	28 051
Miscellaneous	1 820	0 908	0 258	2 986
All Manufacturing	93 954	103 095	7 482	204 531

(b) By temperature range

Unit 10^6 Gcal

	Low	Medium	High		
	District heat and cogeneration	District heat and cogeneration	Direct heat	Electricity	All forms
Basic Materials	8 452	65 828	69 398	5 160	74 558
Machinery and Equipment	1 124	10 116	12 040	1 376	13 416
Non-durable Goods	2 020	14 647	10 696	0 688	11 384
Miscellaneous	0 908	-	1 820	0 258	2 078
All Manufacturing	12 504	90 591	93 954	7 482	101 436

Table B.5 Thermal Energy Demand (Useful) in Manufacturing for the Base Year (1989)

(a) Totals

Unit: 10^6 Gcal

	Thermal uses			
	Direct heat	District heat and cogeneration	Electricity	All forms
Basic Materials	38.169	74.280	5.160	117.609
Machinery and Equipment	6.622	11.240	1.376	19.238
Non-durable Goods	5.883	16.667	0.688	23.238
Miscellaneous	1.000	0.908	0.258	2.166
All Manufacturing	51.674	103.095	7.482	162.251

(b) By temperature range

	Low		Medium		High			
	District heat and cogeneration		District heat and cogeneration		Direct heat	Electricity	All forms	
	10^6 Gcal	%	10^6 Gcal	%	10^6 Gcal	10^6 Gcal	10^6 Gcal	%
Basic Materials	8.452	7.19	65.828	55.97	38.169	5.160	43.329	36.84
Machinery and Equipment	1.124	5.84	10.116	52.58	6.622	1.376	7.998	41.58
Non-durable Goods	2.020	8.69	14.647	63.03	5.883	0.688	6.571	28.28
Miscellaneous	0.908	41.92	-	-	1.000	0.258	1.258	58.08
All Manufacturing	12.504	7.70	90.591	55.80	51.674	7.482	59.156	36.46

However, no official projections concerning the development of steel industry during the study period were available at the time the study was carried out. In addition, the steel production modelling in MAED through a linear relation dependent on GDP, does not suit to Romania's particular condition (GDP has decreased on the first part of the study period and it is expected to grow after 1995).

For these reasons, it has been estimated that the steel production will remain at the level of the Base year throughout the whole study period, namely 14.416 million tons.

B.1.4 Estimation of Feedstock Consumption (CFEED(1), CFEED(2))

For the same reasons given in Section B.1.3, the feedstock consumption was supposed to remain constant within the whole study period at the level of the base year, namely 7.264 million toe (10.377 million tce).

B.1.5. Constants Used to Project the Total Demand for Freight Transportation (CTKFRT (1), CTKFRT(2))

Regarding the statistical data related to freight transportation (see Table A.21) it should be noticed that the total freight transport volume increased within the 1980-1989 period with an average annual rate of 2.17%. In years 1990 and 1991 the volume of freight transportation decreased as a result of the economic recession but it is expected that, after 1994-1995, in parallel with the economic revival, the volume of freight transportation should start growing.

This kind of evolution cannot be shaped by means of the present MAED model, namely through a linear (direct) relation. Therefore, it has been assumed that the increasing trend experienced through the 1980-1989 period, will be maintained in the period 1989-2010, but with an average annual growth rate lower (1.1%) in 2010 than in 1989 which will determine a total freight transportation demand of $200*10^9$ t-km in 2010. In order to get this projection of the freight transportation total demand, the following constants were used:

CTKFRT(1)=101.5180
CTKFRT(2)= 1.8835

B.1.6 Constants Used to Project the Total Motor Fuel Demand in the Miscellaneous Transportation (CMISMF(1), CMISMF(2))

Since the available statistics do not explicitly indicate either the volume of international and military transportation or its motor fuels consumption, it was assumed that they are included in the total volume of transportation as well as in the motor fuels total consumption of the Transportation sector. Therefore, the following constants were assumed in the study:

CMISMF(1)=0.0
CMISMF(2)=0.0

B.1.7 Dwellings in the Base Year

Statistical publications show that in 1989 the total stock of dwellings was 7.960 million with an average inhabitable area of 33.6 m^2 each. Taking into account the geographical location, all dwellings must be heated during cold weather, the average number of degrees day being 3,100.

The heat demand for apartment with central heating was determined based on designed standards and on the number of dwellings and their geographical distribution. This resulted in an average heat demand for heating of 4,670 Mcal/year. The demand for single family house with central heating was estimated by experts at 5,040 Mcal/year and of 4,030 Mcal/year for the other types of dwellings (dwelling with room heating only).

B.1.8 Service Sector

In order to make up for the lack of statistical data related to the Service sector floor area some assumptions were made based on the estimates for new dwellings. It was assumed that the services located at the ground floor of the blocks of flats, especially shops and restaurants, totalize an area representing 15% of the area of dwellings in the respective buildings while the rest of services (hospitals, hotels, banks, schools, etc.) would represent

about 20% of the dwellings area. Considering these assumptions, the area occupied by the Service sector in 1989 was estimated at 75 million m^2.

The necessary thermal energy for the Service sector consists mainly in the demand for space heating and hot water. From the statistical data, the specific heat consumption for the base year was calculated at 180 Mcal/sqm and year. In the last 10 years, the heat demand for the Service sector has not been met with varying rates of imbalance. For the year 1989 the demand was estimated to be 18% higher than the actual consumption. Therefore the specific heat requirements of "Old" Service sector buildings for the base year was estimated at 220 $Mcal/m^2$ and year (useful energy).

B.1.9 Constant Used to Project the Service Sector Share in the Total Labour Force (CPLSER)

Romanian Statistical Yearbook gives the evolution of the number of employees in the Service sector. Therefore the constant CPLSER was calculated using the MAED equations, in order to retrieve the number of employees in the base year.

B.1.10 Amount of Non-commercial Fuels Used in the Base Year (BYRWCF)

The non-commercial fuel is considered a complementary source for the commercial fuel amounts used by population. Due to the lack of statistical data concerning this demand the specialists have considered a level of 2.550 Mtce for 1989.

B.2 Time Dependent (scenario) Parameters

The time dependent parameters characterize the evolution of scenarios for each reference year. Taking into account that a range of parameters have the same values in the three scenarios, a presentation of them for the Basic Scenario is made in the following sections, making reference to those parameters that differ for the Low and High Scenario.

Table B.6 shows the time dependent parameters specifying the changes from one scenario to the other. The reasons for the selection of these values is described in the following paragraphs.

B.2.1 Demography

B.2.1.1 Population (Po)

The future evolution of the population, shown in Table B.7, was estimated having in view the trend in the last period of decreasing natural growth, together with the forecast on the demographic growth in some west European countries.

B.2.1.2 Potential Labour Force and Fraction of the Potential Labour Force Actually Working (PLF, PARTLF)

Potential labour force (consisting in 15-64 years old population) in 1989 represented about 66% of the whole country population. This percentage had varied very little along the years and for this reason it was kept constant in the future.

Table B.6 Input Time Dependent Parameters and Value

Description		Variable	1989	1992	1995	2000	2005	2010
A. Demography								
1 Total population (million)		PO	23 152	23 256	23 400	23 690	24 050	24 410
2 Fraction at population of age 15-64 (potential labour force)		PLF	0 660	0 660	0 660	0 660	0 660	0 660
3 Fraction of potential labour force actually working		PARTLF	0 717	0 669	0 680	0 685	0 690	0 695
4 Share of population living outside large cities		POLC	0 489	0 470	0 458	0 436	0 420	0 405
5 Share of rural population (according to UN definition)		PRUR	0 468	0 450	0 432	0 399	0 359	0 309
6 Average household size (persons/household)		CAPH	2 910	2 880	2 850	2 820	2 800	2 785
B. GDP-Formation and expenditure								
Total GDP (10^9 US$)	L	Y	45 600	31 300	31 100	37 100	45 900	57 200
	B		45 600	31 300	32 100	40 500	51 900	66 100
	H		45 600	31 300	33 000	43 700	57 300	75 000
Distribution of GDP formation by kind of economic activity among following sectors								
1 Agriculture		PYAG	0 1390	0 187	0 195	0 204	0 208	0 210
2 Construction		PYB	0 0634	0 057	0 055	0 050	0 048	0 045
3 Mining		PYMIN	0 0328	0 042	0 041	0 040	0 038	0 035
4 Manufacturing		PYMAN	0 4367	0 382	0 380	0 380	0 380	0 380
5 Energy		PYEN	0 0591	0 050	0 045	0 040	0 035	0 035
6 Services		PYSER	0 2690	0 282	0 284	0 286	0 291	0 295
7 Distribution of manufacturing value added by sub-sector								
- Basic Materials		PVAIG	0 3403	0 325	0 323	0 320	0 315	0 310
- Machinery & Equipment		PVAM	0 3274	0 315	0 317	0 320	0 320	0 320
- Non-durable Goods		PVAC	0 3050	0 323	0 323	0 323	0 328	0 333
- Miscellaneous industries		PVAMIS	0 0273	0 037	0 037	0 037	0 037	0 037
8 Share of GDP spent on investments		I	0 0	0 0	0 0	0 0	0 0	0 0
9 Share of investments spent in construction		IB	0 0	0 0	0 0	0 0	0 0	0 0
10 Share of investments spent in Machinery & equipment		IM	0 0	0 0	0 0	0 0	0 0	0 0
11 Share of private consumption expenditures in total GDP		P	0 0	0 0	0 0	0 0	0 0	0 0
12 Share of private consumption spent in Durable goods		PCDG	0 0	0 0	0 0	0 0	0 0	0 0
13 Share of private consumption spent in Non-durable Goods		PCNDG	0 0	0 0	0 0	0 0	0 0	0 0
14 Share of private consumption spent in Services		PCSER	0 0	0 0	0 0	0 0	0 0	0 0
C. Industry								
1 Ratio of energy intensity in current year relative to the base year by sector (I) and energy form (J) Sectors								
1 AGR=Agriculture Energy forms								
1 MF=Motor fuels	L	CH AGR MF	1 0	1 0	1 0	1 03	1 03	1 07
	B		1 0	1 0	1 0	1 04	1 07	1 10
	H		1 0	1 0	1 0	1 05	1 10	1 15
2 EL=Electricity	L	CH AGR EL	1 0	1 0	1 0	1 03	1 03	1 07
	B		1 0	1 0	1 0	1 04	1 07	1 10
	H		1 0	1 0	1 0	1 05	1 10	1 15
3 TH=Thermal uses	L	CH AGR TH	1 0	0 9	0 9	0 87	0 87	0 80
	B		1 0	0 9	0 9	0 85	0 80	0 75
	H		1 0	0 9	0 9	0 82	0 75	0 70

Table B.6 Input Time Dependent Parameters and Value (cont.)

Description		Variable	1989	1992	1995	2000	2005	2010
2 CON=Construction Energy forms								
1 MF=Motor fuels	L	CH CON MF	1 0	1 0	1 0	0 97	0 97	0 93
	B		1 0	1 0	1 0	0 96	0 93	0 90
	H		1 0	1 0	1 0	0 95	0 90	0 85
2 EL=Electricity	L	CH CON EL	1 0	1 0	1 0	1 00	1 00	1 00
	B		1 0	1 0	1 0	1 03	1 05	1 07
	H		1 0	1 0	1 0	1 04	1 07	1 10
3 TH=Thermal uses	L	CH CON TH	1 0	1 0	1 0	0 90	0 90	0 80
	B		1 0	1 0	1 0	0 88	0 80	0 75
	H		1 0	1 0	1 0	0 85	0 75	0 70
3 MIN=Mining Energy forms								
1 MF=Motor fuels	L	CH MIN MF	1 0	1 0	1 0	0 97	0 97	0 93
	B		1 0	1 0	1 0	0 96	0 93	0 90
	H		1 0	1 0	1 0	0 95	0 90	0 85
2 EL=Electricity	L	CH MIN EL	1 0	1 0	1 0	1 00	1 00	1 00
	B		1 0	1 0	1 0	1 03	1 05	1 07
	H		1 0	1 0	1 0	1 04	1 07	1 10
3 TH=Thermal uses	L	CH MIN TH	1 0	1 0	1 0	0 90	0 90	0 80
	B		1 0	1 0	1 0	0 88	0 80	0 75
	H		1 0	1 0	1 0	0 85	0 75	0 70
2 Ratio of energy intensity in current year relative to the base year in manufacturing by energy form								
1 MF= Motor fuels	L	CH MAN MF	1 0	1 0	1 0	0 97	0 97	0 93
	B		1 0	1 0	1 0	0 96	0 93	0 90
	H		1 0	1 0	1 0	0 95	0 90	0 85
2 EL=Electricity	L	CH MAN EL	1 0	1 0	1 0	1 00	1 00	1 00
	B		1 0	1 0	1 0	1 03	1 05	1 07
	H		1 0	1 0	1 0	1 04	1 07	1 10
3 US=Thermal uses	L	CH MAN US	1 0	1 0	1 0	0 90	0 90	0 80
	B		1 0	1 0	1 0	0 88	0 80	0 75
	H		1 0	1 0	1 0	0 85	0 75	0 70
3 Share of useful thermal energy demand in manufacturing for steam and space and water heating		STSHI	0 666	0 666	0 666	0 666	0 666	0 666
4 Share of useful thermal energy demand in manufacturing for steam generation		STI	0 585	0 585	0 585	0 585	0 585	0 585
5 Share of low-temperature process heat in the total low and medium temperature process heat		LTH	0 121	0 121	0 121	0 121	0 121	0 121
6 Penetration of electricity on the various markets of useful thermal energy demand in manufacturing								
Categories 1 Steam generation		ELP I STM	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000
2 Furnace/direct heat		ELP I FUR	0 1266	0 1266	0 1266	0 1300	0 1400	0 1500
3 Space/water heating		ELP I SH	0 0000	0 0000	0 0000	0 0010	0 0050	0 0100
7 Average electricity penetration into thermal uses in manufacturing		ELP I AVE	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000
8 Contribution of heat pumps to steam generation and space and water heating uses in manufacturing		HPI	0 0	0 0	0 0	0 0	0 0	0 0
9 Coefficient of performance of (electric) heat pumps in manufacturing		EFFHPI	2 0	2 0	2 0	2 0	2 0	2 0
10 District heat penetration for steam generation and space and water heating in manufacturing		IDH	1 0	1 0	1 0	1 0	1 0	1 0
11 Solar penetration in low temperature process heat and space/water heating in manufacturing		SPLT	0 00	0 00	0 00	0 00	0 01	0 02
12 Solar penetration in medium temperature process heat in manufacturing		SPHT	0 00	0 00	0 00	0 00	0 00	0 00

Table B.6 Input Time Dependent Parameters and Value (cont.)

Description	Variable	1989	1992	1995	2000	2005	2010
13 Approximate share of useful thermal energy demand than can be met by a solar installation	FIDS	0 00	0 01	0 01	0 01	0 01	0 01
14 Share of the manufacturing demand for low temperature steam and space/water heating which is supplied by fossil fuels but with cogeneration of electricity	ICOGEN	0 00	0 00	0 00	0 00	0 00	0 00
15 System efficiency of cogeneration	EFFCOG	0 67	0 67	0 68	0 70	0 71	0 72
16 Ratio heat electricity in output of cogeneration systems	HELRAT	4 27	4 27	4 13	4 02	3 86	3 65
17 Average efficiency of fossil fuel use for thermal process j in manufacturing	EFF I STM	0 72	0 72	0 73	0 77	0 81	0 84
relative to the efficiency of electricity	EFF I FUR	0 55	0 55	0 55	0 57	0 60	0 62
(same categories as for ELPIND above)	EFF I SH	0 70	0 71	0 72	0 75	0 78	0 82
18 Average efficiency of fossil fuel use in thermal processes relative to the efficiency of electricity	EFF I AVE	0 00	0 00	0 00	0 00	0 00	0 00
19 Share of steel produced in non-electric furnaces	BOF	0 76	0 76	0 76	0 76	0 76	0 76
20 Specific consumption of pig iron in non-electric steel works	IRONST	0 83	0 83	0 83	0 83	0 83	0 83
21 Coke input in blast furnaces per unit output of pig iron (kg/ton)	EICOK	627 00	627 00	627 00	627 00	627 00	627 00
D. Transportation							
1 Fraction of total freight transportation made by - truck	TRU	0 189	0 190	0 195	0 200	0 210	0 220
- rail	FTRA	0 511	0 510	0 485	0 460	0 450	0 430
- barge	BA	0 258	0 258	0 280	0 300	0 300	0 310
- pipelines	PIP	0 042	0 042	0 040	0 040	0 040	0 040
2 Share of local truck transportation in the total truck transportation	TRUL	0 806	0 806	0 806	0 808	0 813	0 813
3 Fraction of total freight traffic made by electric trains	TRAEF	0 400	0 420	0 440	0 460	0 480	0 500
4 Share of steam trains in total freight transportation by rail	TRASTF	0 008	0 007	0 005	0 003	0 001	0 000
5 Energy intensity of trucks (kcal/t-km)	DTRU	180 00	180 00	177 00	172 00	169 00	166 00
6 Energy intensity of trucks for local transportation (kcal/t-km)	DTRUL	200 00	200 00	220 00	242 00	266 00	280 00
7 Energy intensity of diesel freight trains (kcal/t-km)	DTRAF	107 00	107 00	105 00	104 00	102 00	100 00
8 Average ratio between energy intensity of steam trains and diesel trains	STDTRA	3 700	3 700	3 700	3 700	3 700	3 700
9 Average ratio between energy intensity of electric and diesel trains (final energy)	ELDTRA	0 460	0 460	0 460	0 460	0 460	0 460
10 Energy intensity of barges (kcal/t-km)	DBA	40 000	40 000	39 500	38 700	38 500	37 000
11 Energy intensity of pipelines (kcal/t-km)	DPIP	40 000	40 000	40 000	40 000	40 000	40 000
12 Average intercity distance travelled per person per year (km/per/day)	DI	2952 0	2980 0	3025 0	3060 0	3200 0	3400 0
13 Average intracity distance travelled per person per day (km/per/yr)	DU	5 000	5 000	5 300	5 300	5 500	6 000
14 Inverse of car ownership ratio (pop/cars)	CO	19 880	18 500	17 900	16 700	16 000	15 000
15 Average intercity distance driven per car per year (km/car/yr)	DIC	1690 0	1700 0	1800 0	1900 0	2100 0	2300 0
16 Average load factor of cars in intercity travel (person/car)	LFIC	3 000	3 000	3 000	3 000	3 000	3 000
17 Share of cars in the total demand for intracity (urban) passenger transportation	UC	0 190	0 190	0 200	0 220	0 240	0 280
18 Share of electric cars in the total intracity car travel	UCE	0 000	0 000	0 000	0 000	0 000	0 000
19 Average load factor of cars in intracity travel (person/car)	LFUC	2 000	2 000	2 000	2 000	2 000	2 000

Table B.6 Input Time Dependent Parameters and Value (cont.)

Description	Variable	1989	1992	1995	2000	2005	2010
20 Share of buses in intercity passenger travel excluding travel by car	PBU	0 370	0 362	0 359	0 355	0 350	0 345
21 Share of trains in intercity passenger travel excluding travel by car	PTRA	0 569	0 577	0 580	0 582	0 585	0 590
22 Share of electric trains in the total intercity travel by train	TRAEP	0 500	0 510	0 530	0 540	0 570	0 600
23 Share of steam trains in the total intercity travel by train	TRASTP	0 000	0 000	0 000	0 000	0 000	0 000
24 Share of air planes in intercity passenger travel excluding travel by car	PLA	0 062	0 061	0 061	0 063	0 065	0 065
25 Average load factor of buses (intercity) (pers/bus)	LFBU	40 000	40 000	40 000	39 000	37 500	35 500
26 Average load factor of trains (intercity) (pers/train)	LFTRA	800 00	800 00	787 00	765 00	725 00	675 00
27 Average capacity utilization factor of air planes	LFP	0 950	0 800	0 800	0 800	0 800	0 800
28 Share of mass transportation systems in intracity traffic	UMT	0 810	0 810	0 800	0 780	0 760	0 720
29 Fraction of intracity traffic performed by electric modes	UMTE	0 400	0 400	0 410	0 430	0 450	0 470
30 Average load factor of intracity buses (pers/bus)	LFMTB	90 000	90 000	87 000	84 000	79 000	75 000
31 Average load factor of electric mass transit system (intracity) (pers/veh)	LFMTE	135 00	135 00	135 00	134 00	131 00	128 00
32 Specific gasoline consumption of cars in intercity travel (liter/100 vehicle-km)	GIC	8 000	8 000	7 800	7 500	7 000	6 000
33 Specific gasoline consumption of cars in intracity travel (liter/100 vehicle-km)	GUC	12 000	12 000	12 000	11 500	11 000	10 000
34 Specific electricity consumption of electric cars (intracity) (kWh/vehicle-km)	ELUC	0 000	0 000	0 000	0 000	0 000	0 000
35 Specific diesel consumption of intercity buses (liter/100 vehicle-km)	DBU	33 000	33 000	31 500	29 500	27 000	25 000
36 Specific diesel consumption of diesel passenger train (intercity) (kcal/train-km)	DTRAP	72000	72000	70500	67000	62500	55000
37 Specific energy consumption of air planes (kcal/seat-km)	DPLA	600 00	600 00	580 00	550 00	520 00	475 00
38 Specific diesel consumption of buses (intracity) (liter/100 vehicle-km)	DMT	45 000	45 000	44 000	42 000	40 000	39 000
39 Specific electricity consumption of intracity mass transportation systems (kWh/vehicle-km)	ELMT	3 500	3 500	3 500	3 470	3 400	3 300
E. Household/Service							
1 Specific energy consumption for cooking in dwellings (in useful energy terms) (10^3 kcal/per/yr)	COOKDW	1048 0	1040 0	1030 0	1000 0	950 00	900 00
2 Share of dwellings with hot water heating	DWHW	0 750	0 750	0 750	0 750	0 780	0 800
3 Specific energy consumption for water heating per person (useful energy) (10^3 kcal/dw/yr)	HWCAP	683 00	830 00	900 00	950 00	950 00	950 00
4 Share of dwellings with air conditioning	DWAC	0 000	0 000	0 000	0 005	0 008	0 013
5 Specific cooling requirements per dwelling (10^3 kcal/dw/yr)	ACDW	260 00	260 00	260 00	260 00	260 00	260 00
6 Specific (final) electricity consumption per dwelling for uses other than space/ water heating, cooking and air conditioning (kWh/dw/yr) L	EI APDW	513 46	923 00	948 00	1140 0	1290 0	1480 0
B		513 46	923 00	979 00	1241 0	1458 0	1713 0
H		513 46	923 00	1006 0	1339 0	1604 0	1944 0
7 Electricity penetration in households for uses other than space/water heating, cooking and air conditioning	PEL	0 961	0 961	0 961	0 961	0 971	0 975

Table B.6 Input Time Dependent Parameters and Value (cont.)

Description	Variable	1989	1992	1995	2000	2005	2010
8 Coefficient of total "losses" in the electric network	ELOSS	1 091	1 091	1 091	1 091	1 091	1 091
9 Fraction of "old" dwellings per type							
1 Single family house centrally heated	PREDW(1)	0 038	0 038	0 038	0 037	0 036	0 035
2 Apartment with central heating	PREDW(2)	0 387	0 390	0 394	0 400	0 407	0 413
3 Dwelling with room heating only	PREDW(3)	0 575	0 572	0 568	0 563	0 557	0 553
10 Share of service sector floor area actually heated	AREAH	1 000	1 000	1 000	1 000	1 000	1 000
11 Specific electricity consumption in "old" service sectors buildings ($kWh/m^2/yr$) L	ELARO	37 920	50 000	55 000	55 000	57 000	69 000
B		37 920	50 000	58 000	60 000	65 000	80 000
H		37 920	50 000	59 600	64 700	71 500	90 800
12 Share of air conditioned service floor area	AREAAC	0 000	0 000	0 000	0 010	0 030	0 050
13 Specific cooling requirements in the service sector (10^3 $kcal/m^2/yr$)	ACAREA	50 000	50 000	50 000	50 000	50 000	50 000
14 Coefficient of performance of (elect) air conditioners	EFFAC	2 000	2 000	2 000	2 000	2 000	2 000
15 Average demolition rate of dwellings over a 5-year period between previous and current years	DEMDW	0 000	0 014	0 016	0 0165	0 017	0 0175
16 Distribution of dwellings constructed between the last previous and current years by dwelling type							
1 Single family house centrally heated	NEWDW(1)	0 000	0 200	0 200	0 200	0 200	0 200
2 Apartment with central heating	NEWDW(2)	0 000	0 300	0 300	0 300	0 300	0 300
3 Dwelling with room heating only	NEWDW(3)	0 000	0 500	0 500	0 500	0 500	0 500
17 Average floor area heated in "New" dwellings (definition of dwelling types as for NEWDW above) (m^2/dw)	DWS(1)	33 600	33 600	33 600	34 000	36 000	38 000
	DWS(2)	33 600	33 600	33 600	34 000	35 500	36 000
	DWS(3)	33 600	33 600	33 600	34 000	35 000	35 000
18 Specific heat loss rate in "NEW" dwellings (definition of dwelling types as for NEWDW above) ($kcal/m^2/^\circ C/h$)	K(1)	2 016	2 016	2 000	1 950	1 890	1 810
	K(2)	1 867	1 867	1 850	1 810	1 750	1 680
	K(3)	1 612	1 612	1 600	1 560	1 520	1 450
19 Reduction of the average rate space heat demand of "old" dwellings in current year relative to that in the base year due to better insulation (definition of dwelling types as for PREDW above)	ISO(1)	0 000	0 000	0 000	0 010	0 030	0 050
	ISO(2)	0 000	0 000	0 000	0 010	0 030	0 050
	ISO(3)	0 000	0 000	0 000	0 010	0 030	0 050
20 Average floor area per employee in the service sector (m^2/employ)	AREAL	33 97	34 500	35 000	35 000	35 000	35 000
21 Average demolition rate on the floor area of service sector buildings over a 5-year period between previous and current year	DEMAR	0 000	0 014	0 016	0 0162	0 0164	0 0165
22 Specific heat requirements of "New" service sector buildings (useful energy) (10^3 $kcal/m^2/yr$)	HARLAN	0 000	210 00	205 00	200 00	195 00	190 00
23 Specific electricity consumption in "NEW" service sector buildings L	ELARN	0 000	50 000	55 000	57 000	61 000	73 000
($kWh/m^2/yr$) B		0 000	50 000	59 500	65 000	68 000	85 000
H		0 000	50 000	61 200	70 100	74 800	96 500
24 Reduction of the average heat demand in "old" service sector buildings in current year relative to that in the base year due to better insulation	ISOSV	0 000	0 010	0 020	0 030	0 040	0 050
25 Electricity penetration into thermal uses in the Household/Service sector							
H SH= Space heating (households)	ELP H SH	0 006	0 006	0 011	0 014	0 017	0 020
H HW= Water heating (households)	ELP H HW	0 009	0 009	0 015	0 030	0 040	0 050
H CK= Cooking (household)	ELP H CK	0 001	0 002	0 010	0 030	0 050	0 100
S TH= Thermal uses (service sector)	ELP S TH	0 005	0 006	0 011	0 014	0 017	0 020
26 Contribution of heat pump to electric space and water heating in the Household/Service sector	HPHS	0 000	0 000	0 000	0 000	0 000	0 000

Table B.6 Input Time Dependent Parameters and Value (cont.)

Description	Variable	1989	1992	1995	2000	2005	2010
27 Coefficient of performance of (electric) heat pumps in the Household/Service sector	EFFHPR	2 000	2 000	2 000	2 000	2 000	2 000
28 District heat penetration into space and water heating of dwellings and thermal uses in Service sector	DHPH	0 987	0 987	0 990	0 990	0 990	0 990
29 Solar penetration into space heating in "NEW" single family houses with central heating	SPSH	0 000	0 000	0 000	0 000	0 000	0 000
30 Approximate share of space heat demand in households that can be met by a solar installation	FDSHS	0 100	0 100	0 100	0 100	0 100	0 100
31 Solar penetration into water heating in dwellings	SPHW	0 000	0 002	0 002	0 002	0 002	0 002
32 Approximate share of the hot water demand in households that can be met by a solar installation	FDHWS	0 300	0 300	0 300	0 300	0 300	0 300
33 Share of low-rise buildings (e g , up to 3 floors) in total Service sector floor area	PLB	0 300	0 300	0 300	0 300	0 300	0 300
34 Solar penetration into thermal uses in "NEW" low-rise Service sector buildings	SPSV	0 000	0 000	0 000	0 000	0 020	0 050
35 Approximate share of the thermal energy demand in Services that can be met by a solar installation	FDHS	0 050	0 050	0 050	0 050	0 050	0 050
36 Ratio of the amount of Non-commercial fuels used in the current year relative to that in the base year	CHGNCF	1 000	1 000	1 000	1 000	0 950	0 900
37 Efficiency of fossil fuel use relative to that of electricity use for thermal uses in the Household and Service sectors							
H SH= Space heating (households)	EFF H SH	0 600	0 600	0 600	0 600	0 600	0 600
H HW= Water heating (households)	EFF H HW	0 600	0 600	0 600	0 600	0 600	0 600
H CK= Cooking (household)	EFF H CK	0 500	0 500	0 550	0 600	0 700	0 700
S TH= Thermal uses (service sector)	EFF S TH	0 600	0 600	0 600	0 650	0 700	0 700
38 Efficiency of non-commercial fuel use relative to that of thermal electricity uses	EFFNCF	0 120	0 120	0 120	0 130	0 140	0 150

Note L = LOW SCENARIO
B = BASIC SCENARIO
H = HIGH SCENARIO

As to the fraction of the labour force actually working (PARTLF), it represented 71 7% in 1989 In parallel to the transition crisis and the economic reconstruction it is forecast an increase of the unemployment rate up to 1992-1993 and then a slight reduction towards the year 2010 Table B 8 lists the evolution of the labour force potential within 1989-2010

B.2.1.3 Population Living Outside Large Cities (POLC)

In 1989, the population of large cities accounted for 11,835 million inhabitants which represented 51 5% of the Romanian population In the study, the category of large cities includes urban settlements with over 20,000 inhabitants Such a ceiling was chosen due to the fact that settlements with a population exceeding 20,000 inhabitants have a developed heat centralized supplying network and an important passengers transportation system

It was considered an average annual rate of about 1% between 1989-2010 in the evolution of population in the large cities, much less than the average annual growth of 2 2%

Table B.7 Population Growth Forecast for All Scenarios

Unit million persons

Year			Urban			Large cities[2]		Rural		
	Total	Annual growth rate (%)	Total	Annual growth rate (%)	Share[1] (%)	Total	Share[1] (%)	Total	Annual growth rate (%)	Share[1] (%)
1989	23 152	-	12 312	-	53 2	11 835	51 1	10 840	-	46 8
1992	23 256	0 15	12 791	1 30	55 0	12 236	53 0	10 465	-1 17	45 0
1995	23 400	0 20	13 289	1 30	56 8	12 800	54 7	10 111	-1 14	43 2
2000	23 690	0 25	14 246	1 40	60 1	13 361	56 4	9 444	-1 40	39 9
2005	24 050	0 30	15 423	1 60	64 1	13 950	58 0	8 627	-1 80	35 9
2010	24 410	0 30	16 857	1 80	69 1	14 524	59 5	7 553	-2 60	30 9

Source National Commission for Statistics for 1989-1991
ISPE and INCE for 1992-2010 forecast

Note (1) Relative to Total population
(2) More than 20000 inhabitants

Table B.8 Labour Force Forecast for All Scenarios

Labour Force (Age 15-64)	Unit	1989	1992	1995	2000	2005	2010
Total	10^6 inh	15 275	15 349	15 444	15 635	15 873	16 111
Growth rate[1]	%	-	0 160	0 200	0 250	0 300	0 300
Actually Working	10^6 inh	10 946	10 271	10 502	10 710	10 952	11 197
Growth rate[1]	%		-2 100	0 700	0 400	0 400	0 400
Labour force	%	71 700	66 900	68 000	68 500	69 000	69 500

Note (1) Average annual growth rate between reference years

that was attained the last 10 years Assuming this, the population of large cities will reach 14,524 million inhabitants in year 2010 Regarding the population living outside the large cities, it will decrease from 11,317 million in 1989 to 9,886 million inhabitants in 2010 (Table B 7)

B.2.1.4 Share of Rural Population (PRUR)

Statistical data show that in 1989 the share of population who lived in rural areas represented 46 8% It is estimated that, in the future, the rate of migration from villages to towns would decrease due to both the land reform and the economic adjustment Thus, an average annual decrease of rural population by 1 7% was assumed for the whole period, as shown in Table B 7 As a result, the rural population in the year 2010 was evaluated at 7,553 million inhabitants with a share of 30 9% of the total population

B.2.1.5 Number of Inhabitants per Household (CAPH)

In 1989, the statistical data concerning the number of dwellings and the number of inhabitants helped determining the average number of persons per dwelling at 2 91 to express

the size of a dwelling. In parallel with the assumption of the growth of population comfort rate, it was taken into consideration a slight decrease of this parameter, to 2.785 persons per dwelling in the year 2010.

B.2.2 GDP Formation and Expenditure

The GDP projections performed by national and international organizations have become obsolete and according to the latest information in the field and the assumptions made for the ENPP Study, three scenarios have been defined.

The Low scenario considers a decrease of GDP in 1993 by 3% against 1992, a stop of the output decline in 1994 (a growth with 0.3% against 1993) and an actual pickup of the economic recovery in 1995 (a growth by 2% against the previous year). In 1995, GDP will be $31.1*10^9$ US$ equal to that in 1992. An average annual rate of growth of 3.4% was assumed for the whole study period 1992-2010.

The Basic scenario: within this scenario, it was estimated that GDP would continue to decrease by 1% in 1993 against 1992 but in 1994 it would reach a 1% growth against 1993. Over the period between 1992-1995 an average annual rate of growth of 0.8% is assumed while for the whole study period (1992-2010) the average annual rate of growth is of 4.2%.

The High scenario considers that in 1993 the output decline would cease, with GDP reaching the value of 1992. An average annual growth rate of 1.8% was assumed for the period 1992-1995, and of 5% for the whole period between 1992-2010.

Within the three scenarios, it was considered just one GDP structural variant, having in view the following premises to determine the evolution of GDP structure:

- agriculture participation in GDP formation increasing from 13.9% in 1989 to 21% in 2010 as a result of completion of implementation of the land law and the stimulation of modern technologies utilisation and the increase of mechanisation.

- the construction sector will slightly diminish its contribution to GDP for the study period, from 6.34% in 1989 to 4.5% in 2010 due to the reduction of new investments which cannot be compensated by the growth of the works of rehabilitation and modernization.

- the participation of the mining sector in GDP formation is assumed to grow in 1992 to 4.2% (against 3.28% in 1989) and then to slightly decrease to 3.5% in 2010. The activity of this sector will decrease due to the closing down of some inefficient mines and to exhaustion of some ores that are presently being exploited.

- the manufacturing sector is expected to play a more important effect in the economy both because of the reduction of its share within GDP to 38% in 2010 against 43.67% in 1989 and because of structural changes in the sector.

- Regarding the structure of Manufacturing Industry it was forecast a reduction of the share of the Basic Materials from 34% in 1989 to 31% in 2010; the growth of Consumer Goods from 30.5% in 1989 to 33.3% in 2010, while the share of Machinery & Equipment will remain around 32%.

Table B.9 GDP Formation

Unit 10^9 US$

	1989	1992	1995	2000	2005	2010
Low Scenario	45 600	31 300	31 100	37 100	45 900	57 200
Agriculture	6 338	5 853	6 064	7 568	9 547	12 012
Construction	2 891	1 784	1 711	1 855	2 203	2 574
Mining	1 496	1 315	1 275	1 484	1 744	2 002
Manufacturing of which	9 914	11 957	11 818	14 098	17 442	21 736
* Basic Materials	6 777	3 886	3 817	4 511	5 494	6 738
* Machinery & equipments	6 520	3 766	3 746	4 511	5 581	6 956
* Food & textiles	6 074	3 862	3 817	4 554	5 721	7 238
* Miscellaneous	0 544	0 442	0 437	0 522	0 645	0 804
Energy sector	2 695	1 565	1 400	1 484	1 607	2 002
Services	12 266	8 827	8 832	10 611	13 357	16 874
Basic Scenario	45 600	31 300	32 100	40 500	51 900	66 100
Agriculture	6 338	5 853	6 259	8 262	10 795	13 881
Construction	2 891	1 784	1 765	2 025	2 491	2 974
Mining	1 496	1 315	1 316	1 620	1 972	2 313
Manufacturing of which	19 914	11 957	12 198	15 390	19 722	25 118
* Basic Materials	6 777	3 886	3 940	4 925	6 212	7 787
* Machinery & equipments	6 520	3 766	3 867	4 925	6 311	8 038
* Food & textiles	6 074	3 862	3 940	4 971	6 469	8 364
* Miscellaneous	0 544	0 442	0 451	0 569	0 730	0 929
Energy sector	2 695	1 565	1 444	1 620	1 817	2 313
Services	12 266	8 827	9 116	11 583	15 103	19 499
High Scenario	45 600	31 300	33 000	43 700	57 300	75 000
Agriculture	6 338	5 853	6 435	8 915	11 918	15 750
Construction	2 891	1 784	1 815	2 185	2 750	3 375
Mining	1 496	1 315	1 353	1 748	2 177	2 625
Manufacturing of which	19 914	11 957	12 540	16 606	21 774	28 500
* Basic Materials	6 777	3 886	4 050	5 314	6 859	8 835
* Machinery & equipments	6 520	3 766	3 975	5 314	6 968	9 120
* Food & textiles	6 074	3 862	4 050	5 364	7 142	9 491
* Miscellaneous	0 544	0 442	0 464	0 614	0 806	1 054
Energy sector	2 695	1 565	1 485	1 748	2 006	2 625
Services	12 266	8 827	9 372	12 498	16 674	22 125

- The GDP contribution of the Service sector is forecast to grow continuously from 26 9% in 1989 to 29 5% in 2010 both due to the development of the current types of activities of this sector and by meeting the requirements for new services

Table B 9 presents the GDP levels for the three scenarios (in constant US$ 1989) and their distribution by type of economic activity

Since the GDP formation and Manufacturing VA structure were specified exogenously the parameters for the alternative solution (to be calculated by I, IB, IM, P, PCDG, PCNDG, PCSER) should be null Table B 6 has already presented the definitions and symbols of these parameters

B.2.3 Industry

B.2.3.1 Ratio of Energy Intensity in Industry Relative to the Base Year (CH(I,J))

Energy intensity in Industry was considered to vary from one scenario to the other in accordance with the rate of rehabilitation, modernization and the achievement of new investments

It was taken into consideration that both rehabilitation and modernization of industry would lead to the growth of electricity demand: the higher rate of rehabilitation will lead to an higher electricity share in the demand of final energy. Within 1989-1995 it was supposed that both rehabilitation and modernization would be low and would not contribute to considerably reduce the energy intensities.

Agriculture (CH.AGR(J))

The evolution of motor fuels consumption in agriculture between 1989-2010 was supposed to follow the pace at which this sector is provided with more equipment. This parameter and the equipment performance were used to establish the scenarios. Against the base year, in the year 2010 the intensity in motor fuel was estimated to grow about 7% in the Low Scenario, by 10% in the Basic Scenario and by 15% in the High Scenario.

With regard to electricity consumption, the assumptions are the following:

- a decrease of the energy specific consumption for pumping water in the irrigating systems by diminishing infiltrations and increasing the pump efficiency.
- electricity penetration into agriculture by means of rehabilitation and modernization

According to the evolution of these factors, it was estimated that electricity intensity would grow in 2010 by 7% in the Low Scenario, 10% in the Basic Scenario and 15% in the High Scenario against the value registered in 1989.

The consumption of thermal energy was assumed to decrease mainly by improving thermal insulations and updated heating greenhouses and live-stock farms. It was thus forecast to diminish the energy intensity in thermal energy in the year 2010 against 1989 by 20% in the Low Scenario, 25% in the Basic Scenario and 30% in the High Scenario.

Construction (CH.CON(J))

For the construction sector it is envisaged an important action of upgrading and mechanizing works with the following impact of the energy intensity:

- the intensity of motor fuels use will decrease in 2010 against 1989 by 7% in the Low Scenario, 10% in the Basic Scenario and 15% in the High Scenario.
- the electricity intensity is kept constant throughout the study period in the Low Scenario, and it is assumed to grow by 7% and 10% in the Basic Scenario and High Scenario, respectively, in year 2010 with respect to 1989.
- the intensity for thermal energy was estimated to decrease in 2010 against 1989 in all scenarios namely, by 20% in Low Scenario, 25% in the Basic Scenario and 30% in the High Scenario.

Mining (CH.MIN(J))

The efficiency of mining activity is expected to increase by means of rehabilitation and modernization of mining units, and this will determine the decrease of the energy intensity in motor fuel in 2010 against 1989, namely by 7% in the Low Scenario, 10% in the Basic Scenario and 15% in the High Scenario.

The energy intensity for thermal uses was forecast to decrease by 20% in the Low Scenario, 25% in the Medium Scenario and 30% in the High Scenario.

The intensity for specific electricity was assumed to remain constant in the Low Scenario, and to grow by 7% and 10% in the Basic Scenario and High Scenario, respectively.

Manufacturing (CH.MAN(J))

Analyses made in the past have indicated that restructuring should have applied urgently to metallurgy, chemistry and mechanical engineering, especially to energy intensive branches. The ideas behind the restructuring of these industrial branches are the following:

- there is the possibility that the main metallurgical works might reach international qualitative standards by rehabilitation and updating under the conditions of economic efficiency but the demand on the foreign market is going to decrease due to the new products replacing steel;
- chemical fertilizers industry must be rehabilitated for supplying Romania's agriculture with fertilizers under more efficient terms;
- petrochemical industry can maintain its own delivery markets by making important investments for increasing efficiency;
- mechanical engineering industry can reduce its specific energy and materials consumptions by rehabilitation and updating at the accepted level of the respective field;
- electronic and electric engineering industry may become very efficient and with a delivery market at home and abroad by getting access to the top technologies;
- light industry (textiles, clothes, footwear) is the sector with the highest efficiency; by upgrading this sector, it may increase its quality and productivity and may allow it to penetrate into new markets;
- food industry must be readjusted and refitted with the view to processing the available raw materials.

Having in view the big amount of investments requested by these works, scenarios were set up on the rehabilitating rate of industry, and the reduction of the energy intensity consistent with the GDP growth. It was considered therefore that those scenarios with a higher GDP growth rate and the larger reduction of the energy intensity will have a more important impact than those scenarios with reduced GDP rate of growth.

In keeping with these actions, it was estimated that the energy intensities will vary in 2010 against 1989, as follows:

- the intensity of motor fuels will decrease in the Low Scenario by 7%, in the Basic Scenario by 10% and in the High Scenario by 15%;
- the intensity of specific electricity will grow in the Basic Scenario by 7%, in the High Scenario by 10%, while in the Low Scenario it will remain constant;
- the intensity of thermal uses will decrease in the Low Scenario by 20%, in the Basic Scenario by 25%, and in the High Scenario by 30%.

The evolution of energy intensities in Industry compared with the base year for the reference years of the period 1989-2010, is presented in Table B-6.

B.2.3.2 Share of Useful Thermal Energy Demand in Manufacturing for Steam and Space/water Heating Together (STSHI)

In 1989 the share of space and water heating was 66.6% of the total heat consumption. It was estimated that this share will remain constant through the year 2010 due to the lack of studies demonstrating that there should be some structural changes.

B.2.3.3 Share of Useful Thermal Energy Demand in Manufacturing for Steam Generation Only (STI)

In 1989 the rate of steam consumption in the useful thermal energy demand was 58.5% and the same share was maintained constant for the study period.

B.2.3.4 Share of Low-temperature Process Heat in the Total Low and Medium Temperature Process Heat (LTH)

The share of heat consumption of low temperature processes in both low and medium temperature heat demand was about 12.1% in 1989. It was estimated to remain constant until the year 2010.

B.2.3.5 Penetration of Electricity on the Useful Thermal Energy Demand in Manufacturing [ELPIND(J)]

It has been assumed that electricity would not be utilized for generating steam. It was thus estimated that the share of electricity in both direct heating and furnaces would grow from 12.66% in 1989 to 15% in 2010. On the other hand, the share of electricity consumption in the total consumption for space heating and hot water, will be 0.1% in the year 2000 increasing to 1% in 2010.

Since the penetration of electricity is provided by type of industrial process it is not necessary to define another parameter that should represent the average electricity penetration into thermal processes (ELP.I.AVE=0).

B.2.3.6 Contribution of Heat Pumps to Steam Generation and Space and Water Heating Uses in Manufacturing (HPI)

In 1989, several heat pumps units were commissioned in the manufacturing sector, but playing just an experimental role. Their share in the total consumption is insignificant. Further development of such equipments in the future was not forecast.

B.2.3.7 Coefficient of Performance of (Electric) Heat Pumps in Manufacturing (EFFHPI)

The coefficient of performance of heat pumps in manufacturing was estimated at 2.0 (thermal energy extracted per unit of electric energy input) and was kept constant throughout the period 1989-2010.

B.2.3.8 District Heat Penetration for Steam Generation and Space and Water Heating in Manufacturing (IDH)

The use of district heat systems for to meet the space and water heating demand in manufacturing was the only solution in 1989 and this is due to common practices of grouping together industrial customers for using one power station to supply steam and hot water In the future, it was considered necessary to maintain this solution due to this kind of grouping industrial customers

B.2.3.9 Solar Penetration in Low Temperature Process Heat and Space/water Heating in Manufacturing (SPLT)

In 1989, solar energy was utilized both for generating hot water and in certain drying processes, mainly in the Consumer Goods manufacturing The share of solar energy in the total consumption was insignificant Statistical data for 1989 showed that the contribution of all new sources of energy, especially solar energy, geothermal energy and biogas was 0 01% of the manufacturing sector heat consumption As a result, assumption has been made of a growth of solar penetration in the low temperature processes to 2% in the year 2010 and the far future

B.2.3.10 Solar Penetration in Medium Temperature Process Heat in Manufacturing (SPHT)

Solar energy was not utilized in 1989 for meeting the demand for medium temperature heat It has been assumed that solar energy would not be used for this purpose in the future

B.2.3.11 Approximate Share of Useful Thermal Energy Demand that Can Be Met by a Solar Installation (FIDS)

It is assumed that about 1% of the useful thermal energy can be covered by means of solar installations

B.2.3.12 Share of the Manufacturing Demand for Low Temperature Steam and Space/water Heating Supplied by Fossil Fuels but with Electricity Cogeneration (ICOGEN)

The statistical data do not include distinct information concerning heat consumption covered by district heat, cogeneration within industrial plants and cogeneration in central power plants For the reason that a power plant usually supplies several customers, but at the same time one customer may be supplied from several heat sources, the whole heat consumption under the form of steam and hot water, was dealt with using the form of district heating

Assuming this, the share of the manufacturing demand for low temperature steam and space/water heating which is supplied by cogeneration within industrial plants, was considered 'zero' both in 1989 and in the far future

B.2.3.13 System Efficiency of Cogeneration (EFFCOG)

The efficiency of the cogeneration systems was evaluated at 67% in 1989, but it is estimated to increase to 72% in 2010 due to the improvement of power plants operations and maintenance and to the attempts of modernizing them

B.2.3.14 Ratio of Heat to Electricity in Output of Cogeneration Systems (HELRAT)

The steam specific output per electricity unit in cogeneration systems was 4.27 kWh steam/kWh electricity in 1989. Until 2010, it is assumed a growth of the share of lower pressure steam output which will determine a gradual decrease of the value to 3.65 kWh steam per kWh electricity.

B.2.3.15 Average Efficiency of Fossil Fuel Use for Thermal Processes in Manufacturing (EFFIND(J))

As a result of modernization and rehabilitation in manufacturing industries, it has been estimated to improve fossil fuel utilization efficiency in thermal processes, as follows:

- a growth of efficiency from 72% in 1989 to 84% in 2010, in the steam generation;
- in direct heating processes and furnaces, the efficiency of fossil fuel utilization was forecast to grow from 55% (in 1989) to 62% in 2010;
- regarding space and water heating the efficiency of fossil fuel utilisation was estimated to grow from 70% in 1989 to 82% in 2010.

Since the efficiencies by types of utilities are defined for the study, it is no longer necessary to specify an average efficiency (EFF.I.AVE = 0).

B.2.3.16 Share of Steel Produced in Non-electric Furnaces (BOF)

In 1989, the share of steel produced by non-electric furnaces in the total steel output represented 76%. Since no strategy of modernization and rehabilitation of steel furnaces has been elaborated, it has been assumed to keep constant the 1989 parameters up to the year 2010.

B.2.3.17 Specific Consumption of Pig Iron in Non-electric Steel Works (IRONST)

The specific consumption of pig iron per unit output of steel was 83% in 1989, which was assumed to remain constant until 2010 (due to the same reason to B.2.3.16).

B.2.3.18 Coke Input in Blast Furnaces per unit Output of Pig Iron (EICOK)

In 1989, the specific consumption of coke per unit output of pig iron was 627 kg. and the same value is assumed for the period 1989-2010 (due to the same reason to B.2.3.16).

B.2.4 Transportation

B.2.4.1 Freight Transportation

Share of different modes of transport in freight transportation (TRU, TRUL, FTRA, TRAEF, TRASTF, BA, PIP)

The volume of freight transportation has been developed in close connection with the economic activity. As far as the evolution of the share of different modes of transport in the transportation of goods is concerned, it will be determined by economic factors. Freight transportation in Romania has been performed by means of trucks, trains, barges and pipes. It

was assumed that within the period 1989-2010, no significant changes could affect the evolution of the share of different means of conveyances due to the lack of funds for important investments necessary to achieve a proper infrastructure.

Against this background, the assumptions regarding the evolution of different means of freight transportation are presented below.

By increasing the importance of the time-factor in the freight transportation performance, it was foreseen the growth of the share of freight transportation by trucks (TRU) from 18.9% in 1989 to 22% in 2010.

Within the total freight transportation by trucks, in 1989 the biggest share (80.6%) corresponds to the local freight transportation (TRUL) while the long distance truck represented only 19.4%. Through the 1989-2010 period some small changes of the shares have been estimated. In the year 2010, the share of local freight transportation by truck will increase to 81.3% while that of long distance truck will decrease to 18.7%.

The freight transportation by train (FTRA) represented 51.1% in 1989 of the whole freight transportation. Throughout the forecasting period the tendency manifested in the years 1990-1991 of reducing railway traffic, was estimated to continue. In 2010, the railway transport of goods was foreseen to reach the share of 43%.

Railway freight transportation is achieved by means of steam engines, diesel and electric engines. Freight transportation by steam engines (TRASTF) represented 0.8% of the total railway transports of goods n 1989. It was foreseen, up to year 2010, to substitute this mode of transport by other systems. Within the transport of goods, a growth of the share of electric trains was foreseen (TRAEF) from 40%, in 1989 to 50% in 2010 by continuing to electrify some railway segments that are intensely used. As a consequence, the share of railway freight transportation by diesel engines will decrease from 59.2% in 1989 to 50% in 2010.

The share of freight transportation on river and sea routes was estimated to grow both by the penetration of the Danube-Black Sea Canal into the European circuit and by upgrading Constanta harbour. It was therefore, forecast a growth of the share of freight transport by barges (BA) from 25.8% in 1989 to 31% in 2010.

Pipelines are utilised to transport oil, oil products and gas. In 1989, the share of transports by pipelines (PIP) was only 4.2% and throughout the forecasting period, it was foreseen to maintain this level of 4%, constant.

Energy intensity in freight transportation (DTRU, DTRUL, DTRAF, STDTRA, ELDTRA, DBA, DPIP)

Throughout the forecasting period it has been assumed to improve the performances of the modes of transport both by increasing the efficiency of the existing ones and by partially substituting the old equipments with new ones having a better performance. It is foreseen that this can be achieved both by imports and by means of home made products. In this regard, it should be stated that Romania has trucks and engines works, ship building sites which may contribute, by rehabilitation and modernization, to provide the country with high performance modes of transport.

The energy intensity in the long distance freight transportation by trucks has been evaluated at 180 kcal per t-km in 1989. Beginning with 1992, it is foreseen a reduction of the specific consumption, reaching 166 Kcal per t-km in the year 2010.

Concerning local freight transportation, it was assumed a growth of the energy intensity (DTRUL) from 200 kcal/t-km in 1989 to 280 kcal/t-km in 2010, on the basis that speed should prevail against the rate of using the capacity factor,.

Regarding railway freight transportation, it was also estimated a reduction of the energy intensity for the diesel engine trains (DTRAF) from 107 kcal/t-km in 1989 to 100 kcal/t-km, in 2010. As to the specific consumption of steam engines against that of the diesel engines (STDTRA) it was assumed at 3.7 for the whole study period. In addition, the specific consumption of electric engines against that of the diesel engines (ELDTRA) was assumed to be 46%, and kept constant for the whole period 1989-2010.

In the freight transportation by barges, the specific consumption of energy (DBA) was estimated to decrease from 40 kcal per t-km (in 1989) to 37 kcal per t-km in 2010. Finally, the energy specific consumption in pipelines transportation (DPIP) was assumed to remain constant throughout the whole period, namely 40 kcal per t-km.

B.2.4.2 Passenger Transportation

Average intensity distance travelled per person per year (DI)

Statistical data show that in 1989 the average travelled distance was 2,952 km per person, against 2,475 km in 1985 and 2,257 km in 1980. Through 1989-2010 it was estimated a continuation of the growth of population's mobility rate, but at a much more reduced rhythm (0.7%) than in the latest years (3%), suggesting an average travelled distance of 3,400 km per person in 2010.

Average intracity distance travelled per person per day (DU)

In 1989, the average distance travelled by a person per day in urban areas was estimated at 5 km on the basis of statistical information concerning the number of passengers yearly conveyed, the length of the routes of public modes of transport, the number of cars, etc.

Throughout the period 1989-2010, the average travelled distance was considered to grow with an average annual rate of 0.9%. Consequently, the average distance travelled per person is foreseen to reach 6 km per day in the year 2010.

Car ownership ratio - population per car (CO)

In 1989, the car ownership expressed by the number of persons per car, was 19.88. In accordance with the last years trend, it has been assumed a growth of the number of private cars both home made and from import. In the year 2010, the car ownership ratio will reach 15 persons per car.

Parameters regarding the use of cars in urban and intercity transport (DIC, LFIC, UC, UCE, LFUC, GIC, GUC, ELUC)

The average annual distance travelled by car in intercity travel (DIC) was calculated at 1,690 km in 1989.

Due to the increase of importance of the time factor, it was assumed a growth of the share of cars utilisation both in the urban and intercity transport. Within the period 1989-2010, it was assumed that the average distance travelled by car for intercity travel would reach 2,300 km in 2010, implying an average annual growth rate of 1.5%.

It was estimated that cars would participate in the urban traffic with a 28% share (UC) in the year 2010 against 1989, when the share was 19%. For the period 1989-2010, the average load factor of cars for intercity travel (LFIC) was assumed to be 3.0 for persons per car, while that for intracity traffic (LFUC) would be of 2.0 persons per car.

It has been assumed a reduction of the specific fuel consumption of cars in intercity travel (GIC) from 8 liters per 100 km in 1989 to 6 liters per 100 km in the year 2010. Similarly, the consumption in the intracity travel (GUC) was assumed to reduce from 12 l/100 km in 1989 to 10 l/100 km in 2010. Until the year 2010 is was not foreseen the use of electric cars (UCE=0; ELUC=0) for urban transport of passengers.

Intercity passenger travel by mode (PBU, PTRA, TRAEP, TRASTP, PLA)

In 1989, the biggest share in the intercity mass passenger travel was represented by the railway transport with 56.9% (PTRA) followed by bus transport (PBU) with 36.95% while the air transport (PLA) participated with 6.15%.

In order to determine the future evolution of the intercity passenger travel, the economic crisis was taken into account for new investments within the 1989-2010 period to achieve the necessary infrastructure for some basic structural changes of the passenger travel.

Within this context, for the 1989-2010 period it was assumed a reduction of the structural changes in the intercity passenger travel that characterized the years 1990 and 1991. Thus, until the year 2010, the share of intercity bus travel (PBU) will decrease to 34.5%, the railway passenger travel (PTRU) will grow to 59% and the airplane travel will be 6.5%.

Within the framework of the passenger railway travel it is foreseen a growth of the share of electric trains passengers travel (TRAEP) from 50.0% in 1989 to 60% in the year 2010 and reduction of the travel by diesel engine trains.

Finally, trains with steam engines are not used for passenger travel by train (TRASTP=0).

Average load factor in intercity travel (LFBU, LFTRA, LFP)

In defining the scenarios, great importance has been given to foreseeing an increase of comfort in the development of the intercity passenger travelling system. In this respect, it has been assumed the decrease of the average loading factors for all modes of transport, namely the loading factor for bus travel (LFBU) was forecast to decrease from 40 passengers per bus in 1983 to 35.5 in the year 2010. For the train transport, it was estimated a reduction of the loading factor (LFTRA) from 800 passengers per train in 1989 to 675 passengers in 2010. For the airplane transport, the average capacity utilizing factor (LFP) was foreseen to decrease from 95% in 1989 to 80% in 2010.

Specific energy consumption in intercity passenger travel (DBU, DTRAP, DPLA)

It was also foreseen the reduction of the specific energy intercity passenger travel both by modernizing part of the existing equipments and by substituting them with new, more efficient, equipments. In consequence, it was estimated a reduction of the specific fuel oil consumption for buses from 33 liters per 100 km in 1989 to 25 liters per 100 km in the year 2010. The specific fuel oil consumption of diesel engines trains was forecast to decrease from 73000 kcal per train-km, in 1989 to 55,000 kcal per train-km in the year 2010; and the airplane specific energy consumption (DPLA) was assumed to decrease from 600 kcal per seat-km in 1989 to 475 kcal per seat-km in 2010.

Urban mass transit (UMT, UMTE)

Urban transport is performed by means of urban mass transit and by private cars. As it has been already discussed, the share of cars in the urban transport (UC) was forecast to grow from 19% in 1989 to 28% in 2010, to the detriment of the urban mass transit (UMT) which will decrease from 81% in 1989 to 72% in 2010.

Average load factor in urban mass transit (LFMTB, LFMTE)

The modernization of urban mass transport activities assumes also the increase of comfort conditions. It was therefore considered the reduction of the average load factor of buses (LFMTB) from 90 passengers per bus in 1989 to 75 passengers per bus in the year 2010 and of the electric vehicles load factor from 135 passengers per vehicle in 1989 to 128 passengers per vehicle in the year 2010.

Specific energy consumption in mass transit (DMT, ELMT)

By modernizing and renewing the park of vehicles it was estimated a reduction of the energy intensity throughout the study period, namely: for the bus transit, the specific fuel oil consumption (DMT) was estimated to decrease from 45 liters per 100 km-vehicle, in 1989 to 39 liters per 100 km-vehicle, in 2010. For the electric vehicles transit (subway, tram, trolley-bus) it was assumed a reduction of the electricity specific consumption from 3.5 kWh/vehicle-km, in 1989 to 3.3 kWh/vehicle-km in 2010.

B.2.5 Household/Service

B.2.5.1 Specific Energy Consumption for Cooking in Dwellings (COOKDW)

Statistics do not discriminate the energy consumption of households by structure: space heating, hot water, cooking, etc. For this reason, the energy consumption of dwellings was broken down into uses by means of statistical data related to the structure of fuel and energy forms and the ownership of equipment and appliances by dwelling, as well as the standards normally used in design and planing. Based on this, the useful energy demand per dwelling for cooking was evaluated at 1,048 Mcal for the year 1989. For the period 1989-2010 it was estimated a 14% reduction of this consumption due to a more spread use of the semi-prepared food products as well as to the services supplied by canteens, restaurants, etc.

B.2.5.2 Share of Dwellings with Hot Water Facilities (DWHW)

In Romania, the solution chosen to cover hot water demand in dwellings was usually similar to that for meeting the demand for space heating. Having in view this outlook:

- those dwellings provided with heat from district heating system succeeded covering both their heat demand for space and water heating;
- dwellings provided with district heating and with their own heat supplying sources could also provide hot water from the same sources;
- dwellings provided with stoves for spaces heating had their own installations for heating water.

All dwellings provided with district heating have hot water facilities, but the same cannot be stated about those dwellings provided with other type of heating systems.

As to the division by location it can be stated that dwellings in urban areas could benefit from very developed district heating systems due to the urbanizing works performed in the past and therefore, the share of dwellings with hot water facilities is very high. In the rural areas where most houses are equipped with stoves for heating, the share of dwellings with hot water is low. In order to illustrate the high consumption of hot water, it was estimated that about 75% of the dwellings had available water facilities in 1989. As old dwellings will be updated and new will be built up, it is forecast a growth of the share of dwellings provided with hot water facilities, namely to 80% in the year 2010.

B.2.5.3 Specific Useful Energy Consumption for Water Heating per Person (HWCAP)

For determining hot water consumption per person, the same methodology as in section B.2.5.1, was utilized leading to a value of 683 Mcal per year. For the far future it was considered the gradual elimination of difficulties in providing fuel and running water and the modernization of the existing dwellings to increase the number of dwellings provided with hot water facilities. As a result, a growth of the specific consumption to 950 Mcal in the year 2010.

B.2.5.4 Share of Dwellings with Air Conditioning (DWAC)

In 1989 there were not any dwellings provided with air conditioning facilities. For the future, as long as dwellings will be modernized, it is forecast the use air conditioning facilities. In the year 2000 the number of dwellings provided with air conditioning facilities was estimated to reach 0.5% of the total, reaching 1.5% in 2010.

B.2.5.5 Specific Cooling Requirements per Dwelling (ACDW)

Specific cooling requirements per dwelling was assumed to be 260 Mcal for the whole study period.

B.2.5.6 Specific Electricity Consumption per Dwelling (ELAPDW)

The average specific electricity consumption per dwelling for electric appliances and for lighting was 513.46 kWh in 1989. For the period 1989-2010 it is forecast a growth of this

consumption, differentiated within each scenario, taking into account both the growth of the number of dwellings equipped with electric appliances and the improvement of technical performances. Table B.10 and Table B.11 show the evolution of the ownership rate of electrical appliances in households and their specific electricity consumption for each scenario.

Table B.10 Ownership of Household Appliances

Unit: %

	Scenario	1989	1992	1995	2000	2005	2010
Washing machines	Low	51	51	53	54	55	57
	Basic	51	51	53.6	57.8	60	65
	High	51	51	54	59.4	65	75
Refrigerators	Low	60	60	60	62	63	65
	Basic	60	60	61	64	66	68
	High	60	60	61	65.8	68	69.4
Freezers	Low	...	10	11	15	22	34
	Basic	...	10	13	20	32	52.5
	High	...	10	15.1	23	36.3	58.2
TV sets	Low	66	67	72.5	90	93	95.7
	Basic	66	66	75	91	94.3	96.4
	High	66	66	84.2	100	118.3	146

Table B.11 Specific Electricity Consumption per Appliance

Unit: kWh/yr

	Scenario	1989	1992	1995	2000	2005	2010
Washing machines	Low	420	420	420	390	378	360
	Basic	420	420	420	370	356	320
	High	420	420	397	360	330	300
Refrigerators	Low	400	400	395	380	372	355
	Basic	400	400	395	368	356	344
	High	400	400	390	360	347	340
Freezers	Low	600	600	592	590	585	583
	Basic	600	600	592	550	528	520
	High	600	600	570	540	520	515
TV sets	Low	220	210	200	199	190	185
	Basic	220	210	200	197	195	194
	High	220	210	195	190	186	185

B.2.5.7 Electricity Penetration in Households (PEL)

The electrification rate of dwellings in 1989 was estimated at 96.1%. By extending electric distribution networks and upgrading rural settlements it was assumed that a slight increase of this parameter will occur throughout the study period, reaching 97.5% in 2010.

B.2.5.8 Coefficient of Total Losses in the Electric Network (ELOSS)

In 1989, the electricity losses in the transmission and distribution networks represented 6.1% of the total delivered electricity. This coefficient increased to 9.1% for the years 1990 and 1991 due to the important growth of consumption of the low voltage network caused by the growth of population, services, small industry consumption. Although it is foreseen to modernize the transmission and distribution networks within 1992-2010, the level of these losses has been kept constant through the study period in view of the assumptions related to the important growth of the share of consumption in the medium and low voltage networks.

B.2.5.9 Evolution of Old Dwellings per Type (PREDW(J) and DEMDW)

In 1989 the number of dwellings raised to 7.960 million out of which 0.300 million were considered dwellings in villas provided with district heating, 3.81 million (38.7%) in standard buildings (blocks of flats) and 4,579 million dwellings (57.53%) in houses provided with individual heating systems.

About 20% of the "old" dwellings would be included in buildings that should have been either rehabilitated or demolished during the study period. It is assumed that about 60% of these dwellings would be rehabilitated and the rest replaced by new and modern buildings. The average demolition rate of old dwellings was forecast at a lower value in 1992, namely 1.4% and that it would increase at 1.75% in 2010 as much as the population's income increases.

B.2.5.10 Share of Services Sector Floor Area Actually Heated (AREAH)

Due to the continental moderate climate, in winter time, the buildings with flats require space heating. Owing to the lack of statistical information in this field, it was assumed that all the area occupied by services requires heating.

B.2.5.11 Specific Electricity Consumption in Old Service Sector Buildings (ELARO)

The statistical data concerning the services sector include information for the total consumption of electricity but not divided according to specific electricity and thermal facilities. Until 1989, the solutions regarding the use of electricity for thermal purposes were the most expensive and very scarcely used. It was estimated in this respect, that the share of electricity used for thermal purposes was 0.45% of the heat consumption of the Service sector in 1989.

Therefore, out of the total consumption of electricity consumed by the Service sector in 1989, representing 2932 GWh (see Table 3.5) it was estimated that 88 GWh (see Table 3.6) was for thermal uses and 2844 GWh for specific electricity consumption.

The specific consumption of electricity per m^2 area of the services sector was forecast to have an important and differentiated growth within each scenario. This growth was estimated to the achieved by means of modernization of the existing services meaning a growth of service establishment equipped with electric appliances.

B.2.5.12 Share of Air-conditioned Service Sector Floor Area (AREAAC)

In 1989, the consumption of the air-conditioning installations in the services sector can be considered negligible. Along with the modernization of this sector, it is expected that air conditioning penetration would be observed. At the level of the year 2000 it was thus assumed that 1% of the area occupied by the Service sector will use air conditioning, increasing to 5% in the year 2010.

B.2.5.13 Specific Cooling Requirements in the Service Sector (ACAREA)

Specific cooling requirements in the service sector was assumed at 50 Mcal/m^2 per year.

B.2.5.14 Coefficient of Performance of Air Conditioners (EFFAC)

The coefficient of performance of air conditioners was considered equal to 2.0.

B.2.5.15 Distribution of New Dwellings by Type [NEWDW(J)]

Regarding the structure of new dwellings it had been taken into consideration both the distribution of dwellings among urban and rural area and the growth of the share of dwellings provided with district heating systems. In accordance with these factors it was estimated that 20% of the new dwellings will be located in villas provided with district heating system, 30% flats with district heating system and 50% of the new dwellings will be provided with other heating system, within 1989-2010 period.

B.2.5.16 Average Floor Area Heated in New Dwellings by Type [(DWS(J)]

The average useful area of the new dwellings was estimated to remain constant until the year 2000. After that year a differentiated growth of the useful area for all type of dwellings has been assumed. Therefore, the average area of the new dwellings in villas is estimated to grow by 10% around in the year 2010 against 2000, the apartments area by 6% and private houses area by 3% within the same period for all types of dwellings.

B.2.5.17 Specific Heat Loss Rate in New Dwellings by Type [K(J)]

After 1992 it has been assumed that new dwellings will be built with improved thermal insulation standards. Thus the specific heat losses were estimated to decrease by 10% around in 2010 against 1992.

B.2.5.18 Reduction of the Average Space Heat Demand of Old Dwellings [ISO(J)]

Specific studies conducted in Romania have indicated the possibility to improve thermal insulation mainly for the existing blocks of flats but they also indicate that, until 1995, no steps will be undertaken in this particular field. After 1995, it has been assumed that the heat losses would be reduced in those dwellings built before 1989, by 1% on average, in the year 2000, reaching a 5% reduction in 2010.

B.2.5.19 Average Floor Area per Employee in the Service Sector (AREAL)

In 1989, the average floor area per employee in the services sector was evaluated at 33.97 m^2. A slight increase up to 35 m^2 in the year 1995 has been estimated and then this level will be preserved until 2010.

B.2.5.20 Average Demolition Rate on the Floor Area of Service Sector Buildings (DEMAR)

The average demolition rate of service sector buildings was evaluated in a similar way to that for dwellings. It is considered that it would be less in the first part of the study period (1.4% in 1992) and it will grow towards the end (1.65% in the year 2010).

B.2.5.21 Specific Heat Requirements of New Service Sector Buildings (HAREAN)

Service sector buildings constructed after 1989 benefit from a more careful execution and better thermal insulating materials that will decrease the heat demand for space heating. It was thus forecast a reduction of the heat demand necessary to heat, from 210 Mcal/m^2 and year in 1992 to 190 Mcal/m^2 and year in 2010.

B.2.5.22 Specific Electricity Consumption in New Service Sector Buildings (ELARN)

It was considered that new services sector buildings would be provided with a greater number of equipments and electric appliances against the existing services. In addition, it was assumed that the ownership rate is different from one scenario to another. Therefore, against the consumption per m^2 and year in 1992 (common to all scenarios) it was estimated a growth by 46% until the year 2010 in the Low Scenario, 70% in the Basic Scenario and 93% in the High Scenario.

B.2.5.23 Reduction of the Average Heat Demand in Old Service Buildings (ISOSV)

Similar to the hypothesis made for dwellings, it has been considered an improvement of thermal insulation of old service sector buildings along the study period.

It was estimated that the effect of this assumption would determine the reduction of the thermal energy demand by 5% in the year 2010.

B.2.5.24 Electricity Penetration into the Various Thermal Uses in the Household/Service Sector (ELPHS(I))

In 1989 the electricity penetration into various thermal uses in the Household/ Service Sector was very low, namely: 0.6% in space heating, 0.9% in hot water and 0.1% in cooking in dwellings, and 0.45% in thermal uses in the service sector. It was also foreseen a moderate growth of electricity penetration into thermal uses for the study period, both in household and services. At the level of 2010, it was forecast that the penetration of electricity into thermal processes in dwellings will reach 2% for space heating, 5% for hot water, and 5% for cooking. Electricity penetration for thermal uses in the service sector was assumed to reach 10%.

B.2.5.25 Contribution of Heat Pumps to Electric Space and Water Heating in Household/ Service Sector (HPHS)

The use of heat pumps for meeting the demand for space heating and hot water was not considered in the study.

B.2.5.26 Coefficient of Performance of Heat Pumps in Household/Service Sector (EFFHPR)

The coefficient of performance of heat pumps was considered 2.0 obtained from the data available in the MAED documentation.

B.2.5.27 District Heat Penetration into Space and Water Heating of Dwellings of Thermal Uses in the Service Sector (DHPH)

As it has been already mentioned in other chapters, district heating in Romania, to cover the demand for space and water heating of the household and services sector has been developed in all towns and even some rural places located close to some industrial platforms. In order to model this as accurate as possible, the category of urban settlements with a population up to 20,000 inhabitants (B.1.4) was included into the category of "large towns" and a parameter of district heating penetration was evaluated. Consistent outcomes have been obtained for the value 98.7% and consequently a constant value of 99% has been assumed for the period ranging from 1992-2010.

B.2.5.28 Solar Penetration into Space Heating in New Single Family Houses with Central heating (SPSH)

The use of solar energy for space heating was not considered in the present study.

B.2.5.29 Approximate Share of Space Heat Demand in Households that Can Be Met by a Solar Installation (FDSHS)

Studies performed for buildings with better insulating standards than of the ordinary constructions indicated that solar energy could cover around 10% of the space heat energy demand.

B.2.5.30 Solar Penetration into Water Heating in Dwellings (SPHW)

In 1989, several solar installations were experimentally commissioned for water heating for dwellings. Their performance has been far from the expected (designed) due to both the design of installations by the pattern of district ones and to the quality of solar receivers. For the study it was considered that the use of solar energy for hot water may cover about 0.2% of the demand.

B.2.5.31 Approximate Share of the Hot Water Demand in Households that Can Be Met by a Solar Installation (FDHWS)

Studies have demonstrated that solar installations may cover about 30% of the hot water demand per dwelling.

B.2.5.32 Share of Low-rise Buildings (e.g. up to 3 floors) in the Total Service Sector Floor area (PLB)

The share of low-rise buildings up to 3 floors in the total service sector floor area was estimated at 30% for the year 1989. The same ratio was maintained over the period 1989-2010,

B.2.5.33 Solar Penetration into Thermal Uses in New Low-rise Buildings of the Service Sector (SPSV)

Similar to the hypothesis made for dwellings, the use of solar installations to cover the heat demand in the Service sector dwellings was forecast to be important after the year 2000. It was estimated that, at the level of 2010, solar energy will cover about 5% of the heat demand in the low-size buildings of the service sector.

B.2.5.34 Approximate Share of the Thermal Energy Demand in the Service Sector that Can Be Met by a Solar Installation (FDHS)

In accordance with the studies elaborated on the use of solar energy, it was assumed that solar installations could cover about 5% of the demand of energy under the form of service sector heat.

B.2.5.35 Ratio of the Amount of Non-commercial Fuels Used in the Current Year, Relative to that in the Base Year (CHGNCF)

In 1989, the non-commercial fuel mainly consisted in agricultural residues and energies resulting from wood hygienizing performance.

In parallel with the completion of the implementation of the land law a part of the woods will be given back to the old owners. As a result, it was assumed that the share of fire logs would increase, within the non-commercial fuel, replacing at the same time, part of he agricultural wastes. Within 1989-2000, it was considered necessary to maintain the amount of non-commercial fuel at the same level as in the year 1989 and then, decrease slightly, reaching 90% in the year 2010 with respect to the 1989 value.

B.2.5.36 Efficiency of Fossil Fuel Use Relative to that of Electricity Use for Thermal Uses in Household/Service Sectors (EFF.H.S(I))

It should be mentioned that no studies were available either at the national level for 1989 or for any year in the past about the efficiency of fossil fuel use in thermal uses in the household and service sectors. Thus for estimating the values of the basic year and their evolution under the scenarios, it was necessary to take into account references provided by the specialized literature.

On this basis it was estimated an efficiency of 60% for space and water heating which was kept up constant within the range 1989-2010. It was also assumed an efficiency of 50% in 1989 for cooking and a growth up to 70%, in the year 2010 by providing the growth of the share of natural gases and liquified oil gases in the used fuel for cooking.

Regarding the service sector it was assumed that the efficiency of fossil fuels use would grow from 60%, as it was estimated in 1989, to 70% in 2010 by improving both the fuel burning installations and by increasing the hydrocarbons share.

B.2.5.37 Efficiency of Non-commercial Fuel Use Relative to that of Thermal Electricity Uses (EFFNCF)

The efficiency of non-commercial fuel use was estimated at 12% in 1989 and it was foreseen to grow to 15% until 2010, mainly by increasing the share of fire logs to the detriment of agricultural wastes.

Appendix C

PRINTED OUTPUTS OF THE MAED ANALYSIS — MODULE 1

This appendix presents the results of the energy demand analysis in the form of the printed outputs for Module 1 of MAED for each of the three scenarios of the development considered in the study.

The input data required by Module of MAED 1 is also illustrated by means of the listing of the three data files required for the run, namely: the Scenario Definition (SD) file with general information about the scenario, the Constant Parameters (CP) file with the information for the base year, and the Time Dependent Parameters (TP) file with the scenario data for all years of study. The listing of these files are included for the Basic Scenario only, in order to reduce the size of this document. Furthermore, the CP file is identical for the three scenarios, the SD file only changes the specification of the scenario name, and finally, the contents of the TP file are repeated in the output tables of Module 1. In addition, all input data to Module 1 has been described in Appendix B.

Consequently, the following tables are presented in sequence:

Basic Scenario:

Table C.1 a) Module 1 - Input Data File Scenario Definition (SD)

b) Module 1 - Input Data File Constant Parameters (CP)

c) Module 1 - Input Data File Time Dependent Parameters (TP)

Table C.2 Module 1 - Output Tables

Low Scenario:

Table C.3 Module 1 - Output Tables

High Scenario:

Table C.4 Module 1 - Output Tables

Table C.1.a Basic Scenario: Module 1- Input Data File Scenario Definition (SD)

```
NAME OF REGION OR COUNTRY (MAX. 8 LETTERS):
*******************************************
ROMANIA

NUMBER OF SCENARIO (MAX. 1 DIGIT, FORMAT I1):
*********************************************
2

NUMBER OF YEARS (MAX. 7, FORMAT I2):
************************************
6

LIST OF THESE YEARS (IN FORMAT 7(I4,1X)):
*****************************************
1989,1992,1995,2000,2005,2010,

NUMBER OF PRINT-BLOCKS (MAX. 3, FORMAT I1):
*******************************************
1

NUMBER OF YEARS IN BLOCK 1 (MAX. 7, FORMAT I1):
***********************************************
6

LIST OF THESE YEARS (IN FORMAT  7(I4,1X) ):
*******************************************
1989,1992,1995,2000,2005,2010,

NAME OF UNIT (QUAD,MTCE,MTOE,EXJ,GWYR,PCAL):
********************************************
MTCE


BRIEF DESCRIPTION OF THE SCENARIO (MAX. 48 LETTERS):
****************************************************
ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA
```

Table C.1.b Low Scenario: Module 1 - Input Data File Constant Parameters (CP)

```
GDP-FORMATION:
CYAG      =        0.|        0.|
CYB       =        0.|        0.|
CYMIN     =        0.|        0.|
CYMAN     =        0.|        0.|        0.|
CYEN      =        0.|        0.|
CYSER     =        0.|        0.|
CVAMAN    =        0.|        0.|
CVAIG     =        0.|        0.|        0.|        0.|
CVAM      =        0.|        0.|        0.|
CVAC      =        0.|        0.|
CVAMIS    =        0.|        0.|
INDUSTRY:
EI(I,J)   MOTOR FUEL EL.,SPEC.  TH.,FINAL
1:AGR          1.871|      .658|      .998|ELECTR.FOR WATER SUPPLY INCLUDED|
2:CONSTR       1.968|      .523|      .851|
3:MIN           .875|     3.682|     6.398|HYDROCARBONS (OIL&GAS)|
4:MAN     MOTOR FUEL EL.,SPEC.  TH.,USEF.    %STEAM    %FURNACE %SH&HW
A:BASIC        .3016|    3.8108|   17.3541|     .5597|     .3684|     .0719|
B:MACH         .1836|    1.1055|    2.9506|     .5258|     .4158|     .0584|
C:NON-DUR      .3676|     .5212|    3.8258|     .6303|     .2828|     .0869|
D:MISC         .7219|    2.4033|     3.989|       0.|     .5808|     .4192|
STEEL PRODUCTION AND FEEDSTOCK CONSUMPTION:
CPST      =    14.416|        0.|
CFEED     =     7.264|        0.|
TRANSPORTATION:
TKFRT     =   101.518|    1.8835|
TMISMF    =        0.|        0.|
HOUSEHOLD/SERVICE:
DD        =     3100.|
DWSH      =        1.|
DW  80    =      7.96|
SHDWO(1)  =     5040.|
SHDWO(2)  =     4670.|
SHDWO(3)  =     4030.|
ARSH      =        1.|
TAREA 80  =       75.|
CPLSER    =      1.22|
HAREAO    =      220.|
BYRNCF    =      2.55|
```

Table C.1.c Basic Scenario: Module 1 - Input Data File Time Dependent Parameters (TP)

DEMOGRAPHY:						
PO =	23.152	23.256	23.4	23.69	24.05	24.41
PLF =	.66	.66	.66	.66	.66	.66
PARTLF =	.717	.669	.68	.685	.69	.695
POLC =	.489	.47	.458	.436	.42	.405
PRUR =	.468	.45	.432	.399	.359	.309
CAPH =	2.91	2.88	2.85	2.82	2.8	2.785
GDP-FORMATION AND EXPENDITURE:						
Y =	45.6	31.3	32.1	40.5	51.9	66.1
PYAG =	.139	.187	.195	.204	.208	.21
PYB =	.0634	.057	.055	.05	.048	.045
PYMIN =	.0328	.042	.041	.04	.038	.035
PYMAN =	.4367	.382	.38	.38	.38	.38
PYEN =	.0591	.05	.045	.04	.035	.035
PYSER =	.269	.282	.284	.286	.291	.295
PVAIG =	.3403	.325	.323	.32	.315	.31
PVAM =	.3274	.315	.317	.32	.32	.32
PVAC =	.305	.323	.323	.323	.328	.333
PVAMIS =	.0273	.037	.037	.037	.037	.037
I =	0.	0.	0.	0.	0.	0.
IB =	0.	0.	0.	0.	0.	0.
IM =	0.	0.	0.	0.	0.	0.
P =	0.	0.	0.	0.	0.	0.
PCDG =	0.	0.	0.	0.	0.	0.
PCNDG =	0.	0.	0.	0.	0.	0.
PCSER =	0.	0.	0.	0.	0.	0.
INDUSTRY:						
CH.AGR.MF=	1.	1.	1.	1.04	1.07	1.1
CH.AGR.EL=	1.	1.	1.	1.04	1.07	1.1
CH.AGR.TH=	1.	.9	.9	.85	.8	.75
CH.CON.MF=	1.	1.	1.	.96	.93	.9
CH.CON.EL=	1.	1.	1.	1.03	1.05	1.07
CH.CON.TH=	1.	1.	1.	.88	.8	.75
CH.MIN.MF=	1.	1.	1.	.96	.93	.9
CH.MIN.EL=	1.	1.	1.	1.03	1.05	1.07
CH.MIN.TH=	1.	1.	1.	.88	.8	.75
CH.MAN.MF=	1.	1.	1.	.96	.93	.9
CH.MAN.EL=	1.	1.	1.	1.03	1.05	1.07
CH.MAN.TH=	1.	1.	1.	.88	.8	.75
STSHI =	.666	.666	.666	.666	.666	.666
STI =	.585	.585	.585	.585	.585	.585
LTH =	.121	.121	.121	.121	.121	.121
ELP.I.STM=	0.	0.	0.	0.	0.	0.
ELP.I.FUR=	.1266	.1266	.1266	.13	.14	.15
ELP.I.SH =	0.	0.	0.	.001	.005	.01
ELP.I.AVE=	0.	0.	0.	0.	0.	0.
HPI =	0.	0.	0.	0.	0.	0.
EFFHPI =	2.	2.	2.	2.	2.	2.
IDH =	1.	1.	1.	1.	1.	1.
SPLT =	0.	0.	0.	0.	.01	.02
SPHT =	0.	0.	0.	0.	0.	0.
FIDS =	0.	.01	.01	.01	.01	.01
ICOGEN =	0.	0.	0.	0.	0.	0.
EFFCOG =	.67	.67	.68	.7	.71	.72
HELRAT =	4.27	4.27	4.13	4.02	3.86	3.65
EFF.I.STM=	.72	.72	.73	.77	.81	.84
EFF.I.FUR=	.55	.55	.55	.57	.6	.62
EFF.I.SH =	.7	.71	.72	.75	.78	.82
EFF.I.AVE=	0.	0.	0.	0.	0.	0.
BOF =	.76	.76	.76	.76	.76	.76
IRONST =	.83	.83	.83	.83	.83	.83
EICOK =	627.	627.	627.	627.	627.	627.
TRANSPORTATION:						
TRU =	.189	.19	.195	.2	.21	.22
TRUL =	.806	.806	.806	.808	.813	.813
FTRA =	.511	.51	.485	.46	.45	.43
TRAEF =	.4	.42	.44	.46	.48	.5
TRASTF =	.0076	.007	.005	.003	.001	0.
BA =	.2581	.258	.28	.3	.3	.31
PIP =	.0419	.042	.04	.04	.04	.04
DTRU =	180.	180.	177.	172.	169.	166.
DTRUL =	200.	200.	220.	242.	266.	280.
DTRAF =	107.	107.	105.	104.	102.	100.
STDTRA =	3.7	3.7	3.7	3.7	3.7	3.7
ELDTRA =	.46	.46	.46	.46	.46	.46
DBA =	40.	40.	39.5	38.7	38.5	37.
DPIP =	40.	40.	40.	40.	40.	40.
DI =	2952.	2980.	3025.	3060.	3200.	3400.
DU =	5.	5.	5.3	5.3	5.5	6.
CO =	19.88	18.5	17.9	16.7	16.	15.

Table C.1.c (cont.)

DIC	=	1690.	1700.	1800.	1900.	2100.	2300.
LFIC	=	3.	3.	3.	3.	3.	3.
UC	=	.19	.19	.2	.22	.24	.28
UCE	=	0.	0.	0.	0.	0.	0.
LFUC	=	2.	2.	2.	2.	2.	2.
PBU	=	.3695	.362	.359	.355	.35	.345
PTRA	=	.569	.577	.58	.582	.585	.59
TRAEP	=	.5	.51	.53	.54	.57	.6
TRASTP	=	0.	0.	0.	0.	0.	0.
PLA	=	.0615	.061	.061	.063	.065	.065
LFBU	=	40.	40.	40.	39.	37.5	35.5
LFTRA	=	800.	800.	787.	765.	725.	675.
LFP	=	.95	.8	.8	.8	.8	.8
UMT	=	.81	.81	.8	.78	.76	.72
UMTE	=	.4	.4	.41	.43	.45	.47
LFMTB	=	90.	90.	87.	84.	79.	75.
LFMTE	=	135.	135.	135.	134.	131.	128.
GIC	=	8.	8.	7.8	7.5	7.	6.
GUC	=	12.	12.	12.	11.5	11.	10.
ELUC	=	0.	0.	0.	0.	0.	0.
DBU	=	33.	33.	31.5	29.5	27.	25.
DTRAP	=	72000.	72000.	70500.	67000.	62500.	55000.
DPLA	=	600.	600.	580.	550.	520.	475.
DMT	=	45.	45.	44.	42.	40.	39.
ELMT	=	3.5	3.5	3.5	3.47	3.4	3.3
HOUSEHOLD/SERVICE:							
COOKDW	=	1048.	1040.	1030.	1000.	950.	900.
DWHW	=	.75	.75	.75	.75	.78	.8
HWCAP	=	683.	830.	900.	950.	950.	950.
DWAC	=	0.	0.	0.	.005	.0075	.0125
ACDW	=	260.	260.	260.	260.	260.	260.
ELAPDW	=	513.46	923.	979.	1241.	1458.	1713.
PEL	=	.961	.961	.961	.965	.971	.975
ELOSS	=	1.061	1.091	1.091	1.091	1.091	1.091
PREDW(1)	=	.0377	.038	.038	.037	.036	.0345
PREDW(2)	=	.387	.39	.394	.4	.407	.413
PREDW(3)	=	.5753	.572	.568	.563	.557	.5525
AREAH	=	1.	1.	1.	1.	1.	1.
ELARO	=	37.92	50.	58.	60.	65.	80.
AREAAC	=	0.	0.	0.	.01	.03	.05
ACAREA	=	50.	50.	50.	50.	50.	50.
EFFAC	=	2.	2.	2.	2.	2.	2.
DEMDW	=	0.	.014	.016	.0165	.017	.0175
NEWDW(1)	=	0.	.2	.2	.2	.2	.2
NEWDW(2)	=	0.	.3	.3	.3	.3	.3
NEWDW(3)	=	0.	.5	.5	.5	.5	.5
DWS(1)	=	33.6	33.6	33.6	34.	36.	38.
DWS(2)	=	33.6	33.6	33.6	34.	35.5	36.
DWS(3)	=	33.6	33.6	33.6	34.	35.	35.
K(1)	=	2.0161	2.0161	2.	1.95	1.89	1.81
K(2)	=	1.8667	1.8667	1.85	1.81	1.75	1.68
K(3)	=	1.612	1.612	1.6	1.56	1.52	1.45
ISO(1)	=	0.	0.	0.	.01	.03	.05
ISO(2)	=	0.	0.	0.	.01	.03	.05
ISO(3)	=	0.	0.	0.	.01	.03	.05
AREAL	=	33.97	34.5	35.	35.	35.	35.
DEMAR	=	0.	.014	.016	.0162	.0164	.0165
HAREAN	=	0.	210.	205.	200.	195.	190.
ELARN	=	0.	50.	59.5	65.	68.	85.
ISOSV	=	0.	.01	.02	.03	.04	.05
ELP.H.SH	=	.006	.006	.011	.014	.017	.02
ELP.H.HW	=	.009	.009	.015	.03	.04	.05
ELP.H.CK	=	.001	.0015	.01	.03	.05	.1
ELP.S.TH	=	.0045	.006	.011	.014	.017	.02
HPHS	=	0.	0.	0.	0.	0.	0.
EFFHPR	=	2.	2.	2.	2.	2.	2.
DHPH	=	.987	.987	.99	.99	.99	.97
SPSH	=	0.	0.	0.	0.	0.	0.
FDSHS	=	.1	.1	.1	.1	.1	.1
SPHW	=	0.	.002	.002	.002	.002	.002
FDHWS	=	.3	.3	.3	.3	.3	.3
PLB	=	.3	.3	.3	.3	.3	.3
SPSV	=	0.	0.	0.	0.	.02	.05
FDHS	=	.05	.05	.05	.05	.05	.05
CHGNCF	=	1.	1.	1.	1.	.95	.9
EFF.H.SH	=	.6	.6	.6	.6	.6	.6
EFF.H.HW	=	.6	.6	.6	.6	.6	.6
EFF.H.CK	=	.5	.5	.55	.6	.7	.7
EFF.S.TH	=	.6	.6	.6	.65	.7	.7
EFFNCF	=	.12	.12	.12	.13	.14	.15
YEAR	=	1989	1992	1995	2000	2005	2010

Table C.2 Basic Scenario: Module 1 - Output Tables

SUMMARY OF INPUTS (SCENARIO VARIABLES) INTO MAED/TABLE 1A: ROMANIA /SCENARIO-2

PRINCIPAL VARIABLES CHANGED FROM ONE SCENARIO TO ANOTHER
VALUES AS FRACTIONS EXCEPT WHEN INDICATED OTHERWISE

YEAR:	1989	1992	1995	2000	2005	2010
VARIABLES RELATED TO THE INDUSTRIAL SECTOR:						
RATIO OF ELECTRICITY INTENSITY VS BASE YEAR IN:						
- AGRICULTURE	1.000	1.000	1.000	1.040	1.070	1.100
- CONSTRUCTION	1.000	1.000	1.000	1.030	1.050	1.070
- MINING	1.000	1.000	1.000	1.030	1.050	1.070
- MANUFACTURING	1.000	1.000	1.000	1.030	1.050	1.070
SHARE OF USEFUL THERMAL ENERGY WHICH IS SUPPLIED BY ELECTRICITY IN MANUFACTURING FOR PROCESS:						
- FURNACE/DIRECT HEAT	.127	.127	.127	.130	.140	.150
- SPACE/WATER HEATING	.000	.000	.000	.001	.005	.010
CONTRIBUTION OF ELECTRIC HEAT PUMPS TO LOW-TEMPERATURE HEAT PRODUCTION:	.000	.000	.000	.000	.000	.000
SHARE OF MANUFACTURING DEMAND FOR L.T. STEAM AND HOT WATER WHICH IS SUPPLIED BY SOLAR:	.000	.000	.000	.000	.010	.020
COKE INPUT IN BLAST FURNACES PER UNIT OUTPUT OF PIG IRON (KG COKE/TON PIG IRON)	627.000	627.000	627.000	627.000	627.000	627.000
VARIABLES RELATED TO THE TRANSPORTATION SECTOR:						
SHARE OF ELECTRIC TRAINS IN:						
- TOTAL FREIGHT TRANSPORTATION BY RAIL	.400	.420	.440	.460	.480	.500
- TOTAL INTERCITY TRAVEL BY TRAIN	.500	.510	.530	.540	.570	.600
SHARE OF ELECTRIC MASS TRANSIT IN TOTAL INTRACITY MASS TRANSPORTATION:	.400	.400	.410	.430	.450	.470
VARIABLES RELATED TO HOUSEHOLD/SERVICE SECTOR:						
SPECIFIC ELECTRICITY CONSUMPTION IN:						
- DWELLINGS FOR USES OTHER THAN SPACE/WATER HEATING, COOKING AND A.C. (KWH/YR/DW)	513.460	923.000	979.000	1241.000	1458.000	1713.000
- OLD-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	37.920	50.000	58.000	60.000	65.000	80.000
- NEW-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	.000	50.000	59.500	65.000	68.000	85.000
ELECTRICITY PENETRATION INTO THERMAL USES FOR:						
- SPACE HEATING HOUSEHOLDS	.006	.006	.011	.014	.017	.020
- WATER HEATING HOUSEHOLDS	.009	.009	.015	.030	.040	.050
- COOKING HOUSEHOLDS	.001	.002	.010	.030	.050	.100
- THERMAL USES SERVICE SECTOR	.004	.006	.011	.014	.017	.020
CONTRIBUTION OF HEAT PUMPS TO ELECTRIC SPACE AND WATER HEATING	.000	.000	.000	.000	.000	.000
COEFFICIENT OF LOSSES OF ELECTRIC NETWORK:	1.061	1.091	1.091	1.091	1.091	1.091

SUMMARY OF RESULTS OF MAED/TABLE 1B: ROMANIA /SCENARIO-2

BASIC INPUT INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION:						
TOTAL (MILLION PEOPLE)	23.152	23.256	23.400	23.690	24.050	24.410
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	.150	.178	.209	.238	.252
G.D.P.:						
TOTAL (10**9 MONETARY UNITS OF BASE YEAR)	45.600	31.300	32.100	40.500	51.900	66.100
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-11.788	-5.683	-1.072	.812	1.784
PER CAPITA (10**3 MU/CAP)	1.970	1.346	1.372	1.710	2.158	2.708
FINAL ENERGY RESULTS:						
COMMERCIAL ENERGY:						
TOTAL (GWYR)	70.260	56.709	57.562	61.383	66.782	74.264
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-6.894	-3.268	-1.220	-.317	.264
PER CAPITA (KWYR/CAP)	3.035	2.438	2.460	2.591	2.777	3.042
ELECTRICITY DEMAND:						
TOTAL (GWYR)	7.708	5.827	6.131	7.708	9.697	12.242
(TWHR)	67.524	51.044	53.711	67.526	84.949	107.239
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-8.905	-3.743	.000	1.445	2.227
PER CAPITA (KWYR/CAP)	.333	.251	.262	.325	.403	.502
(KWHR/CAP)	2916.571	2194.856	2295.363	2850.410	3532.203	4393.242
RATIO OF ELECTRICITY TO ENERGY	.110	.103	.107	.126	.145	.165

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 2 : ROMANIA /SCENARIO-2

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	57.432	42.008	42.534	46.317	51.695	58.781
TRANSPORTATION	3.616	3.459	3.542	3.768	4.144	4.542
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	14.572	15.568	15.877	15.981	16.038	16.607
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	61.953	66.065	71.877	79.930
BY ENERGY FORM:						
FOSSIL (SUBST.)	25.206	19.273	19.213	19.333	19.782	21.243
CENTRALIZED HEAT SUPPLY	19.246	13.551	14.009	15.280	17.075	19.249
SOFT SOLAR	.000	.001	.001	.001	.002	.003
ELECTRICITY	8.296	6.271	6.599	8.297	10.437	13.176
MOTOR FUEL	6.758	5.832	6.032	7.065	8.498	10.179
COAL, SPEC.USES	5.737	5.730	5.721	5.713	5.706	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	61.953	66.065	71.877	79.930
NON-COMMERCIAL FUELS	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMMERCIAL+NON-COMMERCIAL)	78.170	63.585	64.503	68.615	74.299	82.225
FINAL ENERGY RESULTS (%):						
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	75.9	68.8	68.7	70.1	71.9	73.5
TRANSPORTATION	4.8	5.7	5.7	5.7	5.8	5.7
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	19.3	25.5	25.6	24.2	22.3	20.8
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
BY ENERGY FORM:						
FOSSIL (SUBST.)	33.3	31.6	31.0	29.3	27.5	26.6
CENTRALIZED HEAT SUPPLY	25.5	22.2	22.6	23.1	23.8	24.1
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	11.0	10.3	10.7	12.6	14.5	16.5
MOTOR FUEL	8.9	9.6	9.7	10.7	11.8	12.7
COAL, SPEC.USES	7.6	9.4	9.2	8.6	7.9	7.1
FEEDSTOCKS	13.7	17.0	16.8	15.7	14.4	13.0
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL FUELS	3.4	4.2	4.1	3.9	3.4	2.9
TOTAL (COMMERCIAL+NON-COMMERCIAL)	103.4	104.2	104.1	103.9	103.4	102.9

DETAILED RESULTS OF MAED/TABLE 3A: ROMANIA /SCENARIO-2

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	16.042	10.034	10.216	11.007	12.114	13.748
CENTRALIZED HEAT SUPPLY	14.727	8.632	8.774	9.686	11.186	13.237
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	7.052	4.518	4.608	5.872	7.559	9.649
MOTOR FUEL	3.532	2.745	2.859	3.672	4.757	6.067
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	57.432	42.008	42.534	46.317	51.695	58.781
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	13.419	7.865	7.995	8.486	9.198	10.406
CENTRALIZED HEAT SUPPLY	14.727	8.632	8.774	9.686	11.186	13.237
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	5.677	3.336	3.393	4.289	5.521	7.090
MOTOR FUEL	.838	.515	.525	.635	.789	.973
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	50.741	36.425	36.765	39.175	42.772	47.787
TRANSPORTATION:						
ELECTRICITY	.356	.344	.349	.364	.399	.430
MOTOR FUEL	3.226	3.087	3.174	3.392	3.741	4.112
STEAM COAL	.035	.028	.019	.012	.004	.000
TOTAL	3.616	3.459	3.542	3.768	4.144	4.542
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	9.165	9.239	8.998	8.326	7.668	7.496
CENTRALIZED HEAT SUPPLY	4.519	4.919	5.235	5.593	5.889	6.012
SOFT SOLAR	.000	.001	.001	.001	.002	.002
ELECTRICITY	.888	1.409	1.642	2.060	2.480	3.097
TOTAL COMMERCIAL	14.572	15.568	15.877	15.981	16.038	16.607
NON-COMMERCIAL	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMM.+NON-COMM.)	17.122	18.118	18.427	18.531	18.461	18.902

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 3B: ROMANIA /SCENARIO-2

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	27.9	23.9	24.0	23.8	23.4	23.4
CENTRALIZED HEAT SUPPLY	25.6	20.5	20.6	20.9	21.6	22.5
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	12.3	10.8	10.8	12.7	14.6	16.4
MOTOR FUEL	6.1	6.5	6.7	7.9	9.2	10.3
METALL.COKE	9.9	13.6	13.4	12.3	11.0	9.7
FEEDSTOCKS	18.1	24.7	24.4	22.4	20.1	17.7
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	26.4	21.6	21.7	21.7	21.5	21.8
CENTRALIZED HEAT SUPPLY	29.0	23.7	23.9	24.7	26.2	27.7
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	11.2	9.2	9.2	10.9	12.9	14.8
MOTOR FUEL	1.7	1.4	1.4	1.6	1.8	2.0
METALL.COKE	11.2	15.7	15.5	14.6	13.3	11.9
FEEDSTOCKS	20.5	28.5	28.2	26.5	24.3	21.7
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
TRANSPORTATION:						
ELECTRICITY	9.8	10.0	9.9	9.7	9.6	9.5
MOTOR FUEL	89.2	89.2	89.6	90.0	90.3	90.5
STEAM COAL	1.0	.8	.5	.3	.1	00.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	62.9	59.3	56.7	52.1	47.8	45.1
CENTRALIZED HEAT SUPPLY	31.0	31.6	33.0	35.0	36.7	36.2
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	6.1	9.1	10.3	12.9	15.5	18.6
TOTAL COMMERCIAL	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL	17.5	16.4	16.1	16.0	15.1	13.8
TOTAL (COMM.+NON-COMM.)	117.5	116.4	116.1	116.0	115.1	113.8

DETAILED RESULTS OF MAED/TABLE 4A: ROMANIA /SCENARIO-2

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	25.206	19.273	19.213	19.333	19.782	21.243
AGR/CONSTR/MIN/MAN.	16.042	10.034	10.216	11.007	12.114	13.748
HOUSEHOLD/SERVICE	9.165	9.239	8.998	8.326	7.668	7.496
CENTRALIZED HEAT SUPPLY:	19.246	13.551	14.009	15.280	17.075	19.249
AGR/CONSTR/MIN/MAN.	14.727	8.632	8.774	9.686	11.186	13.237
HOUSEHOLD/SERVICE	4.519	4.919	5.235	5.593	5.889	6.012
SOFT SOLAR:	.000	.001	.001	.001	.002	.003
AGR/CONSTR/MIN/MAN.	.000	.000	.000	.000	.000	.001
HOUSEHOLD/SERVICE	.000	.001	.001	.001	.002	.002
ELECTRICITY:	8.296	6.271	6.599	8.297	10.437	13.176
AGR/CONSTR/MIN/MAN.	7.052	4.518	4.608	5.872	7.559	9.649
TRANSPORTATION	.356	.344	.349	.364	.399	.430
HOUSEHOLD/SERVICE	.888	1.409	1.642	2.060	2.480	3.097
MOTOR FUEL:	6.758	5.832	6.032	7.065	8.498	10.179
AGR/CONSTR/MIN/MAN.	3.532	2.745	2.859	3.672	4.757	6.067
TRANSPORTATION	3.226	3.087	3.174	3.392	3.741	4.112
COAL, SPEC.USES:	5.737	5.730	5.721	5.713	5.706	5.702
AGR/CONSTR/MIN/MAN.	5.702	5.702	5.702	5.702	5.702	5.702
TRANSPORTATION	.035	.028	.019	.012	.004	.000
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	10.377	10.377	10.377	10.377	10.377	10.377
ALL FORMS (EXCL.NON-COMM.):	75.620	61.035	61.953	66.065	71.877	79.930
AGR/CONSTR/MIN/MAN.	57.432	42.008	42.534	46.317	51.695	58.781
TRANSPORTATION	3.616	3.459	3.542	3.768	4.144	4.542
HOUSEHOLD/SERVICE	14.572	15.568	15.877	15.981	16.038	16.607
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	2.550	2.550	2.550	2.550	2.422	2.295

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 4B: ROMANIA /SCENARIO-2

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	63.6	52.1	53.2	56.9	61.2	64.7
HOUSEHOLD/SERVICE	36.4	47.9	46.8	43.1	38.8	35.3
CENTRALIZED HEAT SUPPLY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	76.5	63.7	62.6	63.4	65.5	68.8
HOUSEHOLD/SERVICE	23.5	36.3	37.4	36.6	34.5	31.2
SOFT SOLAR:	00.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	00.0	00.0	00.0	00.0	13.5	23.6
HOUSEHOLD/SERVICE	00.0	100.0	100.0	100.0	86.5	76.4
ELECTRICITY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	85.0	72.0	69.8	70.8	72.4	73.2
TRANSPORTATION	4.3	5.5	5.3	4.4	3.8	3.3
HOUSEHOLD/SERVICE	10.7	22.5	24.9	24.8	23.8	23.5
MOTOR FUEL:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	52.3	47.1	47.4	52.0	56.0	59.6
TRANSPORTATION	47.7	52.9	52.6	48.0	44.0	40.4
COAL, SPEC.USES:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	99.4	99.5	99.7	99.8	99.9	100.0
TRANSPORTATION	.6	.5	.3	.2	.1	00.0
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	100.0	100.0	100.0	100.0	100.0	100.0
ALL FORMS (EXCL.NON-COMM.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	75.9	68.8	68.7	70.1	71.9	73.5
TRANSPORTATION	4.8	5.7	5.7	5.7	5.8	5.7
HOUSEHOLD/SERVICE	19.3	25.5	25.6	24.2	22.3	20.8
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	100.0	100.0	100.0	100.0	100.0	100.0

DETAILED RESULTS OF MAED/TABLE 5 : ROMANIA /SCENARIO-2

USEFUL/SPECIFIC ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
THERMAL USES, MAN. (USEFUL)	23.178	13.584	13.808	15.247	17.610	20.845
STEAM GENERATION	12.940	7.557	7.681	8.481	9.798	11.601
FURNACE	8.451	4.953	5.035	5.560	6.417	7.591
SPACE HEATING	1.787	1.074	1.092	1.207	1.395	1.654
THERMAL USES, AGR/CONSTR/MIN. (FINAL)	2.622	2.169	2.221	2.521	2.916	3.341
SPECIFIC ELECTRICITY DEMAND (FINAL)	5.982	3.891	3.970	5.148	6.654	8.494
MOTOR FUEL (FINAL)	3.532	2.745	2.859	3.672	4.757	6.067
METALL.COKE (FINAL)	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS (FINAL)	10.377	10.377	10.377	10.377	10.377	10.377
TRANSPORTATION:						
STEAM COAL (FINAL):	.035	.028	.019	.012	.004	.000
FREIGHT	.035	.028	.019	.012	.004	.000
PASSENGER, INTERCITY	.000	.000	.000	.000	.000	.000
MOTOR FUEL (FINAL):	3.226	3.087	3.174	3.392	3.741	4.112
FREIGHT	1.849	1.616	1.661	1.839	2.113	2.401
PASSENGER, INTERCITY	1.011	1.089	1.079	1.082	1.103	1.090
PASSENGER, URBAN	.366	.382	.433	.471	.525	.622
MISCELLANEOUS	.000	.000	.000	.000	.000	.000
ELECTRICITY (FINAL):	.356	.344	.349	.364	.399	.430
FREIGHT	.228	.212	.208	.220	.241	.260
PASSENGER, INTERCITY	.105	.109	.115	.116	.127	.136
PASSENGER, URBAN	.022	.023	.026	.028	.031	.034
HOUSEHOLDS:						
USEFUL ENERGY:						
SPACE HEATING	4.908	4.984	5.071	5.142	5.177	5.179
WATER HEATING	1.695	2.068	2.256	2.411	2.546	2.650
COOKING	1.192	1.200	1.208	1.200	1.166	1.127
AIR CONDITIONING	.000	.000	.000	.002	.002	.004
SECONDARY ELECTR. APPLIANCES (FINAL)	.483	.880	.949	1.236	1.494	1.798
SERVICE SECTOR:						
USEFUL ENERGY:						
THERMAL USES	2.357	2.351	2.429	2.464	2.533	2.588
AIR CONDITIONING	.000	.000	.000	.006	.018	.032
SPECIFIC ELECTRICITY DEMAND (FINAL)	.349	.465	.565	.606	.684	.880

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 6 : ROMANIA /SCENARIO-2

DEMOGRAPHIC AND MACRO-ECONOMIC INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION (MILLION PEOPLE):	23.152	23.256	23.400	23.690	24.050	24.410
%IN CITIES	(51.1)	(53.0)	(54.2)	(56.4)	(58.0)	(59.5)
GDP/CAP. (10**3MU/CAP.)	1.970	1.346	1.372	1.710	2.158	2.708
PRIVATE CONSUMPTION/CAP. (10**3MU/CAP.)	.000	.000	.000	.000	.000	.000
GDP EXPENDITURE (%):						
GROSS FIXED CAPITAL FORMATION	00.0	00.0	00.0	00.0	00.0	00.0
EQUIPMENT	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
CONSTRUCTION	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
PRIVATE CONSUMPTION	00.0	00.0	00.0	00.0	00.0	00.0
DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
NON-DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
SERVICES	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
GDP FORMATION (10**9 MU):	45.600	31.300	32.100	40.500	51.900	66.100
AGRICULTURE	6.338	5.853	6.259	8.262	10.795	13.881
CONSTRUCTION	2.891	1.784	1.765	2.025	2.491	2.974
MINING	1.496	1.315	1.316	1.620	1.972	2.313
MANUFACTURING	19.914	11.957	12.198	15.390	19.722	25.118
ENERGY SECTOR	2.695	1.565	1.444	1.620	1.817	2.313
SERVICES (INCL.TRANSPORTATION)	12.266	8.827	9.116	11.583	15.103	19.499
GDP FORMATION (%):	100.0	100.0	100.0	100.0	100.0	100.0
AGRICULTURE	13.9	18.7	19.5	20.4	20.8	21.0
CONSTRUCTION	6.3	5.7	5.5	5.0	4.8	4.5
MINING	3.3	4.2	4.1	4.0	3.8	3.5
MANUFACTURING	43.7	38.2	38.0	38.0	38.0	38.0
ENERGY SECTOR	5.9	5.0	4.5	4.0	3.5	3.5
SERVICES (INCL.TRANSPORTATION)	26.9	28.2	28.4	28.6	29.1	29.5
VA, MANUFACTURING (10**9 MU):	19.914	11.957	12.198	15.390	19.722	25.118
BASIC MATERIALS	6.777	3.886	3.940	4.925	6.212	7.787
MACHINERY AND EQUIPMENT	6.520	3.766	3.867	4.925	6.311	8.038
FOOD & TEXTILES	6.074	3.862	3.940	4.971	6.469	8.364
MISCELLANEOUS	.544	.442	.451	.569	.730	.929
VA, MANUFACTURING (%):	100.0	100.0	100.0	100.0	100.0	100.0
BASIC MATERIALS	34.0	32.5	32.3	32.0	31.5	31.0
MACHINERY AND EQUIPMENT	32.7	31.5	31.7	32.0	32.0	32.0
FOOD & TEXTILES	30.5	32.3	32.3	32.3	32.8	33.3
MISCELLANEOUS	2.7	3.7	3.7	3.7	3.7	3.7

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7A: ROMANIA /SCENARIO-2

ENERGY INTENSITY ASSUMPTIONS IN AGR/CONSTR/MIN/MAN.:

YEAR:	1989	1992	1995	2000	2005	2010
AGRICULTURE:						
MOTOR FUEL (FINAL;KWH/MU)	2.176	2.176	2.176	2.263	2.328	2.393
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.658	.658	.658	.684	.704	.724
THERMAL (FINAL;KWH/MU)	1.160	1.044	1.044	.986	.928	.870
CONSTRUCTION:						
MOTOR FUEL (FINAL;KWH/MU)	2.288	2.288	2.288	2.197	2.128	2.060
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.523	.523	.523	.539	.549	.560
THERMAL (FINAL;KWH/MU)	.990	.990	.990	.871	.792	.742
MINING:						
MOTOR FUEL (FINAL;KWH/MU)	1.017	1.017	1.017	.977	.946	.916
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.682	3.682	3.682	3.792	3.866	3.940
THERMAL (FINAL;KWH/MU)	7.440	7.440	7.440	6.547	5.952	5.580
MANUF. OF BASIC MATERIALS:						
MOTOR FUEL (FINAL;KWH/MU)	.351	.351	.351	.337	.326	.316
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.811	3.811	3.811	3.925	4.001	4.078
THERMAL (USEFUL;KWH/MU)	20.179	20.179	20.179	17.758	16.143	15.134
MANUF. OF MACHINERY AND EQUIPMENT:						
MOTOR FUEL (FINAL;KWH/MU)	.213	.213	.213	.205	.199	.192
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.105	1.105	1.105	1.139	1.161	1.183
THERMAL (USEFUL;KWH/MU)	3.431	3.431	3.431	3.019	2.745	2.573
MANUF. OF FOOD & TEXTILES:						
MOTOR FUEL (FINAL;KWH/MU)	.427	.427	.427	.410	.398	.385
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.521	.521	.521	.537	.547	.558
THERMAL (USEFUL;KWH/MU)	4.449	4.449	4.449	3.915	3.559	3.336
MISCELLANEOUS MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.839	.839	.839	.806	.781	.755
ELECTR.,SPECIFIC (FINAL;KWH/MU)	2.403	2.403	2.403	2.475	2.523	2.572
THERMAL (USEFUL;KWH/MU)	4.638	4.638	4.638	4.082	3.711	3.479
ALL MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.343	.350	.350	.336	.326	.315
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.883	1.844	1.839	1.885	1.905	1.923
THERMAL (USEFUL;KWH/MU)	9.474	9.247	9.214	8.064	7.268	6.755
THERMAL (FINAL;KWH/MU)	11.942	11.657	11.615	9.994	8.787	8.036

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B: ROMANIA /SCENARIO-2

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
STEAM GENERATION:	12.940	7.557	7.681	8.481	9.798	11.601
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.720)	(.720)	(.730)	(.770)	(.810)	(.840)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	100.0	100.0	100.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
FURNACE, DIRECT HEAT:	8.451	4.953	5.035	5.560	6.417	7.591
%FOSSIL	87.3	87.3	87.3	87.0	86.0	85.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ELECTRICITY	12.7	12.7	12.7	13.0	14.0	15.0
SPACE AND WATER HEATING:	1.787	1.074	1.092	1.207	1.395	1.654
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.700)	(.710)	(.720)	(.750)	(.780)	(.820)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	99.9	99.5	99.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	.1	.5	1.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B (CONT'D): ROMANIA /SCENARIO-2

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
ALL THERMAL USES IN MANUFACTURING:	23.178	13.584	13.808	15.247	17.610	20.845
%FOSSIL	31.8	31.8	31.8	31.7	31.3	31.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	63.5	63.5	63.5	63.5	63.5	63.5
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	4.6	4.6	4.6	4.7	5.1	5.5
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
ON-SITE COGENERATION:						
HEAT	.000	.000	.000	.000	.000	.000
BY-PRODUCT ELECTRICITY	.000	.000	.000	.000	.000	.000
STEEL PROD. (10**6 TONS):	14.416	14.416	14.416	14.416	14.416	14.416
OF WHICH ELECTRIC (10**6 TONS):	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)
FEEDSTOCK REQU. (10**6 TOE):	7.264	7.264	7.264	7.264	7.264	7.264

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8A: ROMANIA /SCENARIO-2

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (10**9 TKM)	158.857	140.486	141.482	152.169	166.133	183.688
TRUCK	30.024	26.692	27.589	30.434	34.888	40.411
LOCAL	(24.199)	(21.514)	(22.237)	(24.591)	(28.364)	(32.854)
LONG-DISTANCE	(5.825)	(5.178)	(5.352)	(5.843)	(6.524)	(7.557)
TRAIN	81.176	71.648	68.619	69.998	74.760	78.986
STEAM	(.617)	(.502)	(.343)	(.210)	(.075)	(.000)
DIESEL	(48.088)	(41.054)	(38.083)	(37.589)	(38.800)	(39.493)
ELECTRIC	(32.470)	(30.092)	(30.192)	(32.199)	(35.885)	(39.493)
BARGE	41.001	36.245	39.615	45.651	49.840	56.943
PIPE	6.656	5.900	5.659	6.087	6.645	7.348
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (10**9 PKM)	68.345	69.303	70.785	72.491	76.960	82.994
CAR	5.904	6.411	7.059	8.086	9.470	11.229
BUS	23.072	22.767	22.878	22.864	23.622	24.759
TRAIN	35.528	36.289	36.961	37.484	39.482	42.342
STEAM	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DIESEL	(17.764)	(17.781)	(17.372)	(17.243)	(16.977)	(16.937)
ELECTRIC	(17.764)	(18.507)	(19.589)	(20.241)	(22.505)	(25.405)
PLANE	3.840	3.836	3.887	4.058	4.387	4.665
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (10**9 PKM)	21.591	22.494	24.535	25.847	28.003	31.807
CAR	4.102	4.274	4.907	5.686	6.721	8.906
MOTOR FUEL	(4.102)	(4.274)	(4.907)	(5.686)	(6.721)	(8.906)
ELECTRIC	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
MASS TRANSIT	17.489	18.220	19.628	20.161	21.282	22.901
MOTOR FUEL	(10.493)	(10.932)	(11.580)	(11.492)	(11.705)	(12.138)
ELECTRIC	(6.995)	(7.288)	(8.047)	(8.669)	(9.577)	(10.764)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8B: ROMANIA /SCENARIO-2

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
TRUCK	18.9	19.0	19.5	20.0	21.0	22.0
LOCAL	(80.6)	(80.6)	(80.6)	(80.8)	(81.3)	(81.3)
LONG-DISTANCE	(19.4)	(19.4)	(19.4)	(19.2)	(18.7)	(18.7)
TRAIN	51.1	51.0	48.5	46.0	45.0	43.0
STEAM	(.8)	(.7)	(.5)	(.3)	(.1)	(00.0)
DIESEL	(59.2)	(57.3)	(55.5)	(53.7)	(51.9)	(50.0)
ELECTRIC	(40.0)	(42.0)	(44.0)	(46.0)	(48.0)	(50.0)
BARGE	25.8	25.8	28.0	30.0	30.0	31.0
PIPE	4.2	4.2	4.0	4.0	4.0	4.0
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	8.6	9.3	10.0	11.2	12.3	13.5
BUS	33.8	32.9	32.3	31.5	30.7	29.8
TRAIN	52.0	52.4	52.2	51.7	51.3	51.0
STEAM	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
DIESEL	(50.0)	(49.0)	(47.0)	(46.0)	(43.0)	(40.0)
ELECTRIC	(50.0)	(51.0)	(53.0)	(54.0)	(57.0)	(60.0)
PLANE	5.6	5.5	5.5	5.6	5.7	5.6
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	19.0	19.0	20.0	22.0	24.0	28.0
MOTOR FUEL	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
ELECTRIC	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
MASS TRANSIT	81.0	81.0	80.0	78.0	76.0	72.0
MOTOR FUEL	(60.0)	(60.0)	(59.0)	(57.0)	(55.0)	(53.0)
ELECTRIC	(40.0)	(40.0)	(41.0)	(43.0)	(45.0)	(47.0)

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8C: ROMANIA /SCENARIO-2

ENERGY INTENSITY (AND LOAD FACTORS) ASSUMED:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION (KWH/TKM):						
TRUCK						
LOCAL	.233	.233	.256	.281	.309	.326
LONG-DISTANCE	.209	.209	.206	.200	.197	.193
TRAIN						
STEAM	.460	.460	.452	.447	.439	.430
DIESEL	.124	.124	.122	.121	.119	.116
ELECTRIC	.057	.057	.056	.056	.055	.053
BARGE	.047	.047	.046	.045	.045	.043
PIPE	.047	.047	.047	.047	.047	.047
PASSENGER TRANSPORTATION, INTERCITY (KWH/PKM):						
CAR	.264	.264	.257	.247	.231	.198
(P/CAR)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)
BUS	.086	.086	.082	.079	.075	.074
(P/BUS)	(40.000)	(40.000)	(40.000)	(39.000)	(37.500)	(35.500)
TRAIN						
(P/TRAIN)	(800.000)	(800.000)	(787.000)	(765.000)	(725.000)	(675.000)
STEAM	.387	.387	.385	.377	.371	.351
DIESEL	.105	.105	.104	.102	.100	.095
ELECTRIC	.048	.048	.048	.047	.046	.044
PLANE	.734	.872	.843	.799	.756	.690
(% OF SEATS OCCUPIED)	(.950)	(.800)	(.800)	(.800)	(.800)	(.800)
PASSENGER TRANSPORTATION, URBAN (KWH/PKM):						
CAR						
(P/CAR)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
MOTOR FUEL	.593	.593	.593	.568	.544	.494
ELECTRIC	.000	.000	.000	.000	.000	.000
MASS TRANSIT						
MOTOR FUEL	.052	.052	.053	.052	.053	.054
(P/BUS)	(90.000)	(90.000)	(87.000)	(84.000)	(79.000)	(75.000)
ELECTRIC	.026	.026	.026	.026	.026	.026
(P/TRAIN)	(135.000)	(135.000)	(135.000)	(134.000)	(131.000)	(128.000)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9A: ROMANIA /SCENARIO-2

DWELLINGS AND SERVICE SECTOR BUILDINGS:

YEAR:	1989	1992	1995	2000	2005	2010
PERSONS/HOUSEHOLD	2.910	2.880	2.850	2.820	2.800	2.785
DWELLINGS (MILLION UNITS)	7.960	8.075	8.211	8.401	8.589	8.765
OF WHICH IN AREAS REQU. HEATING:	7.960	8.075	8.211	8.401	8.589	8.765
CONSTRUCTED BEFORE BASE YEAR	7.960	7.893	7.815	7.680	7.537	7.387
SINGLE FAMILY HOME/CENTRAL HEATING	(.300)	(.300)	(.297)	(.284)	(.271)	(.255)
APARTMENT/CENTRAL HEATING	(3.081)	(3.078)	(3.079)	(3.072)	(3.068)	(3.051)
ROOM HEATING	(4.579)	(4.515)	(4.439)	(4.324)	(4.198)	(4.081)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
CONSTRUCTED AFTER BASE YEAR	.000	.182	.395	.721	1.052	1.378
SINGLE FAMILY HOME/CENTRAL HEATING	(.000)	(.036)	(.079)	(.144)	(.210)	(.276)
APARTMENT/CENTRAL HEATING	(.000)	(.055)	(.119)	(.216)	(.316)	(.413)
ROOM HEATING	(.000)	(.091)	(.198)	(.361)	(.526)	(.689)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DWELLINGS REQUIRING HEATING(%):	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	97.7	95.2	91.4	87.7	84.3
SINGLE FAMILY HOME/CENTRAL HEATING	(3.8)	(3.8)	(3.8)	(3.7)	(3.6)	(3.4)
APARTMENT/CENTRAL HEATING	(38.7)	(39.0)	(39.4)	(40.0)	(40.7)	(41.3)
ROOM HEATING	(57.5)	(57.2)	(56.8)	(56.3)	(55.7)	(55.3)
NO HEATING	(.0)	(.0)	(.0)	(.0)	(.0)	(.0)
CONSTRUCTED AFTER BASE YEAR	00.0	2.3	4.8	8.6	12.3	15.7
SINGLE FAMILY HOME/CENTRAL HEATING	(00.0)	(20.0)	(20.0)	(20.0)	(20.0)	(20.0)
APARTMENT/CENTRAL HEATING	(00.0)	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)
ROOM HEATING	(00.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)
NO HEATING	(100.0)	(.0)	(.0)	(.0)	(.0)	(.0)
SERVICE SECTOR WORK FORCE (MILLION WORKERS)	2.208	2.192	2.261	2.326	2.429	2.525
SERVICE SECTOR BUILDINGS (MILLION SQM)	75.000	75.619	79.138	81.402	85.021	88.379
OF WHICH IN AREAS REQU. HEATING:	75.000	75.619	79.138	81.402	85.021	88.379
CONSTRUCTED BEFORE BASE YEAR	75.000	74.368	73.640	72.358	71.023	69.620
CONSTRUCTED AFTER BASE YEAR	.000	1.250	5.498	9.044	13.998	18.759
HEATED SERVICE SECTOR BUILDINGS (%)	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	98.3	93.1	88.9	83.5	78.8
CONSTRUCTED AFTER BASE YEAR	00.0	1.7	6.9	11.1	16.5	21.2

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9B: ROMANIA /SCENARIO-2

ENERGY INTENSITY ASSUMED FOR THE HOUSEHOLD SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:						
CONSTR.BEFORE BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.465	5860.465	5860.465	5801.860	5684.651	5567.442
APARTMENT/CENTRAL HEATING	5430.232	5430.232	5430.232	5375.930	5267.325	5158.721
ROOM HEATING	4686.046	4686.046	4686.046	4639.186	4545.465	4451.744
CONSTR.AFTER BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.380	5860.380	5813.581	5735.721	5886.251	5950.270
APARTMENT/CENTRAL HEATING	5426.106	5426.106	5377.563	5323.925	5374.535	5232.223
ROOM HEATING	4685.746	4685.746	4650.865	4588.576	4602.418	4390.465
SIZE OF DWELLINGS CONSTR.AFTER BASE YEAR (SQM):						
SINGLE FAMILY/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(36.000)	(38.000)
APARTMENT/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.500)	(36.000)
ROOM HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.000)	(35.000)
HEATING DEGREE-DAYS:	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)
WATER HEATING (USEFUL;KWH/DW/YR):	2311.081	2779.535	2982.558	3115.116	3093.023	3076.453
(% OF DWELLINGS WITH HOT WATER)	(75.0)	(75.0)	(75.0)	(75.0)	(78.0)	(80.0)
COOKING (USEFUL;KWH/DW/YR):	1218.605	1209.302	1197.674	1162.791	1104.651	1046.512
AIR CONDITIONING (USEFUL;KWH/DW/YR):	302.326	302.326	302.326	302.326	302.326	302.326
(% OF DWELLINGS WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(.5)	(.7)	(1.3)
SECONDARY ELECTR. APPL. (KWH/DW/YR):	513.460	923.000	979.000	1241.000	1458.000	1713.000

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9C: ROMANIA /SCENARIO-2

THERMAL ENERGY DEMAND (USEFUL) BY THE HOUSEHOLD SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:	4.908	4.984	5.071	5.142	5.177	5.179
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	45.0	43.4	41.7	39.0	37.1	36.4
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	57.7
%SOLAR	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, CONVENTIONAL	.6	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
WATER HEATING:	1.695	2.068	2.256	2.411	2.546	2.650
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	44.7	43.0	41.2	37.3	34.7	33.4
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	57.7
%SOLAR	00.0	.1	.1	.1	.1	.1
%ELECTRICITY, CONVENTIONAL	.9	.9	1.5	3.0	4.0	5.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
COOKING:	1.192	1.200	1.208	1.200	1.166	1.127
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	96.0	96.1	95.4	93.2	91.2	86.2
(EFFICIENCY)	(.500)	(.500)	(.550)	(.600)	(.700)	(.700)
%ELECTRICITY	.1	.2	1.0	3.0	5.0	10.0
AIR CONDITIONING:	.000	.000	.000	.002	.002	.004
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Table C.2 Basic Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9D: ROMANIA /SCENARIO-2

YEAR:	1989	1992	1995	2000	2005	2010
ENERGY INTENSITY ASSUMED FOR THE SERVICE SECTOR:						
SPACE AND WATER HEATING (USEFUL;KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	255.814	253.256	250.698	248.140	245.581	243.023
BUILDINGS CONSTR.AFTER BASE YEAR	.000	244.186	238.372	232.558	226.744	220.930
(% OF FLOOR AREA HEATED)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
AIR CONDITIONING:						
SPEC. CONS. (USEFUL;KWH/SQM/YR)	58.140	58.140	58.140	58.140	58.140	58.140
(% OF FLOOR AREA WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(1.0)	(3.0)	(5.0)
SPECIFIC USE OF ELECTRICITY (KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	37.920	50.000	58.000	60.000	65.000	80.000
BUILDINGS CONSTR.AFTER BASE YEAR	.000	50.000	59.500	65.000	68.000	85.000
THERMAL ENERGY DEMAND (USEFUL) BY THE SERVICE SECTOR (MTCE); PENETRATION OF COMPETING ENERGY SOURCES; AND EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):						
SPACE AND WATER HEATING:	2.357	2.351	2.429	2.464	2.533	2.588
%FOSSIL	49.1	47.1	45.2	42.8	40.9	40.3
(EFFICIENCY)	(.600)	(.600)	(.600)	(.650)	(.700)	(.700)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	57.7
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	.4	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
AIR CONDITIONING:	.000	.000	.000	.006	.018	.032
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Table C.3 Low Scenario: Module 1 - Output Tables

SUMMARY OF INPUTS (SCENARIO VARIABLES) INTO MAED/TABLE 1A: ROMANIA /SCENARIO-3
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PRINCIPAL VARIABLES CHANGED FROM ONE SCENARIO TO ANOTHER
VALUES AS FRACTIONS EXCEPT WHEN INDICATED OTHERWISE

YEAR:	1989	1992	1995	2000	2005	2010
VARIABLES RELATED TO THE INDUSTRIAL SECTOR:						
RATIO OF ELECTRICITY INTENSITY VS BASE YEAR IN:						
- AGRICULTURE	1.000	1.000	1.000	1.030	1.030	1.070
- CONSTRUCTION	1.000	1.000	1.000	1.000	1.000	1.000
- MINING	1.000	1.000	1.000	1.000	1.000	1.000
- MANUFACTURING	1.000	1.000	1.000	1.000	1.000	1.000
SHARE OF USEFUL THERMAL ENERGY WHICH IS SUPPLIED BY ELECTRICITY IN MANUFACTURING FOR PROCESS:						
- FURNACE/DIRECT HEAT	.127	.127	.127	.130	.140	.150
- SPACE/WATER HEATING	.000	.000	.000	.001	.005	.010
CONTRIBUTION OF ELECTRIC HEAT PUMPS TO LOW-TEMPERATURE HEAT PRODUCTION:	.000	.000	.000	.000	.000	.000
SHARE OF MANUFACTURING DEMAND FOR L.T. STEAM AND HOT WATER WHICH IS SUPPLIED BY SOLAR:	.000	.000	.000	.000	.010	.020
COKE INPUT IN BLAST FURNACES PER UNIT OUTPUT OF PIG IRON (KG COKE/TON PIG IRON)	627.000	627.000	627.000	627.000	627.000	627.000
VARIABLES RELATED TO THE TRANSPORTATION SECTOR:						
SHARE OF ELECTRIC TRAINS IN:						
- TOTAL FREIGHT TRANSPORTATION BY RAIL	.400	.420	.440	.460	.480	.500
- TOTAL INTERCITY TRAVEL BY TRAIN	.500	.510	.530	.540	.570	.600
SHARE OF ELECTRIC MASS TRANSIT IN TOTAL INTRACITY MASS TRANSPORTATION:	.400	.400	.410	.430	.450	.470
VARIABLES RELATED TO HOUSEHOLD/SERVICE SECTOR:						
SPECIFIC ELECTRICITY CONSUMPTION IN:						
- DWELLINGS FOR USES OTHER THAN SPACE/WATER HEATING, COOKING AND A.C. (KWH/YR/DW)	513.460	923.000	948.000	1140.000	1290.000	1480.000
- OLD-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	37.920	50.000	55.000	55.000	57.000	69.000
- NEW-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	.000	50.000	55.000	57.000	61.000	73.000
ELECTRICITY PENETRATION INTO THERMAL USES FOR:						
- SPACE HEATING HOUSEHOLDS	.006	.006	.011	.014	.017	.020
- WATER HEATING HOUSEHOLDS	.009	.009	.015	.030	.040	.050
- COOKING HOUSEHOLDS	.001	.002	.010	.030	.050	.100
- THERMAL USES SERVICE SECTOR	.004	.006	.011	.014	.017	.020
CONTRIBUTION OF HEAT PUMPS TO ELECTRIC SPACE AND WATER HEATING	.000	.000	.000	.000	.000	.000
COEFFICIENT OF LOSSES OF ELECTRIC NETWORK:	1.061	1.091	1.091	1.091	1.091	1.091

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF RESULTS OF MAED/TABLE 1B: ROMANIA /SCENARIO-3

BASIC INPUT INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION:						
TOTAL (MILLION PEOPLE)	23.152	23.256	23.400	23.690	24.050	24.410
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	.150	.178	.209	.238	.252
G.D.P.:						
TOTAL (10**9 MONETARY UNITS OF BASE YEAR)	45.600	31.300	31.100	37.100	45.900	57.200
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-11.788	-6.179	-1.858	.041	1.085
PER CAPITA (10**3 MU/CAP)	1.970	1.346	1.329	1.566	1.909	2.343
FINAL ENERGY RESULTS:						
COMMERCIAL ENERGY:						
TOTAL (GWYR)	70.260	56.709	56.725	59.115	64.782	69.426
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-6.894	-3.504	-1.558	-.506	-.057
PER CAPITA (KWYR/CAP)	3.035	2.438	2.424	2.495	2.694	2.844
ELECTRICITY DEMAND:						
TOTAL (GWYR)	7.708	5.827	5.940	6.995	8.480	10.333
(TWHR)	67.524	51.044	52.038	61.278	74.284	90.516
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-8.905	-4.249	-.879	.598	1.405
PER CAPITA (KWYR/CAP)	.333	.251	.254	.295	.353	.423
(KWHR/CAP)	2916.571	2194.856	2223.849	2586.674	3088.745	3708.137
RATIO OF ELECTRICITY TO ENERGY	.110	.103	.105	.118	.131	.149

DETAILED RESULTS OF MAED/TABLE 2 : ROMANIA /SCENARIO-3

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	57.432	42.008	41.710	44.093	49.902	54.176
TRANSPORTATION	3.616	3.459	3.525	3.710	4.038	4.382
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	14.572	15.568	15.817	15.822	15.784	16.165
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	61.052	63.625	69.724	74.722
BY ENERGY FORM:						
FOSSIL (SUBST.)	25.206	19.273	18.895	18.638	19.680	19.986
CENTRALIZED HEAT SUPPLY	19.246	13.551	13.736	14.668	17.018	18.355
SOFT SOLAR	.000	.001	.001	.001	.002	.003
ELECTRICITY	8.296	6.271	6.394	7.529	9.127	11.121
MOTOR FUEL	6.758	5.832	5.928	6.698	7.815	9.179
COAL, SPEC.USES	5.737	5.730	5.721	5.713	5.706	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	61.052	63.625	69.724	74.722
NON-COMMERCIAL FUELS	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMMERCIAL+NON-COMMERCIAL)	78.170	63.585	63.602	66.175	72.147	77.017
FINAL ENERGY RESULTS (%):						
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	75.9	68.8	68.3	69.3	71.6	72.5
TRANSPORTATION	4.8	5.7	5.8	5.8	5.8	5.9
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	19.3	25.5	25.9	24.9	22.6	21.6
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
BY ENERGY FORM:						
FOSSIL (SUBST.)	33.3	31.6	30.9	29.3	28.2	26.7
CENTRALIZED HEAT SUPPLY	25.5	22.2	22.5	23.1	24.4	24.6
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	11.0	10.3	10.5	11.8	13.1	14.9
MOTOR FUEL	8.9	9.6	9.7	10.5	11.2	12.3
COAL, SPEC.USES	7.6	9.4	9.4	9.0	8.2	7.6
FEEDSTOCKS	13.7	17.0	17.0	16.3	14.9	13.9
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL FUELS	3.4	4.2	4.2	4.0	3.5	3.1
TOTAL (COMMERCIAL+NON-COMMERCIAL)	103.4	104.2	104.2	104.0	103.5	103.1

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 3A: ROMANIA /SCENARIO-3

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	16.042	10.034	9.897	10.313	12.011	12.690
CENTRALIZED HEAT SUPPLY	14.727	8.632	8.500	9.075	11.130	12.219
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	7.052	4.518	4.464	5.269	6.514	7.976
MOTOR FUEL	3.532	2.745	2.770	3.357	4.168	5.211
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	57.432	42.008	41.710	44.093	49.902	54.176
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	13.419	7.865	7.746	7.950	9.151	9.606
CENTRALIZED HEAT SUPPLY	14.727	8.632	8.500	9.075	11.130	12.219
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	5.677	3.336	3.287	3.849	4.788	5.866
MOTOR FUEL	.838	.515	.508	.587	.728	.870
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	50.741	36.425	36.120	37.540	41.876	44.640
TRANSPORTATION:						
ELECTRICITY	.356	.344	.347	.358	.388	.414
MOTOR FUEL	3.226	3.087	3.159	3.341	3.646	3.968
STEAM COAL	.035	.028	.019	.011	.004	.000
TOTAL	3.616	3.459	3.525	3.710	4.038	4.382
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	9.165	9.239	8.998	8.326	7.668	7.296
CENTRALIZED HEAT SUPPLY	4.519	4.919	5.235	5.593	5.889	6.136
SOFT SOLAR	.000	.001	.001	.001	.002	.002
ELECTRICITY	.888	1.409	1.582	1.901	2.226	2.731
TOTAL COMMERCIAL	14.572	15.568	15.817	15.822	15.784	16.165
NON-COMMERCIAL	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMM.+NON-COMM.)	17.122	18.118	18.367	18.372	18.207	18.460

DETAILED RESULTS OF MAED/TABLE 3B: ROMANIA /SCENARIO-3

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	27.9	23.9	23.7	23.4	24.1	23.4
CENTRALIZED HEAT SUPPLY	25.6	20.5	20.4	20.6	22.3	22.6
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	12.3	10.8	10.7	12.0	13.1	14.7
MOTOR FUEL	6.1	6.5	6.6	7.6	8.4	9.6
METALL.COKE	9.9	13.6	13.7	12.9	11.4	10.5
FEEDSTOCKS	18.1	24.7	24.9	23.5	20.8	19.2
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	26.4	21.6	21.4	21.2	21.9	21.5
CENTRALIZED HEAT SUPPLY	29.0	23.7	23.5	24.2	26.6	27.4
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	11.2	9.2	9.1	10.3	11.4	13.1
MOTOR FUEL	1.7	1.4	1.4	1.6	1.7	1.9
METALL.COKE	11.2	15.7	15.8	15.2	13.6	12.8
FEEDSTOCKS	20.5	28.5	28.7	27.6	24.8	23.2
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
TRANSPORTATION:						
ELECTRICITY	9.8	10.0	9.9	9.6	9.6	9.4
MOTOR FUEL	89.2	89.2	89.6	90.0	90.3	90.6
STEAM COAL	1.0	.8	.5	.3	.1	00.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	62.9	59.3	56.9	52.6	48.6	45.1
CENTRALIZED HEAT SUPPLY	31.0	31.6	33.1	35.4	37.3	38.0
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	6.1	9.1	10.0	12.0	14.1	16.9
TOTAL COMMERCIAL	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL	17.5	16.4	16.1	16.1	15.3	14.2
TOTAL (COMM.+NON-COMM.)	117.5	116.4	116.1	116.1	115.3	114.2

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 4A: ROMANIA /SCENARIO-3

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	25.206	19.273	18.895	18.638	19.680	19.986
AGR/CONSTR/MIN/MAN.	16.042	10.034	9.897	10.313	12.011	12.690
HOUSEHOLD/SERVICE	9.165	9.239	8.998	8.326	7.668	7.296
CENTRALIZED HEAT SUPPLY:	19.246	13.551	13.736	14.668	17.018	18.355
AGR/CONSTR/MIN/MAN.	14.727	8.632	8.500	9.075	11.130	12.219
HOUSEHOLD/SERVICE	4.519	4.919	5.235	5.593	5.889	6.136
SOFT SOLAR:	.000	.001	.001	.001	.002	.003
AGR/CONSTR/MIN/MAN.	.000	.000	.000	.000	.000	.001
HOUSEHOLD/SERVICE	.000	.001	.001	.001	.002	.002
ELECTRICITY:	8.296	6.271	6.394	7.529	9.127	11.121
AGR/CONSTR/MIN/MAN.	7.052	4.518	4.464	5.269	6.514	7.976
TRANSPORTATION	.356	.344	.347	.358	.388	.414
HOUSEHOLD/SERVICE	.888	1.409	1.582	1.901	2.226	2.731
MOTOR FUEL:	6.758	5.832	5.928	6.698	7.815	9.179
AGR/CONSTR/MIN/MAN.	3.532	2.745	2.770	3.357	4.168	5.211
TRANSPORTATION	3.226	3.087	3.159	3.341	3.646	3.968
COAL, SPEC.USES:	5.737	5.730	5.721	5.713	5.706	5.702
AGR/CONSTR/MIN/MAN.	5.702	5.702	5.702	5.702	5.702	5.702
TRANSPORTATION	.035	.028	.019	.011	.004	.000
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	10.377	10.377	10.377	10.377	10.377	10.377
ALL FORMS (EXCL.NON-COMM.):	75.620	61.035	61.052	63.625	69.724	74.722
AGR/CONSTR/MIN/MAN.	57.432	42.008	41.710	44.093	49.902	54.176
TRANSPORTATION	3.616	3.459	3.525	3.710	4.038	4.382
HOUSEHOLD/SERVICE	14.572	15.568	15.817	15.822	15.784	16.165
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	2.550	2.550	2.550	2.550	2.422	2.295

DETAILED RESULTS OF MAED/TABLE 4B: ROMANIA /SCENARIO-3

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	63.6	52.1	52.4	55.3	61.0	63.5
HOUSEHOLD/SERVICE	36.4	47.9	47.6	44.7	39.0	36.5
CENTRALIZED HEAT SUPPLY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	76.5	63.7	61.9	61.9	65.4	66.6
HOUSEHOLD/SERVICE	23.5	36.3	38.1	38.1	34.6	33.4
SOFT SOLAR:	00.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	00.0	00.0	00.0	00.0	13.5	22.2
HOUSEHOLD/SERVICE	00.0	100.0	100.0	100.0	86.5	77.8
ELECTRICITY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	85.0	72.0	69.8	70.0	71.4	71.7
TRANSPORTATION	4.3	5.5	5.4	4.8	4.2	3.7
HOUSEHOLD/SERVICE	10.7	22.5	24.7	25.3	24.4	24.6
MOTOR FUEL:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	52.3	47.1	46.7	50.1	53.3	56.8
TRANSPORTATION	47.7	52.9	53.3	49.9	46.7	43.2
COAL, SPEC.USES:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	99.4	99.5	99.7	99.8	99.9	100.0
TRANSPORTATION	.6	.5	.3	.2	.1	00.0
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	100.0	100.0	100.0	100.0	100.0	100.0
ALL FORMS (EXCL.NON-COMM.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	75.9	68.8	68.3	69.3	71.6	72.5
TRANSPORTATION	4.8	5.7	5.8	5.8	5.8	5.9
HOUSEHOLD/SERVICE	19.3	25.5	25.9	24.9	22.6	21.6
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	100.0	100.0	100.0	100.0	100.0	100.0

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 5 : ROMANIA /SCENARIO-3

USEFUL/SPECIFIC ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
THERMAL USES, MAN. (USEFUL)	23.178	13.584	13.378	14.285	17.521	19.241
STEAM GENERATION	12.940	7.557	7.442	7.946	9.748	10.708
FURNACE	8.451	4.953	4.878	5.209	6.385	7.006
SPACE HEATING	1.787	1.074	1.058	1.130	1.388	1.527
THERMAL USES, AGR/CONSTR/MIN. (FINAL)	2.622	2.169	2.152	2.362	2.860	3.084
SPECIFIC ELECTRICITY DEMAND (FINAL)	5.982	3.891	3.846	4.591	5.613	6.910
MOTOR FUEL (FINAL)	3.532	2.745	2.770	3.357	4.168	5.211
METALL.COKE (FINAL)	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS (FINAL)	10.377	10.377	10.377	10.377	10.377	10.377
TRANSPORTATION:						
STEAM COAL (FINAL):	.035	.028	.019	.011	.004	.000
FREIGHT	.035	.028	.019	.011	.004	.000
PASSENGER, INTERCITY	.000	.000	.000	.000	.000	.000
MOTOR FUEL (FINAL):	3.226	3.087	3.159	3.341	3.646	3.968
FREIGHT	1.849	1.616	1.647	1.788	2.018	2.256
PASSENGER, INTERCITY	1.011	1.089	1.079	1.082	1.103	1.090
PASSENGER, URBAN	.366	.382	.433	.471	.525	.622
MISCELLANEOUS	.000	.000	.000	.000	.000	.000
ELECTRICITY (FINAL):	.356	.344	.347	.358	.388	.414
FREIGHT	.228	.212	.206	.214	.230	.244
PASSENGER, INTERCITY	.105	.109	.115	.116	.127	.136
PASSENGER, URBAN	.022	.023	.026	.028	.031	.034
HOUSEHOLDS:						
USEFUL ENERGY:						
SPACE HEATING	4.908	4.984	5.071	5.142	5.177	5.179
WATER HEATING	1.695	2.068	2.256	2.411	2.546	2.650
COOKING	1.192	1.200	1.208	1.200	1.166	1.127
AIR CONDITIONING	.000	.000	.000	.002	.002	.004
SECONDARY ELECTR. APPLIANCES (FINAL)	.483	.880	.919	1.131	1.322	1.554
SERVICE SECTOR:						
USEFUL ENERGY:						
THERMAL USES	2.357	2.351	2.429	2.464	2.533	2.588
AIR CONDITIONING	.000	.000	.000	.006	.018	.032
SPECIFIC ELECTRICITY DEMAND (FINAL)	.349	.465	.535	.552	.602	.758

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 6 : ROMANIA /SCENARIO-3

DEMOGRAPHIC AND MACRO-ECONOMIC INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION (MILLION PEOPLE):	23.152	23.256	23.400	23.690	24.050	24.410
%IN CITIES	(51.1)	(53.0)	(54.2)	(56.4)	(58.0)	(59.5)
GDP/CAP. (10**3MU/CAP.)	1.970	1.346	1.329	1.566	1.909	2.343
PRIVATE CONSUMPTION/CAP. (10**3MU/CAP.)	.000	.000	.000	.000	.000	.000
GDP EXPENDITURE (%):						
GROSS FIXED CAPITAL FORMATION	00.0	00.0	00.0	00.0	00.0	00.0
EQUIPMENT	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
CONSTRUCTION	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
PRIVATE CONSUMPTION	00.0	00.0	00.0	00.0	00.0	00.0
DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
NON-DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
SERVICES	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
GDP FORMATION (10**9 MU):	45.600	31.300	31.100	37.100	45.900	57.200
AGRICULTURE	6.338	5.853	6.064	7.568	9.547	12.012
CONSTRUCTION	2.891	1.784	1.711	1.855	2.203	2.574
MINING	1.496	1.315	1.275	1.484	1.744	2.002
MANUFACTURING	19.914	11.957	11.818	14.098	17.442	21.736
ENERGY SECTOR	2.695	1.565	1.400	1.484	1.607	2.002
SERVICES (INCL.TRANSPORTATION)	12.266	8.827	8.832	10.611	13.357	16.874
GDP FORMATION (%):	100.0	100.0	100.0	100.0	100.0	100.0
AGRICULTURE	13.9	18.7	19.5	20.4	20.8	21.0
CONSTRUCTION	6.3	5.7	5.5	5.0	4.8	4.5
MINING	3.3	4.2	4.1	4.0	3.8	3.5
MANUFACTURING	43.7	38.2	38.0	38.0	38.0	38.0
ENERGY SECTOR	5.9	5.0	4.5	4.0	3.5	3.5
SERVICES (INCL.TRANSPORTATION)	26.9	28.2	28.4	28.6	29.1	29.5
VA, MANUFACTURING (10**9 MU):	19.914	11.957	11.818	14.098	17.442	21.736
BASIC MATERIALS	6.777	3.886	3.817	4.511	5.494	6.738
MACHINERY AND EQUIPMENT	6.520	3.766	3.746	4.511	5.581	6.956
FOOD & TEXTILES	6.074	3.862	3.817	4.554	5.721	7.238
MISCELLANEOUS	.544	.442	.437	.522	.645	.804
VA, MANUFACTURING (%):	100.0	100.0	100.0	100.0	100.0	100.0
BASIC MATERIALS	34.0	32.5	32.3	32.0	31.5	31.0
MACHINERY AND EQUIPMENT	32.7	31.5	31.7	32.0	32.0	32.0
FOOD & TEXTILES	30.5	32.3	32.3	32.3	32.8	33.3
MISCELLANEOUS	2.7	3.7	3.7	3.7	3.7	3.7

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7A: ROMANIA /SCENARIO-3

ENERGY INTENSITY ASSUMPTIONS IN AGR/CONSTR/MIN/MAN.:

YEAR:	1989	1992	1995	2000	2005	2010
AGRICULTURE:						
MOTOR FUEL (FINAL;KWH/MU)	2.176	2.176	2.176	2.241	2.241	2.328
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.658	.658	.658	.678	.678	.704
THERMAL (FINAL;KWH/MU)	1.160	1.044	1.044	1.010	1.010	.928
CONSTRUCTION:						
MOTOR FUEL (FINAL;KWH/MU)	2.288	2.288	2.288	2.220	2.220	2.128
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.523	.523	.523	.523	.523	.523
THERMAL (FINAL;KWH/MU)	.990	.990	.990	.891	.891	.792
MINING:						
MOTOR FUEL (FINAL;KWH/MU)	1.017	1.017	1.017	.987	.987	.946
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.682	3.682	3.682	3.682	3.682	3.682
THERMAL (FINAL;KWH/MU)	7.440	7.440	7.440	6.696	6.696	5.952
MANUF. OF BASIC MATERIALS:						
MOTOR FUEL (FINAL;KWH/MU)	.351	.351	.351	.340	.340	.326
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.811	3.811	3.811	3.811	3.811	3.811
THERMAL (USEFUL;KWH/MU)	20.179	20.179	20.179	18.161	18.161	16.143
MANUF. OF MACHINERY AND EQUIPMENT:						
MOTOR FUEL (FINAL;KWH/MU)	.213	.213	.213	.207	.207	.199
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.105	1.105	1.105	1.105	1.105	1.105
THERMAL (USEFUL;KWH/MU)	3.431	3.431	3.431	3.088	3.088	2.745
MANUF. OF FOOD & TEXTILES:						
MOTOR FUEL (FINAL;KWH/MU)	.427	.427	.427	.415	.415	.398
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.521	.521	.521	.521	.521	.521
THERMAL (USEFUL;KWH/MU)	4.449	4.449	4.449	4.004	4.004	3.559
MISCELLANEOUS MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.839	.839	.839	.814	.814	.781
ELECTR.,SPECIFIC (FINAL;KWH/MU)	2.403	2.403	2.403	2.403	2.403	2.403
THERMAL (USEFUL;KWH/MU)	4.638	4.638	4.638	4.175	4.175	3.711
ALL MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.343	.350	.350	.339	.340	.326
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.883	1.844	1.839	1.830	1.814	1.798
THERMAL (USEFUL;KWH/MU)	9.474	9.247	9.214	8.247	8.177	7.205
THERMAL (FINAL;KWH/MU)	11.942	11.657	11.615	10.221	9.885	8.572

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B: ROMANIA /SCENARIO-3

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
STEAM GENERATION:	12.940	7.557	7.442	7.946	9.748	10.708
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.720)	(.720)	(.730)	(.770)	(.810)	(.840)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	100.0	100.0	100.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
FURNACE, DIRECT HEAT:	8.451	4.953	4.878	5.209	6.385	7.006
%FOSSIL	87.3	87.3	87.3	87.0	86.0	85.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ELECTRICITY	12.7	12.7	12.7	13.0	14.0	15.0
SPACE AND WATER HEATING:	1.787	1.074	1.058	1.130	1.388	1.527
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.700)	(.710)	(.720)	(.750)	(.780)	(.820)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	99.9	99.5	99.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	.1	.5	1.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B (CONT'D): ROMANIA /SCENARIO-3

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
ALL THERMAL USES IN MANUFACTURING:	23.178	13.584	13.378	14.285	17.521	19.241
%FOSSIL	31.8	31.8	31.8	31.7	31.3	31.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	63.5	63.5	63.5	63.5	63.5	63.5
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	4.6	4.6	4.6	4.7	5.1	5.5
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
ON-SITE COGENERATION:						
HEAT	.000	.000	.000	.000	.000	.000
BY-PRODUCT ELECTRICITY	.000	.000	.000	.000	.000	.000
STEEL PROD. (10**6 TONS):	14.416	14.416	14.416	14.416	14.416	14.416
OF WHICH ELECTRIC (10**6 TONS):	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)
FEEDSTOCK REQU. (10**6 TOE):	7.264	7.264	7.264	7.264	7.264	7.264

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8A: ROMANIA /SCENARIO-3

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (10**9 TKM)	158.857	140.486	140.237	147.917	158.663	172.624
TRUCK	30.024	26.692	27.346	29.583	33.319	37.977
LOCAL	(24.199)	(21.514)	(22.041)	(23.903)	(27.089)	(30.876)
LONG-DISTANCE	(5.825)	(5.178)	(5.305)	(5.680)	(6.231)	(7.102)
TRAIN	81.176	71.648	68.015	68.042	71.398	74.228
STEAM	(.617)	(.502)	(.340)	(.204)	(.071)	(.000)
DIESEL	(48.088)	(41.054)	(37.748)	(36.538)	(37.056)	(37.114)
ELECTRIC	(32.470)	(30.092)	(29.927)	(31.299)	(34.271)	(37.114)
BARGE	41.001	36.245	39.266	44.375	47.599	53.513
PIPE	6.656	5.900	5.609	5.917	6.347	6.905
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (10**9 PKM)	68.345	69.303	70.785	72.491	76.960	82.994
CAR	5.904	6.411	7.059	8.086	9.470	11.229
BUS	23.072	22.767	22.878	22.864	23.622	24.759
TRAIN	35.528	36.289	36.961	37.484	39.482	42.342
STEAM	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DIESEL	(17.764)	(17.781)	(17.372)	(17.243)	(16.977)	16.937)
ELECTRIC	(17.764)	(18.507)	(19.589)	(20.241)	(22.505)	(25.405)
PLANE	3.840	3.836	3.887	4.058	4.387	4.665
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (10**9 PKM)	21.591	22.494	24.535	25.847	28.003	31.807
CAR	4.102	4.274	4.907	5.686	6.721	8.906
MOTOR FUEL	(4.102)	(4.274)	(4.907)	(5.686)	(6.721)	(8.906)
ELECTRIC	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
MASS TRANSIT	17.489	18.220	19.628	20.161	21.282	22.901
MOTOR FUEL	(10.493)	(10.932)	(11.580)	(11.492)	(11.705)	(12.138)
ELECTRIC	(6.995)	(7.288)	(8.047)	(8.669)	(9.577)	(10.764)

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8B: ROMANIA /SCENARIO-3

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
TRUCK	18.9	19.0	19.5	20.0	21.0	22.0
LOCAL	(80.6)	(80.6)	(80.6)	(80.8)	(81.3)	(81.3)
LONG-DISTANCE	(19.4)	(19.4)	(19.4)	(19.2)	(18.7)	(18.7)
TRAIN	51.1	51.0	48.5	46.0	45.0	43.0
STEAM	(.8)	(.7)	(.5)	(.3)	(.1)	(00.0)
DIESEL	(59.2)	(57.3)	(55.5)	(53.7)	(51.9)	(50.0)
ELECTRIC	(40.0)	(42.0)	(44.0)	(46.0)	(48.0)	(50.0)
BARGE	25.8	25.8	28.0	30.0	30.0	31.0
PIPE	4.2	4.2	4.0	4.0	4.0	4.0
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	8.6	9.3	10.0	11.2	12.3	13.5
BUS	33.8	32.9	32.3	31.5	30.7	29.8
TRAIN	52.0	52.4	52.2	51.7	51.3	51.0
STEAM	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
DIESEL	(50.0)	(49.0)	(47.0)	(46.0)	(43.0)	(40.0)
ELECTRIC	(50.0)	(51.0)	(53.0)	(54.0)	(57.0)	(60.0)
PLANE	5.6	5.5	5.5	5.6	5.7	5.6
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	19.0	19.0	20.0	22.0	24.0	28.0
MOTOR FUEL	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
ELECTRIC	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
MASS TRANSIT	81.0	81.0	80.0	78.0	76.0	72.0
MOTOR FUEL	(60.0)	(60.0)	(59.0)	(57.0)	(55.0)	(53.0)
ELECTRIC	(40.0)	(40.0)	(41.0)	(43.0)	(45.0)	(47.0)

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8C: ROMANIA /SCENARIO-3

ENERGY INTENSITY (AND LOAD FACTORS) ASSUMED:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION (KWH/TKM):						
TRUCK						
LOCAL	.233	.233	.256	.281	.309	.326
LONG-DISTANCE	.209	.209	.206	.200	.197	.193
TRAIN						
STEAM	.460	.460	.452	.447	.439	.430
DIESEL	.124	.124	.122	.121	.119	.116
ELECTRIC	.057	.057	.056	.056	.055	.053
BARGE	.047	.047	.046	.045	.045	.043
PIPE	.047	.047	.047	.047	.047	.047
PASSENGER TRANSPORTATION, INTERCITY (KWH/PKM):						
CAR	.264	.264	.257	.247	.231	.198
(P/CAR)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)
BUS	.086	.086	.082	.079	.075	.074
(P/BUS)	(40.000)	(40.000)	(40.000)	(39.000)	(37.500)	(35.500)
TRAIN						
(P/TRAIN)	(800.000)	(800.000)	(787.000)	(765.000)	(725.000)	(675.000)
STEAM	.387	.387	.385	.377	.371	.351
DIESEL	.105	.105	.104	.102	.100	.095
ELECTRIC	.048	.048	.048	.047	.046	.044
PLANE	.734	.872	.843	.799	.756	.690
(% OF SEATS OCCUPIED)	(.950)	(.800)	(.800)	(.800)	(.800)	(.800)
PASSENGER TRANSPORTATION, URBAN (KWH/PKM):						
CAR						
(P/CAR)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
MOTOR FUEL	.593	.593	.593	.568	.544	.494
ELECTRIC	.000	.000	.000	.000	.000	.000
MASS TRANSIT						
MOTOR FUEL	.052	.052	.053	.052	.053	.054
(P/BUS)	(90.000)	(90.000)	(87.000)	(84.000)	(79.000)	(75.000)
ELECTRIC	.026	.026	.026	.026	.026	.026
(P/TRAIN)	(135.000)	(135.000)	(135.000)	(134.000)	(131.000)	(128.000)

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9A: ROMANIA /SCENARIO-3

DWELLINGS AND SERVICE SECTOR BUILDINGS:

YEAR:	1989	1992	1995	2000	2005	2010
PERSONS/HOUSEHOLD	2.910	2.880	2.850	2.820	2.800	2.785
DWELLINGS (MILLION UNITS)	7.960	8.075	8.211	8.401	8.589	8.765
OF WHICH IN AREAS REQU. HEATING:	7.960	8.075	8.211	8.401	8.589	8.765
CONSTRUCTED BEFORE BASE YEAR	7.960	7.893	7.815	7.680	7.537	7.387
SINGLE FAMILY HOME/CENTRAL HEATING	(.300)	(.300)	(.297)	(.284)	(.271)	(.255)
APARTMENT/CENTRAL HEATING	(3.081)	(3.078)	(3.079)	(3.072)	(3.068)	(3.051)
ROOM HEATING	(4.579)	(4.515)	(4.439)	(4.324)	(4.198)	(4.081)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
CONSTRUCTED AFTER BASE YEAR	.000	.182	.395	.721	1.052	1.378
SINGLE FAMILY HOME/CENTRAL HEATING	(.000)	(.036)	(.079)	(.144)	(.210)	(.276)
APARTMENT/CENTRAL HEATING	(.000)	(.055)	(.119)	(.216)	(.316)	(.413)
ROOM HEATING	(.000)	(.091)	(.198)	(.361)	(.526)	(.689)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DWELLINGS REQUIRING HEATING(%):	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	97.7	95.2	91.4	87.7	84.3
SINGLE FAMILY HOME/CENTRAL HEATING	(3.8)	(3.8)	(3.8)	(3.7)	(3.6)	(3.4)
APARTMENT/CENTRAL HEATING	(38.7)	(39.0)	(39.4)	(40.0)	(40.7)	(41.3)
ROOM HEATING	(57.5)	(57.2)	(56.8)	(56.3)	(55.7)	(55.3)
NO HEATING	(.0)	(.0)	(.0)	(.0)	(.0)	(.0)
CONSTRUCTED AFTER BASE YEAR	00.0	2.3	4.8	8.6	12.3	15.7
SINGLE FAMILY HOME/CENTRAL HEATING	(00.0)	(20.0)	(20.0)	(20.0)	(20.0)	(20.0)
APARTMENT/CENTRAL HEATING	(00.0)	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)
ROOM HEATING	(00.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)
NO HEATING	(100.0)	(.0)	(.0)	(.0)	(.0)	(.0)
SERVICE SECTOR WORK FORCE (MILLION WORKERS)	2.208	2.192	2.261	2.326	2.429	2.525
SERVICE SECTOR BUILDINGS (MILLION SQM)	75.000	75.619	79.138	81.402	85.021	88.379
OF WHICH IN AREAS REQU. HEATING:	75.000	75.619	79.138	81.402	85.021	88.379
CONSTRUCTED BEFORE BASE YEAR	75.000	74.368	73.640	72.358	71.023	69.620
CONSTRUCTED AFTER BASE YEAR	.000	1.250	5.498	9.044	13.998	18.759
HEATED SERVICE SECTOR BUILDINGS (%)	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	98.3	93.1	88.9	83.5	78.8
CONSTRUCTED AFTER BASE YEAR	00.0	1.7	6.9	11.1	16.5	21.2

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9B: ROMANIA /SCENARIO-3

ENERGY INTENSITY ASSUMED FOR THE HOUSEHOLD SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:						
CONSTR.BEFORE BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.465	5860.465	5860.465	5801.860	5684.651	5567.442
APARTMENT/CENTRAL HEATING	5430.232	5430.232	5430.232	5375.930	5267.325	5158.721
ROOM HEATING	4686.046	4686.046	4686.046	4639.186	4545.465	4451.744
CONSTR.AFTER BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.380	5860.380	5813.581	5735.721	5886.251	5950.270
APARTMENT/CENTRAL HEATING	5426.106	5426.106	5377.563	5323.925	5374.535	5232.223
ROOM HEATING	4685.746	4685.746	4650.865	4588.576	4602.418	4390.465
SIZE OF DWELLINGS CONSTR.AFTER BASE YEAR (SQM):						
SINGLE FAMILY/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(36.000)	(38.000)
APARTMENT/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.500)	(36.000)
ROOM HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.000)	(35.000)
HEATING DEGREE-DAYS:	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)
WATER HEATING (USEFUL;KWH/DW/YR):	2311.081	2779.535	2982.558	3115.116	3093.023	3076.453
(% OF DWELLINGS WITH HOT WATER)	(75.0)	(75.0)	(75.0)	(75.0)	(78.0)	(80.0)
COOKING (USEFUL;KWH/DW/YR):	1218.605	1209.302	1197.674	1162.791	1104.651	1046.512
AIR CONDITIONING (USEFUL;KWH/DW/YR):	302.326	302.326	302.326	302.326	302.326	302.326
(% OF DWELLINGS WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(.5)	(.7)	(1.3)
SECONDARY ELECTR. APPL. (KWH/DW/YR):	513.460	923.000	948.000	1140.000	1290.000	1480.000

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9C: ROMANIA /SCENARIO-3

THERMAL ENERGY DEMAND (USEFUL) BY THE HOUSEHOLD SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:	4.908	4.984	5.071	5.142	5.177	5.179
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	45.0	43.4	41.7	39.0	37.1	35.3
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, CONVENTIONAL	.6	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
WATER HEATING:	1.695	2.068	2.256	2.411	2.546	2.650
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	44.7	43.0	41.2	37.3	34.7	32.2
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	.1	.1	.1	.1	.1
%ELECTRICITY, CONVENTIONAL	.9	.9	1.5	3.0	4.0	5.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
COOKING:	1.192	1.200	1.208	1.200	1.166	1.127
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	96.0	96.1	95.4	93.2	91.2	86.2
(EFFICIENCY)	(.500)	(.500)	(.550)	(.600)	(.700)	(.700)
%ELECTRICITY	.1	.2	1.0	3.0	5.0	10.0
AIR CONDITIONING:	.000	.000	.000	.002	.002	.004
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Table C.3 Low Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9D: ROMANIA /SCENARIO-3

YEAR:	1989	1992	1995	2000	2005	2010
ENERGY INTENSITY ASSUMED FOR THE SERVICE SECTOR:						
SPACE AND WATER HEATING (USEFUL;KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	255.814	253.256	250.698	248.140	245.581	243.023
BUILDINGS CONSTR.AFTER BASE YEAR	.000	244.186	238.372	232.558	226.744	220.930
(% OF FLOOR AREA HEATED)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
AIR CONDITIONING:						
SPEC. CONS. (USEFUL;KWH/SQM/YR)	58.140	58.140	58.140	58.140	58.140	58.140
(% OF FLOOR AREA WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(1.0)	(3.0)	(5.0)
SPECIFIC USE OF ELECTRICITY (KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	37.920	50.000	55.000	55.000	57.000	69.000
BUILDINGS CONSTR.AFTER BASE YEAR	.000	50.000	55.000	57.000	61.000	73.000
THERMAL ENERGY DEMAND (USEFUL) BY THE SERVICE SECTOR (MTCE); PENETRATION OF COMPETING ENERGY SOURCES; AND EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):						
SPACE AND WATER HEATING:	2.357	2.351	2.429	2.464	2.533	2.588
%FOSSIL	49.1	47.1	45.2	42.8	40.9	39.1
(EFFICIENCY)	(.600)	(.600)	(.600)	(.650)	(.700)	(.700)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	.4	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
AIR CONDITIONING:	.000	.000	.000	.006	.018	.032
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Table C.4 High Scenario: Module 1 - Output Tables

SUMMARY OF INPUTS (SCENARIO VARIABLES) INTO MAED/TABLE 1A: ROMANIA /SCENARIO-1

PRINCIPAL VARIABLES CHANGED FROM ONE SCENARIO TO ANOTHER
VALUES AS FRACTIONS EXCEPT WHEN INDICATED OTHERWISE

YEAR:	1989	1992	1995	2000	2005	2010
VARIABLES RELATED TO THE INDUSTRIAL SECTOR:						
RATIO OF ELECTRICITY INTENSITY VS BASE YEAR IN:						
- AGRICULTURE	1.000	1.000	1.000	1.050	1.100	1.150
- CONSTRUCTION	1.000	1.000	1.000	1.040	1.070	1.100
- MINING	1.000	1.000	1.000	1.040	1.070	1.100
- MANUFACTURING	1.000	1.000	1.000	1.040	1.070	1.100
SHARE OF USEFUL THERMAL ENERGY WHICH IS SUPPLIED BY ELECTRICITY IN MANUFACTURING FOR PROCESS:						
- FURNACE/DIRECT HEAT	.127	.127	.127	.130	.140	.150
- SPACE/WATER HEATING	.000	.000	.000	.001	.005	.010
CONTRIBUTION OF ELECTRIC HEAT PUMPS TO LOW-TEMPERATURE HEAT PRODUCTION:	.000	.000	.000	.000	.000	.000
SHARE OF MANUFACTURING DEMAND FOR L.T. STEAM AND HOT WATER WHICH IS SUPPLIED BY SOLAR:	.000	.000	.000	.000	.010	.020
COKE INPUT IN BLAST FURNACES PER UNIT OUTPUT OF PIG IRON (KG COKE/TON PIG IRON)	627.000	627.000	627.000	627.000	627.000	627.000
VARIABLES RELATED TO THE TRANSPORTATION SECTOR:						
SHARE OF ELECTRIC TRAINS IN:						
- TOTAL FREIGHT TRANSPORTATION BY RAIL	.400	.420	.440	.460	.480	.500
- TOTAL INTERCITY TRAVEL BY TRAIN	.500	.510	.530	.540	.570	.600
SHARE OF ELECTRIC MASS TRANSIT IN TOTAL INTRACITY MASS TRANSPORTATION:	.400	.400	.410	.430	.450	.470
VARIABLES RELATED TO HOUSEHOLD/SERVICE SECTOR:						
SPECIFIC ELECTRICITY CONSUMPTION IN:						
- DWELLINGS FOR USES OTHER THAN SPACE/WATER HEATING, COOKING AND A.C. (KWH/YR/DW)	513.460	923.000	1006.000	1339.000	1604.000	1944.000
- OLD-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	37.920	50.000	59.600	64.700	71.500	90.800
- NEW-SERVICE SECTOR BUILDINGS (KWH/YR/SQM)	.000	50.000	61.200	70.100	74.800	96.500
ELECTRICITY PENETRATION INTO THERMAL USES FOR:						
- SPACE HEATING HOUSEHOLDS	.006	.006	.011	.014	.017	.020
- WATER HEATING HOUSEHOLDS	.009	.009	.015	.030	.040	.050
- COOKING HOUSEHOLDS	.001	.002	.010	.030	.050	.100
- THERMAL USES SERVICE SECTOR	.004	.006	.011	.014	.017	.020
CONTRIBUTION OF HEAT PUMPS TO ELECTRIC SPACE AND WATER HEATING	.000	.000	.000	.000	.000	.000
COEFFICIENT OF LOSSES OF ELECTRIC NETWORK:	1.061	1.091	1.091	1.091	1.091	1.091

SUMMARY OF RESULTS OF MAED/TABLE 1B: ROMANIA /SCENARIO-1

BASIC INPUT INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION:						
TOTAL (MILLION PEOPLE)	23.152	23.256	23.400	23.690	24.050	24.410
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	.150	.178	.209	.238	.252
G.D.P.:						
TOTAL (10**9 MONETARY UNITS OF BASE YEAR)	45.600	31.300	33.000	43.700	57.300	75.000
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-11.788	-5.247	-.386	1.438	2.398
PER CAPITA (10**3 MU/CAP)	1.970	1.346	1.410	1.845	2.383	3.073
FINAL ENERGY RESULTS:						
COMMERCIAL ENERGY:						
TOTAL (GWYR)	70.260	56.709	58.304	63.107	69.137	78.396
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-6.894	-3.061	-.971	-.101	.523
PER CAPITA (KWYR/CAP)	3.035	2.438	2.492	2.664	2.875	3.212
ELECTRICITY DEMAND:						
TOTAL (GWYR)	7.708	5.827	6.292	8.300	10.720	13.992
(TWHR)	67.524	51.044	55.117	72.707	93.910	122.569
AVERAGE ANNUAL GROWTH RATE VERSUS BASE YEAR (%)	.000	-8.905	-3.327	.675	2.083	2.880
PER CAPITA (KWYR/CAP)	.333	.251	.269	.350	.446	.573
(KWHR/CAP)	2916.571	2194.856	2355.408	3069.100	3904.795	5021.260
RATIO OF ELECTRICITY TO ENERGY	.110	.103	.108	.132	.155	.178

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 2 : ROMANIA /SCENARIO-1

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	57.432	42.008	43.276	47.979	53.915	62.782
TRANSPORTATION	3.616	3.459	3.557	3.822	4.239	4.702
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	14.572	15.568	15.919	16.120	16.256	16.893
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	62.752	67.922	74.411	84.377
BY ENERGY FORM:						
FOSSIL (SUBST.)	25.206	19.273	19.500	19.796	20.206	21.855
CENTRALIZED HEAT SUPPLY	19.246	13.551	14.255	15.689	17.467	20.154
SOFT SOLAR	.000	.001	.001	.001	.002	.003
ELECTRICITY	8.296	6.271	6.772	8.933	11.538	15.059
MOTOR FUEL	6.758	5.832	6.125	7.411	9.115	11.226
COAL, SPEC.USES	5.737	5.730	5.721	5.714	5.706	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL COMMERCIAL (INCL.FEEDST.)	75.620	61.035	62.752	67.922	74.411	84.377
NON-COMMERCIAL FUELS	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMMERCIAL+NON-COMMERCIAL)	78.170	63.585	65.302	70.472	76.833	86.672
FINAL ENERGY RESULTS (%):						
BY SECTOR:						
AGR/CONSTR/MIN/MAN.(INCL.FEEDST.)	75.9	68.8	69.0	70.6	72.5	74.4
TRANSPORTATION	4.8	5.7	5.7	5.6	5.7	5.6
HOUSEHOLD/SERVICE (EXCL.NON-COMM.)	19.3	25.5	25.4	23.7	21.8	20.0
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
BY ENERGY FORM:						
FOSSIL (SUBST.)	33.3	31.6	31.1	29.1	27.2	25.9
CENTRALIZED HEAT SUPPLY	25.5	22.2	22.7	23.1	23.5	23.9
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	11.0	10.3	10.8	13.2	15.5	17.8
MOTOR FUEL	8.9	9.6	9.8	10.9	12.2	13.3
COAL, SPEC.USES	7.6	9.4	9.1	8.4	7.7	6.8
FEEDSTOCKS	13.7	17.0	16.5	15.3	13.9	12.3
TOTAL COMMERCIAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL FUELS	3.4	4.2	4.1	3.8	3.3	2.7
TOTAL (COMMERCIAL+NON-COMMERCIAL)	103.4	104.2	104.1	103.8	103.3	102.7

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 3A: ROMANIA /SCENARIO-1

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	16.042	10.034	10.502	11.470	12.538	14.559
CENTRALIZED HEAT SUPPLY	14.727	8.632	9.020	10.095	11.578	14.018
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	7.052	4.518	4.737	6.363	8.432	11.156
MOTOR FUEL	3.532	2.745	2.939	3.971	5.288	6.970
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	57.432	42.008	43.276	47.979	53.915	62.782
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	13.419	7.865	8.219	8.844	9.520	11.020
CENTRALIZED HEAT SUPPLY	14.727	8.632	9.020	10.095	11.578	14.018
SOFT SOLAR	.000	.000	.000	.000	.000	.001
ELECTRICITY	5.677	3.336	3.488	4.638	6.129	8.147
MOTOR FUEL	.838	.515	.539	.678	.843	1.043
METALL.COKE	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS	10.377	10.377	10.377	10.377	10.377	10.377
TOTAL (INCL.FEEDST.)	50.741	36.425	37.345	40.335	44.150	50.308
TRANSPORTATION:						
ELECTRICITY	.356	.344	.351	.370	.408	.445
MOTOR FUEL	3.226	3.087	3.187	3.441	3.827	4.257
STEAM COAL	.035	.028	.019	.012	.004	.000
TOTAL	3.616	3.459	3.557	3.822	4.239	4.702
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	9.165	9.239	8.998	8.326	7.668	7.296
CENTRALIZED HEAT SUPPLY	4.519	4.919	5.235	5.593	5.889	6.136
SOFT SOLAR	.000	.001	.001	.001	.002	.002
ELECTRICITY	.888	1.409	1.684	2.200	2.698	3.458
TOTAL COMMERCIAL	14.572	15.568	15.919	16.120	16.256	16.893
NON-COMMERCIAL	2.550	2.550	2.550	2.550	2.422	2.295
TOTAL (COMM.+NON-COMM.)	17.122	18.118	18.469	18.670	18.679	19.188

DETAILED RESULTS OF MAED/TABLE 3B: ROMANIA /SCENARIO-1

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
FOSSIL (SUBST.)	27.9	23.9	24.3	23.9	23.3	23.2
CENTRALIZED HEAT SUPPLY	25.6	20.5	20.8	21.0	21.5	22.3
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	12.3	10.8	10.9	13.3	15.6	17.8
MOTOR FUEL	6.1	6.5	6.8	8.3	9.8	11.1
METALL.COKE	9.9	13.6	13.2	11.9	10.6	9.1
FEEDSTOCKS	18.1	24.7	24.0	21.6	19.2	16.5
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
OF WHICH MANUFACTURING:						
FOSSIL (SUBST.)	26.4	21.6	22.0	21.9	21.6	21.9
CENTRALIZED HEAT SUPPLY	29.0	23.7	24.2	25.0	26.2	27.9
SOFT SOLAR	00.0	00.0	00.0	00.0	.0	.0
ELECTRICITY	11.2	9.2	9.3	11.5	13.9	16.2
MOTOR FUEL	1.7	1.4	1.4	1.7	1.9	2.1
METALL.COKE	11.2	15.7	15.3	14.1	12.9	11.3
FEEDSTOCKS	20.5	28.5	27.8	25.7	23.5	20.6
TOTAL (INCL.FEEDST.)	100.0	100.0	100.0	100.0	100.0	100.0
TRANSPORTATION:						
ELECTRICITY	9.8	10.0	9.9	9.7	9.6	9.5
MOTOR FUEL	89.2	89.2	89.6	90.0	90.3	90.5
STEAM COAL	1.0	.8	.5	.3	.1	00.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
HOUSEHOLD/SERVICE:						
FOSSIL (SUBST.)	62.9	59.3	56.5	51.6	47.2	43.2
CENTRALIZED HEAT SUPPLY	31.0	31.6	32.9	34.7	36.2	36.3
SOFT SOLAR	00.0	.0	.0	.0	.0	.0
ELECTRICITY	6.1	9.1	10.6	13.6	16.6	20.5
TOTAL COMMERCIAL	100.0	100.0	100.0	100.0	100.0	100.0
NON-COMMERCIAL	17.5	16.4	16.0	15.8	14.9	13.6
TOTAL (COMM.+NON-COMM.)	117.5	116.4	116.0	115.8	114.9	113.6

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 4A: ROMANIA /SCENARIO-1

FINAL ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	25.206	19.273	19.500	19.796	20.206	21.855
AGR/CONSTR/MIN/MAN.	16.042	10.034	10.502	11.470	12.538	14.559
HOUSEHOLD/SERVICE	9.165	9.239	8.998	8.326	7.668	7.296
CENTRALIZED HEAT SUPPLY:	19.246	13.551	14.255	15.689	17.467	20.154
AGR/CONSTR/MIN/MAN.	14.727	8.632	9.020	10.095	11.578	14.018
HOUSEHOLD/SERVICE	4.519	4.919	5.235	5.593	5.889	6.136
SOFT SOLAR:	.000	.001	.001	.001	.002	.003
AGR/CONSTR/MIN/MAN.	.000	.000	.000	.000	.000	.001
HOUSEHOLD/SERVICE	.000	.001	.001	.001	.002	.002
ELECTRICITY:	8.296	6.271	6.772	8.933	11.538	15.059
AGR/CONSTR/MIN/MAN.	7.052	4.518	4.737	6.363	8.432	11.156
TRANSPORTATION	.356	.344	.351	.370	.408	.445
HOUSEHOLD/SERVICE	.888	1.409	1.684	2.200	2.698	3.458
MOTOR FUEL:	6.758	5.832	6.125	7.411	9.115	11.226
AGR/CONSTR/MIN/MAN.	3.532	2.745	2.939	3.971	5.288	6.970
TRANSPORTATION	3.226	3.087	3.187	3.441	3.827	4.257
COAL, SPEC.USES:	5.737	5.730	5.721	5.714	5.706	5.702
AGR/CONSTR/MIN/MAN.	5.702	5.702	5.702	5.702	5.702	5.702
TRANSPORTATION	.035	.028	.019	.012	.004	.000
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	10.377	10.377	10.377	10.377	10.377	10.377
ALL FORMS (EXCL.NON-COMM.):	75.620	61.035	62.752	67.922	74.411	84.377
AGR/CONSTR/MIN/MAN.	57.432	42.008	43.276	47.979	53.915	62.782
TRANSPORTATION	3.616	3.459	3.557	3.822	4.239	4.702
HOUSEHOLD/SERVICE	14.572	15.568	15.919	16.120	16.256	16.893
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	2.550	2.550	2.550	2.550	2.422	2.295

DETAILED RESULTS OF MAED/TABLE 4B: ROMANIA /SCENARIO-1

FINAL ENERGY RESULTS (%):	1989	1992	1995	2000	2005	2010
FOSSIL (SUBST.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	63.6	52.1	53.9	57.9	62.1	66.6
HOUSEHOLD/SERVICE	36.4	47.9	46.1	42.1	37.9	33.4
CENTRALIZED HEAT SUPPLY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	76.5	63.7	63.3	64.3	66.3	69.6
HOUSEHOLD/SERVICE	23.5	36.3	36.7	35.7	33.7	30.4
SOFT SOLAR:	00.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	00.0	00.0	00.0	00.0	13.9	24.6
HOUSEHOLD/SERVICE	00.0	100.0	100.0	100.0	86.1	75.4
ELECTRICITY:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	85.0	72.0	69.9	71.2	73.1	74.1
TRANSPORTATION	4.3	5.5	5.2	4.1	3.5	3.0
HOUSEHOLD/SERVICE	10.7	22.5	24.9	24.6	23.4	23.0
MOTOR FUEL:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	52.3	47.1	48.0	53.6	58.0	62.1
TRANSPORTATION	47.7	52.9	52.0	46.4	42.0	37.9
COAL, SPEC.USES:	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	99.4	99.5	99.7	99.8	99.9	100.0
TRANSPORTATION	.6	.5	.3	.2	.1	00.0
FEEDSTOCKS:						
AGR/CONSTR/MIN/MAN.	100.0	100.0	100.0	100.0	100.0	100.0
ALL FORMS (EXCL.NON-COMM.):	100.0	100.0	100.0	100.0	100.0	100.0
AGR/CONSTR/MIN/MAN.	75.9	68.8	69.0	70.6	72.5	74.4
TRANSPORTATION	4.8	5.7	5.7	5.6	5.7	5.6
HOUSEHOLD/SERVICE	19.3	25.5	25.4	23.7	21.8	20.0
NON-COMMERCIAL FUELS:						
HOUSEHOLDS	100.0	100.0	100.0	100.0	100.0	100.0

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

DETAILED RESULTS OF MAED/TABLE 5 : ROMANIA /SCENARIO-1

USEFUL/SPECIFIC ENERGY RESULTS (MTCE):	1989	1992	1995	2000	2005	2010
AGR/CONSTR/MIN/MAN.:						
THERMAL USES, MAN. (USEFUL)	23.178	13.584	14.195	15.891	18.228	22.075
STEAM GENERATION	12.940	7.557	7.897	8.839	10.141	12.285
FURNACE	8.451	4.953	5.176	5.794	6.642	8.038
SPACE HEATING	1.787	1.074	1.123	1.258	1.444	1.751
THERMAL USES, AGR/CONSTR/MIN. (FINAL)	2.622	2.169	2.283	2.626	3.018	3.539
SPECIFIC ELECTRICITY DEMAND (FINAL)	5.982	3.891	4.081	5.609	7.495	9.932
MOTOR FUEL (FINAL)	3.532	2.745	2.939	3.971	5.288	6.970
METALL.COKE (FINAL)	5.702	5.702	5.702	5.702	5.702	5.702
FEEDSTOCKS (FINAL)	10.377	10.377	10.377	10.377	10.377	10.377
TRANSPORTATION:						
STEAM COAL (FINAL):	.035	.028	.019	.012	.004	.000
FREIGHT	.035	.028	.019	.012	.004	.000
PASSENGER, INTERCITY	.000	.000	.000	.000	.000	.000
MOTOR FUEL (FINAL):	3.226	3.087	3.187	3.441	3.827	4.257
FREIGHT	1.849	1.616	1.674	1.888	2.198	2.545
PASSENGER, INTERCITY	1.011	1.089	1.079	1.082	1.103	1.090
PASSENGER, URBAN	.366	.382	.433	.471	.525	.622
MISCELLANEOUS	.000	.000	.000	.000	.000	.000
ELECTRICITY (FINAL):	.356	.344	.351	.370	.408	.445
FREIGHT	.228	.212	.210	.226	.250	.275
PASSENGER, INTERCITY	.105	.109	.115	.116	.127	.136
PASSENGER, URBAN	.022	.023	.026	.028	.031	.034
HOUSEHOLDS:						
USEFUL ENERGY:						
SPACE HEATING	4.908	4.984	5.071	5.142	5.177	5.179
WATER HEATING	1.695	2.068	2.256	2.411	2.546	2.650
COOKING	1.192	1.200	1.208	1.200	1.166	1.127
AIR CONDITIONING	.000	.000	.000	.002	.002	.004
SECONDARY ELECTR. APPLIANCES (FINAL)	.483	.880	.975	1.328	1.644	2.041
SERVICE SECTOR:						
USEFUL ENERGY:						
THERMAL USES	2.357	2.351	2.429	2.464	2.533	2.588
AIR CONDITIONING	.000	.000	.000	.006	.018	.032
SPECIFIC ELECTRICITY DEMAND (FINAL)	.349	.465	.581	.653	.753	.999

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 6 : ROMANIA /SCENARIO-1

DEMOGRAPHIC AND MACRO-ECONOMIC INFORMATION:	1989	1992	1995	2000	2005	2010
POPULATION (MILLION PEOPLE):	23.152	23.256	23.400	23.690	24.050	24.410
%IN CITIES	(51.1)	(53.0)	(54.2)	(56.4)	(58.0)	(59.5)
GDP/CAP. (10**3MU/CAP.)	1.970	1.346	1.410	1.845	2.383	3.073
PRIVATE CONSUMPTION/CAP. (10**3MU/CAP.)	.000	.000	.000	.000	.000	.000
GDP EXPENDITURE (%):						
GROSS FIXED CAPITAL FORMATION	00.0	00.0	00.0	00.0	00.0	00.0
EQUIPMENT	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
CONSTRUCTION	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
PRIVATE CONSUMPTION	00.0	00.0	00.0	00.0	00.0	00.0
DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
NON-DURABLE GOODS	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
SERVICES	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
GDP FORMATION (10**9 MU):	45.600	31.300	33.000	43.700	57.300	75.000
AGRICULTURE	6.338	5.853	6.435	8.915	11.918	15.750
CONSTRUCTION	2.891	1.784	1.815	2.185	2.750	3.375
MINING	1.496	1.315	1.353	1.748	2.177	2.625
MANUFACTURING	19.914	11.957	12.540	16.606	21.774	28.500
ENERGY SECTOR	2.695	1.565	1.485	1.748	2.006	2.625
SERVICES (INCL.TRANSPORTATION)	12.266	8.827	9.372	12.498	16.674	22.125
GDP FORMATION (%):	100.0	100.0	100.0	100.0	100.0	100.0
AGRICULTURE	13.9	18.7	19.5	20.4	20.8	21.0
CONSTRUCTION	6.3	5.7	5.5	5.0	4.8	4.5
MINING	3.3	4.2	4.1	4.0	3.8	3.5
MANUFACTURING	43.7	38.2	38.0	38.0	38.0	38.0
ENERGY SECTOR	5.9	5.0	4.5	4.0	3.5	3.5
SERVICES (INCL.TRANSPORTATION)	26.9	28.2	28.4	28.6	29.1	29.5
VA, MANUFACTURING (10**9 MU):	19.914	11.957	12.540	16.606	21.774	28.500
BASIC MATERIALS	6.777	3.886	4.050	5.314	6.859	8.835
MACHINERY AND EQUIPMENT	6.520	3.766	3.975	5.314	6.968	9.120
FOOD & TEXTILES	6.074	3.862	4.050	5.364	7.142	9.491
MISCELLANEOUS	.544	.442	.464	.614	.806	1.054
VA, MANUFACTURING (%):	100.0	100.0	100.0	100.0	100.0	100.0
BASIC MATERIALS	34.0	32.5	32.3	32.0	31.5	31.0
MACHINERY AND EQUIPMENT	32.7	31.5	31.7	32.0	32.0	32.0
FOOD & TEXTILES	30.5	32.3	32.3	32.3	32.8	33.3
MISCELLANEOUS	2.7	3.7	3.7	3.7	3.7	3.7

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7A: ROMANIA /SCENARIO-1

ENERGY INTENSITY ASSUMPTIONS IN AGR/CONSTR/MIN/MAN.:

YEAR:	1989	1992	1995	2000	2005	2010
AGRICULTURE:						
MOTOR FUEL (FINAL;KWH/MU)	2.176	2.176	2.176	2.284	2.393	2.502
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.658	.658	.658	.691	.724	.757
THERMAL (FINAL;KWH/MU)	1.160	1.044	1.044	.952	.870	.812
CONSTRUCTION:						
MOTOR FUEL (FINAL;KWH/MU)	2.288	2.288	2.288	2.174	2.060	1.945
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.523	.523	.523	.544	.560	.575
THERMAL (FINAL;KWH/MU)	.990	.990	.990	.841	.742	.693
MINING:						
MOTOR FUEL (FINAL;KWH/MU)	1.017	1.017	1.017	.967	.916	.865
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.682	3.682	3.682	3.829	3.940	4.050
THERMAL (FINAL;KWH/MU)	7.440	7.440	7.440	6.324	5.580	5.208
MANUF. OF BASIC MATERIALS:						
MOTOR FUEL (FINAL;KWH/MU)	.351	.351	.351	.333	.316	.298
ELECTR.,SPECIFIC (FINAL;KWH/MU)	3.811	3.811	3.811	3.963	4.078	4.192
THERMAL (USEFUL;KWH/MU)	20.179	20.179	20.179	17.152	15.134	14.125
MANUF. OF MACHINERY AND EQUIPMENT:						
MOTOR FUEL (FINAL;KWH/MU)	.213	.213	.213	.203	.192	.181
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.105	1.105	1.105	1.150	1.183	1.216
THERMAL (USEFUL;KWH/MU)	3.431	3.431	3.431	2.916	2.573	2.402
MANUF. OF FOOD & TEXTILES:						
MOTOR FUEL (FINAL;KWH/MU)	.427	.427	.427	.406	.385	.363
ELECTR.,SPECIFIC (FINAL;KWH/MU)	.521	.521	.521	.542	.558	.573
THERMAL (USEFUL;KWH/MU)	4.449	4.449	4.449	3.781	3.336	3.114
MISCELLANEOUS MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.839	.839	.839	.797	.755	.714
ELECTR.,SPECIFIC (FINAL;KWH/MU)	2.403	2.403	2.403	2.499	2.572	2.644
THERMAL (USEFUL;KWH/MU)	4.638	4.638	4.638	3.943	3.479	3.247
ALL MANUFACTURING:						
MOTOR FUEL (FINAL;KWH/MU)	.343	.350	.350	.332	.315	.298
ELECTR.,SPECIFIC (FINAL;KWH/MU)	1.883	1.844	1.839	1.904	1.941	1.977
THERMAL (USEFUL;KWH/MU)	9.474	9.247	9.214	7.789	6.814	6.305
THERMAL (FINAL;KWH/MU)	11.942	11.657	11.615	9.653	8.237	7.501

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B: ROMANIA /SCENARIO-1

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
STEAM GENERATION:	12.940	7.557	7.897	8.839	10.141	12.285
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.720)	(.720)	(.730)	(.770)	(.810)	(.840)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	100.0	100.0	100.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
FURNACE, DIRECT HEAT:	8.451	4.953	5.176	5.794	6.642	8.038
%FOSSIL	87.3	87.3	87.3	87.0	86.0	85.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ELECTRICITY	12.7	12.7	12.7	13.0	14.0	15.0
SPACE AND WATER HEATING:	1.787	1.074	1.123	1.258	1.444	1.751
%FOSSIL	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.700)	(.710)	(.720)	(.750)	(.780)	(.820)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	100.0	100.0	100.0	99.9	99.5	99.0
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	00.0	00.0	00.0	.1	.5	1.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 7B (CONT'D): ROMANIA /SCENARIO-1

THERMAL ENERGY DEMAND (USEFUL) BY THE MANUFACTURING SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
ALL THERMAL USES IN MANUFACTURING:	23.178	13.584	14.195	15.891	18.228	22.075
%FOSSIL	31.8	31.8	31.8	31.7	31.3	31.0
(EFFICIENCY)	(.550)	(.550)	(.550)	(.570)	(.600)	(.620)
%ON-SITE COGENERATION	00.0	00.0	00.0	00.0	00.0	00.0
(EFFICIENCY)	(.670)	(.670)	(.680)	(.700)	(.710)	(.720)
%DISTRICT HEAT	63.5	63.5	63.5	63.5	63.5	63.5
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	4.6	4.6	4.6	4.7	5.1	5.5
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.0000
ON-SITE COGENERATION:						
HEAT	.000	.000	.000	.000	.000	.000
BY-PRODUCT ELECTRICITY	.000	.000	.000	.000	.000	.000
STEEL PROD. (10**6 TONS):	14.416	14.416	14.416	14.416	14.416	14.416
OF WHICH ELECTRIC (10**6 TONS):	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)	(3.460)
FEEDSTOCK REQU. (10**6 TOE):	7.264	7.264	7.264	7.264	7.264	7.264

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8A: ROMANIA /SCENARIO-1

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (10**9 TKM)	158.857	140.486	142.603	156.171	172.856	194.751
TRUCK	30.024	26.692	27.808	31.234	36.300	42.845
LOCAL	(24.199)	(21.514)	(22.413)	(25.237)	(29.512)	(34.833)
LONG-DISTANCE	(5.825)	(5.178)	(5.395)	(5.997)	(6.788)	(8.012)
TRAIN	81.176	71.648	69.162	71.839	77.785	83.743
STEAM	(.617)	(.502)	(.346)	(.216)	(.078)	(.000)
DIESEL	(48.088)	(41.054)	(38.385)	(38.577)	(40.371)	(41.872)
ELECTRIC	(32.470)	(30.092)	(30.431)	(33.046)	(37.337)	(41.872)
BARGE	41.001	36.245	39.929	46.851	51.857	60.373
PIPE	6.656	5.900	5.704	6.247	6.914	7.790
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (10**9 PKM)	68.345	69.303	70.785	72.491	76.960	82.994
CAR	5.904	6.411	7.059	8.086	9.470	11.229
BUS	23.072	22.767	22.878	22.864	23.622	24.759
TRAIN	35.528	36.289	36.961	37.484	39.482	42.342
STEAM	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DIESEL	(17.764)	(17.781)	(17.372)	(17.243)	(16.977)	(16.937)
ELECTRIC	(17.764)	(18.507)	(19.589)	(20.241)	(22.505)	(25.405)
PLANE	3.840	3.836	3.887	4.058	4.387	4.665
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (10**9 PKM)	21.591	22.494	24.535	25.847	28.003	31.807
CAR	4.102	4.274	4.907	5.686	6.721	8.906
MOTOR FUEL	(4.102)	(4.274)	(4.907)	(5.686)	(6.721)	(8.906)
ELECTRIC	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
MASS TRANSIT	17.489	18.220	19.628	20.161	21.282	22.901
MOTOR FUEL	(10.493)	(10.932)	(11.580)	(11.492)	(11.705)	(12.138)
ELECTRIC	(6.995)	(7.288)	(8.047)	(8.669)	(9.577)	(10.764)

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8B: ROMANIA /SCENARIO-1

ACTIVITY LEVELS ASSUMED FOR THE TRANSPORTATION SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
TRUCK	18.9	19.0	19.5	20.0	21.0	22.0
LOCAL	(80.6)	(80.6)	(80.6)	(80.8)	(81.3)	(81.3)
LONG-DISTANCE	(19.4)	(19.4)	(19.4)	(19.2)	(18.7)	(18.7)
TRAIN	51.1	51.0	48.5	46.0	45.0	43.0
STEAM	(.8)	(.7)	(.5)	(.3)	(.1)	(00.0)
DIESEL	(59.2)	(57.3)	(55.5)	(53.7)	(51.9)	(50.0)
ELECTRIC	(40.0)	(42.0)	(44.0)	(46.0)	(48.0)	(50.0)
BARGE	25.8	25.8	28.0	30.0	30.0	31.0
PIPE	4.2	4.2	4.0	4.0	4.0	4.0
PASSENGER TRANSPORTATION, INTERCITY:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	8.6	9.3	10.0	11.2	12.3	13.5
BUS	33.8	32.9	32.3	31.5	30.7	29.8
TRAIN	52.0	52.4	52.2	51.7	51.3	51.0
STEAM	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
DIESEL	(50.0)	(49.0)	(47.0)	(46.0)	(43.0)	(40.0)
ELECTRIC	(50.0)	(51.0)	(53.0)	(54.0)	(57.0)	(60.0)
PLANE	5.6	5.5	5.5	5.6	5.7	5.6
PASSENGER TRANSPORTATION, URBAN:						
TOTAL ACTIVITY (%)	100.0	100.0	100.0	100.0	100.0	100.0
CAR	19.0	19.0	20.0	22.0	24.0	28.0
MOTOR FUEL	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
ELECTRIC	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)	(00.0)
MASS TRANSIT	81.0	81.0	80.0	78.0	76.0	72.0
MOTOR FUEL	(60.0)	(60.0)	(59.0)	(57.0)	(55.0)	(53.0)
ELECTRIC	(40.0)	(40.0)	(41.0)	(43.0)	(45.0)	(47.0)

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 8C: ROMANIA /SCENARIO-1

ENERGY INTENSITY (AND LOAD FACTORS) ASSUMED:

YEAR:	1989	1992	1995	2000	2005	2010
FREIGHT TRANSPORTATION (KWH/TKM):						
TRUCK						
LOCAL	.233	.233	.256	.281	.309	.326
LONG-DISTANCE	.209	.209	.206	.200	.197	.193
TRAIN						
STEAM	.460	.460	.452	.447	.439	.430
DIESEL	.124	.124	.122	.121	.119	.116
ELECTRIC	.057	.057	.056	.056	.055	.053
BARGE	.047	.047	.046	.045	.045	.043
PIPE	.047	.047	.047	.047	.047	.047
PASSENGER TRANSPORTATION, INTERCITY (KWH/PKM):						
CAR	.264	.264	.257	.247	.231	.198
(P/CAR)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)	(3.000)
BUS	.086	.086	.082	.079	.075	.074
(P/BUS)	(40.000)	(40.000)	(40.000)	(39.000)	(37.500)	(35.500)
TRAIN						
(P/TRAIN)	(800.000)	(800.000)	(787.000)	(765.000)	(725.000)	(675.000)
STEAM	.387	.387	.385	.377	.371	.351
DIESEL	.105	.105	.104	.102	.100	.095
ELECTRIC	.048	.048	.048	.047	.046	.044
PLANE	.734	.872	.843	.799	.756	.690
(% OF SEATS OCCUPIED)	(.950)	(.800)	(.800)	(.800)	(.800)	(.800)
PASSENGER TRANSPORTATION, URBAN (KWH/PKM):						
CAR						
(P/CAR)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
MOTOR FUEL	.593	.593	.593	.568	.544	.494
ELECTRIC	.000	.000	.000	.000	.000	.000
MASS TRANSIT						
MOTOR FUEL	.052	.052	.053	.052	.053	.054
(P/BUS)	(90.000)	(90.000)	(87.000)	(84.000)	(79.000)	(75.000)
ELECTRIC	.026	.026	.026	.026	.026	.026
(P/TRAIN)	(135.000)	(135.000)	(135.000)	(134.000)	(131.000)	(128.000)

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9A: ROMANIA /SCENARIO-1

DWELLINGS AND SERVICE SECTOR BUILDINGS:

YEAR:	1989	1992	1995	2000	2005	2010
PERSONS/HOUSEHOLD	2.910	2.880	2.850	2.820	2.800	2.785
DWELLINGS (MILLION UNITS)	7.960	8.075	8.211	8.401	8.589	8.765
OF WHICH IN AREAS REQU. HEATING:	7.960	8.075	8.211	8.401	8.589	8.765
CONSTRUCTED BEFORE BASE YEAR	7.960	7.893	7.815	7.680	7.537	7.387
SINGLE FAMILY HOME/CENTRAL HEATING	(.300)	(.300)	(.297)	(.284)	(.271)	(.255)
APARTMENT/CENTRAL HEATING	(3.081)	(3.078)	(3.079)	(3.072)	(3.068)	(3.051)
ROOM HEATING	(4.579)	(4.515)	(4.439)	(4.324)	(4.198)	(4.081)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
CONSTRUCTED AFTER BASE YEAR	.000	.182	.395	.721	1.052	1.378
SINGLE FAMILY HOME/CENTRAL HEATING	(.000)	(.036)	(.079)	(.144)	(.210)	(.276)
APARTMENT/CENTRAL HEATING	(.000)	(.055)	(.119)	(.216)	(.316)	(.413)
ROOM HEATING	(.000)	(.091)	(.198)	(.361)	(.526)	(.689)
NO HEATING	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
DWELLINGS REQUIRING HEATING(%):	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	97.7	95.2	91.4	87.7	84.3
SINGLE FAMILY HOME/CENTRAL HEATING	(3.8)	(3.8)	(3.8)	(3.7)	(3.6)	(3.4)
APARTMENT/CENTRAL HEATING	(38.7)	(39.0)	(39.4)	(40.0)	(40.7)	(41.3)
ROOM HEATING	(57.5)	(57.2)	(56.8)	(56.3)	(55.7)	(55.3)
NO HEATING	(.0)	(.0)	(.0)	(.0)	(.0)	(.0)
CONSTRUCTED AFTER BASE YEAR	00.0	2.3	4.8	8.6	12.3	15.7
SINGLE FAMILY HOME/CENTRAL HEATING	(00.0)	(20.0)	(20.0)	(20.0)	(20.0)	(20.0)
APARTMENT/CENTRAL HEATING	(00.0)	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)
ROOM HEATING	(00.0)	(50.0)	(50.0)	(50.0)	(50.0)	(50.0)
NO HEATING	(100.0)	(.0)	(.0)	(.0)	(.0)	(.0)
SERVICE SECTOR WORK FORCE (MILLION WORKERS)	2.208	2.192	2.261	2.326	2.429	2.525
SERVICE SECTOR BUILDINGS (MILLION SQM)	75.000	75.619	79.138	81.402	85.021	88.379
OF WHICH IN AREAS REQU. HEATING:	75.000	75.619	79.138	81.402	85.021	88.379
CONSTRUCTED BEFORE BASE YEAR	75.000	74.368	73.640	72.358	71.023	69.620
CONSTRUCTED AFTER BASE YEAR	.000	1.250	5.498	9.044	13.998	18.759
HEATED SERVICE SECTOR BUILDINGS (%)	100.0	100.0	100.0	100.0	100.0	100.0
CONSTRUCTED BEFORE BASE YEAR	100.0	98.3	93.1	88.9	83.5	78.8
CONSTRUCTED AFTER BASE YEAR	00.0	1.7	6.9	11.1	16.5	21.2

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9B: ROMANIA /SCENARIO-1

ENERGY INTENSITY ASSUMED FOR THE HOUSEHOLD SECTOR:

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:						
CONSTR.BEFORE BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.465	5860.465	5860.465	5801.860	5684.651	5567.442
APARTMENT/CENTRAL HEATING	5430.232	5430.232	5430.232	5375.930	5267.325	5158.721
ROOM HEATING	4686.046	4686.046	4686.046	4639.186	4545.465	4451.744
CONSTR.AFTER BASE YEAR (USEFUL;KWH/DW/YR):						
SINGLE FAMILY/CENTRAL HEATING	5860.380	5860.380	5813.581	5735.721	5886.251	5950.270
APARTMENT/CENTRAL HEATING	5426.106	5426.106	5377.563	5323.925	5374.535	5232.223
ROOM HEATING	4685.746	4685.746	4650.865	4588.576	4602.418	4390.465
SIZE OF DWELLINGS CONSTR.AFTER BASE YEAR (SQM):						
SINGLE FAMILY/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(36.000)	(38.000)
APARTMENT/CENTRAL HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.500)	(36.000)
ROOM HEATING	(33.600)	(33.600)	(33.600)	(34.000)	(35.000)	(35.000)
HEATING DEGREE-DAYS:	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)	(3100.000)
WATER HEATING (USEFUL;KWH/DW/YR):	2311.081	2779.535	2982.558	3115.116	3093.023	3076.453
(% OF DWELLINGS WITH HOT WATER)	(75.0)	(75.0)	(75.0)	(75.0)	(78.0)	(80.0)
COOKING (USEFUL;KWH/DW/YR):	1218.605	1209.302	1197.674	1162.791	1104.651	1046.512
AIR CONDITIONING (USEFUL;KWH/DW/YR):	302.326	302.326	302.326	302.326	302.326	302.326
(% OF DWELLINGS WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(.5)	(.7)	(1.3)
SECONDARY ELECTR. APPL. (KWH/DW/YR):	513.460	923.000	1006.000	1339.000	1604.000	1944.000

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9C: ROMANIA /SCENARIO-1

THERMAL ENERGY DEMAND (USEFUL) BY THE HOUSEHOLD SECTOR (MTCE);
PENETRATION OF COMPETING ENERGY SOURCES; AND
EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):

YEAR:	1989	1992	1995	2000	2005	2010
SPACE HEATING:	4.908	4.984	5.071	5.142	5.177	5.179
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	45.0	43.4	41.7	39.0	37.1	35.3
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	00.0	00.0	00.0	00.0	00.0
%ELECTRICITY, CONVENTIONAL	.6	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
WATER HEATING:	1.695	2.068	2.256	2.411	2.546	2.650
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	44.7	43.0	41.2	37.3	34.7	32.2
(EFFICIENCY)	(.600)	(.600)	(.600)	(.600)	(.600)	(.600)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	.1	.1	.1	.1	.1
%ELECTRICITY, CONVENTIONAL	.9	.9	1.5	3.0	4.0	5.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
COOKING:	1.192	1.200	1.208	1.200	1.166	1.127
%NON-COMMERCIAL	3.9	3.7	3.6	3.8	3.8	3.8
(EFFICIENCY)	(.120)	(.120)	(.120)	(.130)	(.140)	(.150)
%FOSSIL	96.0	96.1	95.4	93.2	91.2	86.2
(EFFICIENCY)	(.500)	(.500)	(.550)	(.600)	(.700)	(.700)
%ELECTRICITY	.1	.2	1.0	3.0	5.0	10.0
AIR CONDITIONING:	.000	.000	.000	.002	.002	.004
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Table C.4 High Scenario: Module 1 - Output Tables (cont.)

SUMMARY OF DETAILED INPUTS INTO MAED/TABLE 9D: ROMANIA /SCENARIO-1

YEAR:	1989	1992	1995	2000	2005	2010
ENERGY INTENSITY ASSUMED FOR THE SERVICE SECTOR:						
SPACE AND WATER HEATING (USEFUL;KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	255.814	253.256	250.698	248.140	245.581	243.023
BUILDINGS CONSTR.AFTER BASE YEAR	.000	244.186	238.372	232.558	226.744	220.930
(% OF FLOOR AREA HEATED)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
AIR CONDITIONING:						
SPEC. CONS. (USEFUL;KWH/SQM/YR)	58.140	58.140	58.140	58.140	58.140	58.140
(% OF FLOOR AREA WITH AIR COND.)	(00.0)	(00.0)	(00.0)	(1.0)	(3.0)	(5.0)
SPECIFIC USE OF ELECTRICITY (KWH/SQM/YR):						
BUILDINGS CONSTR.BEFORE BASE YEAR	37.920	50.000	59.600	64.700	71.500	90.800
BUILDINGS CONSTR.AFTER BASE YEAR	.000	50.000	61.200	70.100	74.800	96.500
THERMAL ENERGY DEMAND (USEFUL) BY THE SERVICE SECTOR (MTCE); PENETRATION OF COMPETING ENERGY SOURCES; AND EFFICIENCIES (REL. TO CONVENTIONAL USE OF ELECTRICITY):						
SPACE AND WATER HEATING:	2.357	2.351	2.429	2.464	2.533	2.588
%FOSSIL	49.1	47.1	45.2	42.8	40.9	39.1
(EFFICIENCY)	(.600)	(.600)	(.600)	(.650)	(.700)	(.700)
%DISTRICT HEAT	50.4	52.3	53.7	55.8	57.4	58.9
%SOLAR	00.0	00.0	00.0	00.0	.0	.0
%ELECTRICITY, CONVENTIONAL	.4	.6	1.1	1.4	1.7	2.0
%ELECTRICITY, HEAT PUMP	00.0	00.0	00.0	00.0	00.0	00.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)
AIR CONDITIONING:	.000	.000	.000	.006	.018	.032
%ELECTRICITY	100.0	100.0	100.0	100.0	100.0	100.0
(COP)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)	(2.000)

Appendix D

STATISTICS AND INPUT DATA FOR MAED ANALYSIS — MODULES 2 AND 3

D.1 Introduction

This appendix provides information related to Modules 2 and 3 of the MAED model. Some statistical data regarding the electricity consumption as well as input data for Modules 2 and 3 of MAED are also presented in this appendix. The output listing refers exclusively to the Basic scenario in order to reduce the size of this appendix and of the document. For the other scenarios only synthetic data are presented.

At the end of the appendix, other electricity demand forecasts are presented and used for drawing a comparison with the forecast of the ENPP study.

D.2 Some Important Statistics

The following tables show statistical data regarding the electricity consumption in Romania within the 1980-1989 period. Tables D.1 and D.2 show the respective consumption of electricity for the two large sectors grouped in Module 2 of MAED: Industry/Transportation and Household/Service. Table D.3 shows the values of the peak load, the generated electricity and the load factor of the total generating system for the same years.

Due to the large share of the Manufacturing sector in the total electricity consumption in Romania, a particular use of the Module 2 has been adopted by displacing Agriculture, Construction and Mining sectors from the Industry/Transportation sector to the Household/Service sector. This was accomplished by properly modifying the input file to

Table D.1 Electricity Consumption in the Industry/Transportation Sector

Year	Basic Materials		Machinery & Equipment		Non-durable Goods		Miscellaneous		Transportation		Total
	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh
1981	28847	69.69	6431	15.53	3684	8 90	432	1 06	1997	4 82	41391
1982	28793	68.37	6427	15 26	3729	8 90	1210	2 87	1952	4 60	42111
1983	29463	69 84	6431	15 26	3758	8 90	398	0 90	2143	5 10	42193
1984	30860	67 81	6982	15 34	3901	8 57	1449	3 18	2315	5 10	45507
1985	30603	66 85	7393	16 15	3833	8 40	1515	3 30	2430	5 30	45774
1986	33087	67 28	7886	16 03	4115	8 36	1503	3 09	2580	5 24	49171
1987	32175	66 35	8035	16 57	4048	8 34	1648	3 39	2583	5 35	48489
1988	33064	65 75	8410	16 72	4123	8 23	1863	3 70	2824	5 60	50284
1989	33121	65 68	8808	17 46	3966	7 86	1605	3 20	2921	5 80	50421
1990	25495	63 84	6663	16 68	3824	9 57	1339	3 35	2614	6 56	39935

Table D.3 Statistics on Electricity Generation System

Year	Peak load (MW)	Energy (GWh)	Annual load factor (%)
1980	10092	67486	76 33
1981	10282	70138	77 87
1982	10082	68923	78 04
1983	9918	70260	80 87
1984	9887	71596	82 66
1985	9783	71819	83 80
1986	10070	75478	85 56
1987	10289	74079	82 12
1988	9926	75322	86 62
1989	10560	76036	82 20

Table D.2 Electricity Consumption in the Household/Service Sector

Year	Agriculture		Construction		Mining		Household		Service		Total
	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh	Share (%)	GWh
1981	3181	19 46	1507	9 20	3729	22 81	5132	31 39	2795	17 14	16344
1982	3457	21 17	1157	7 10	4008	24 54	5050	30 93	2655	16 26	16327
1983	4163	23 80	1112	6 37	4267	24 39	4994	28 54	2958	16 90	17494
1984	3532	20 20	1378	7 80	3027	17 14	4784	27 09	4936	27 95	17657
1985	3948	24 75	1308	8 20	3310	20 75	4814	30 18	2567	16 30	15947
1986	4135	24 88	1354	8 14	3503	21 08	4992	30 05	2633	15 85	16617
1987	3904	25 25	1512	9 78	3599	23 28	4807	31 20	1637	10 58	15459
1988	3666	22 39	1568	9 59	3796	23 18	4482	27 37	2861	17 47	16373
1989	4169	24 34	1511	8 80	4217	24 64	4296	25 10	2932	17 12	17125
1990	3180	18 75	1382	8 14	3868	22 28	5353	31 53	3193	18 80	16976

Module 2 (LOADSCEN file). In this way each sector and subsector considered in Module 1 is represented also in Module 2

D.3 Input Data and Printout for Module 2

As it has been stated before, the information referring to the Basic scenario was selected to illustrate the type of input data and output results involved in the execution of Module 2. Due to the large amount of information contained in the printout results, only the base year is presented in detail in the following tables

Table D 4 Input data on load modulation coefficients for the Industry sector in the base year

Table D.5 Input data on load modulation coefficients for the Household/Service sector in the base year

Table D.6 Input data for additional parameters for all sectors for remaining years of study

Table D.7 Printed output of Module 2

Table D.4 Input Data on Load Modulation Coefficients for the Industry Sector in the Base Year

```
SC 1009 1010 1010 1012 1010 1010 1010 1012  996  968 1010 1010 1001
14 1000 1000  991 1000  995  992  996  989  987  999  995  993  994
27  989  985 1003 1005 1004 1001  986  989  985  995  992 1002  995
40 1010 1008 1006 1002 1001 1010 1010 1010 1010 1005 1005 1002  991
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1  920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
PO 2  850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
PO 3  950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5  920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
PO 6  850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
PO 7  950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
LC S 0  70  15   6   3   6
   1 1006 1002 1006 1010 1002  994  975  988  995 1012 1004  984
     1004 1004 1004 1008 1010 1008  999  998  992  989 1002 1004
   2  862  849  838  814  825  837  849 1100 1196 1184 1100 1137
     1149 1137 1017 1029 1100 1089 1018 1053 1053 1005  897  862
   3  857  857  873  896  917  934  989 1045 1078 1084 1084 1106
     1094 1066 1056 1072 1072 1050 1044 1028 1017  996  923  862
   4  743  743  755  818  841  954 1057 1114 1114 1079 1068 1079
     1136 1114 1057 1079 1102 1125 1114 1068 1045 1011 1011  773
   5  930  910  935  978 1010 1044  953  953  930 1062 1008  952
      942 1021 1044 1010 1067 1067 1112 1112 1055  953  976  976
LC S 1  70  15   6   3   6
   1  906  902  906  910  902  994 1002 1004 1008 1015 1004  984
     1004 1004 1004 1008 1000 1095 1099 1098 1092 1098  986  975
   2  862  849  838  814  825  837  847 1100 1196 1186 1100 1137
     1149 1137 1017 1029 1100 1089 1018 1053 1053 1005  897  862
   3  857  857  873  896  917  934  989 1045 1078 1085 1084 1106
     1094 1066 1056 1072 1072 1050 1044 1028 1017  995  923  862
   4  743  743  755  818  841  954 1057 1114 1114 1079 1068 1079
     1136 1114 1057 1079 1102 1125 1114 1068 1045 1011 1011  773
   5  930 1010 1135 1021 1010 1044  953  953  953  908  953  976
      976 1021 1044 1010 1067 1067 1112 1112 1055  930  908  852
LC S 2  70  15   6   3   6
   1  926  925  901  910  945 1067 1051 1067 1074 1028 1033 1017
      962  953  927  957  973 1073 1049 1047 1054 1076 1079  906
   2  801  838  838  838  885 1016 1568 1423 1345 1299 1127 1095
     1064 1002  908  845  829  929  898  929  914  882  898  829
   3  879  883  892  883  905  922 1454 1287 1250 1338 1254 1204
     1078 1038 1046  945  914  908  874  840  806  800  791  809
   4  908  934  973 1012 1167 1297 1167 1167 1102 1012 1012 1038
     1038 1038  934  934  938  934  908  908  882  882  908  907
   5 1064 1101 1214 1258 1164 1114  939  851  876  951  951 1001
      976  876  901 1089  914  826 1001  838  926 1064 1064 1041
LC S 3  70  15   6   3   6
   1  906  902  906  910  902 1094 1075 1088 1095 1015 1004 1084
     1004 1004 1004 1008 1010 1008  999  998  992  986 1002 1004
   2  860  840  830  810  820  840  856 1109 1196 1188 1105 1137
     1149 1137 1017 1029 1100 1089 1018 1053 1053 1005  897  862
   3  857  847  863  886  907  939  994 1049 1085 1089 1089 1111
     1099 1066 1056 1072 1072 1050 1044 1028 1017  995  923  862
   4  723  713  725  808  841  954 1067 1114 1134 1089 1088 1099
     1146 1114 1057 1079 1102 1125 1114 1068 1045 1011 1011  773
   5  930  910  935  978  910  944  953  953 1030  962 1008 1002
      992 1021 1044 1010 1067 1067 1112 1112 1055 1053  976  976
```

Table D.4 Load modulation coefficients in base year - Industry (cont.)

```
LC S 4   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 5   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 6   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 7   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 0  70  15   6   3   6
   1  925  920  816  914  998  997 1027 1042 1032 1030 1025 1020
     1020 1020 1009 1036 1067 1068 1056 1052 1092 1007  902  925
   2  988  988  973  953  941  929  929  988 1059 1153 1141 1153
     1176 1144 1070 1035 1000  994  994  983  883  819  842  865
   3  955  960  950  950  950  956 1015 1032 1042 1052 1064 1069
     1074 1063 1026 1021 1016  978  978  978  983  967  961  960
   4  878  890  912  923  945  990 1023 1034 1090 1112 1068 1079
     1068 1090 1090 1101 1090 1001 1001  967  945  912  901  890
   5  975 1050 1050 1050 1050 1038  985  964  943  975  912  943
     985  996  985 1006 1059 1017 1006 1038  985  996  996  996
LC W 1  70  15   6   3   6
   1  915  900  906  904  958  997 1041 1027 1042 1035 1041 1059
     1054 1028 1009 1096 1067 1055 1016 1012 1002  987  924  925
   2  988  983  971  950  941  932  934  993 1059 1153 1141 1153
     1176 1144 1070 1035 1000  992  942  919  894  894  883  853
   3  955  960  950  950  950  956 1015 1032 1042 1052 1064 1069
     1074 1063 1026 1021 1016  978  978  978  983  967  961  960
   4  878  890  912  923  945  990 1023 1034 1090 1112 1068 1079
     1068 1090 1090 1101 1090 1001 1001  967  945  912  901  890
   5  975 1050 1050 1050 1050 1038  985  964  943  975  912  943
     985  996  985 1006 1059 1017 1006 1038  985  996  996  996
LC W 2  70  15   6   3   6
   1  921  859  878  935  928 1031 1027 1015 1006 1008 1035 1037
     1041 1003  992  975 1006 1073 1070 1037 1049 1063 1068  943
   2  867 1027 1096 1027 1068 1096 1260 1370 1301 1301 1342 1233
     1164 1041  877  822  822  836  753  712  726  753  753  753
   3  848  855  861  866  891  977 1252 1264 1258 1275 1265 1234
     1203 1155 1138  885  872  879  850  865  868  849  810  780
   4  809  796  784  833  858 1017 1140 1115 1189 1225 1213 1176
     1103 1103 1078 1053  980 1017  943  956  956  916  882  858
   5  982  982  960  950  960 1067 1014  982 1003  992 1024  960
     982 1014 1046 1014  992 1024 1005 1056 1014 1003  992  982
LC W 3  70  15   6   3   6
   1  950  930  914  918  950  925 1020 1020 1000 1035 1041 1059
     1054 1028 1009 1096 1067 1055 1026 1015 1002 1037  924  925
   2  753  726  712  753  753  863 1027 1096 1027 1068 1096 1267
     1370 1174 1100 1115 1080 1034  994  963  963  999 1022 1045
   3  750  730  740  755  870  956 1025 1122 1132 1142 1154 1159
     1164 1073 1026 1031 1096 1068 1068 1068  983  967  961  960
   4  830  820  912  943  965 1010 1043 1053 1109 1112 1068 1079
     1068 1090 1090 1101 1090 1001 1001  967  945  912  901  890
   5  975  950  950  950  950 1038  985  964  943 1075 1012 1043
     1085  996  985 1006 1059 1017 1006 1038  985  996  996  996
LC W 4   9   3  63  22   3
   1  319  319  319  506  844 1124 1217 1162 1255 1255 1067  844
     805 1049 1312 1592 1779 1874 1592 1312  937  693  506  318
   2  999  990  980  970  960  980 1010 1080 1015 1060 1080 1020
     1010 1040 1020 1030  970  960  950  953  953  970 1000 1000
   3  983  980  985 1010 1010 1014 1011 1013 1013 1005 1005 1002
     1013 1014 1013 1014  980 1002 1001  979  981  992  992  988
   4  954  950  964  974  975  975  987  995  998 1052 1073 1009
     1041 1053  990 1030 1022 1013 1015 1006 1007  995  967  955
   5  975 1050 1050 1050 1050 1038  985  964  943  975  912  943
     985  996  985 1006 1059 1017 1006 1038  985  996  996  996
```

Table D.4 Load modulation coefficients in base year - Industry (cont.)

```
LC W 5   9   3  63  22   3
   1  319  319  319  506  844 1124 1217 1162 1255 1255 1067  844
      805 1049 1312 1592 1779 1874 1592 1312  937  693  506  318
   2  999  990  980  970  960  980 1010 1080 1015 1060 1080 1020
     1010 1040 1020 1030  970  960  950  953  953  970 1000 1000
   3  983  980  985 1010 1010 1014 1011 1013 1013 1005 1005 1002
     1013 1014 1013 1014  980 1002 1001  979  981  992  992  988
   4  954  950  964  974  975  975  987  995  998 1052 1073 1009
     1041 1053  990 1030 1022 1013 1015 1006 1007  995  967  955
   5  975 1050 1050 1050 1050 1038  985  964  943  975  912  943
      985  996  985 1006 1059 1017 1006 1038  985  996  996  996
LC W 6   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 7   9   3  63  22   3
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2  700  700  760  760  760  900 1110 1110 1150 1140 1140 1050
     1010 1110 1170 1170 1170 1135 1135 1060 1030  980  950  800
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
```

** LOAD COEFFICIENTS FOR INDUSTRY/TRANSPORT SECTOR OF ROMANIA **

Table D.5 Input Data on Load Modulation Coefficients for the Household/ Service Sector in the Base Year

```
SC 1019 1020 1018 1011 1012 1013 1017 1004 1008 1010 1014 1019 1011
14 1005 1002  986 1000  982  985  986  999  990  979  985  981  984
27  990  996 1000 1002 1004 1001  972  989  985  973  982  978  980
40 1007 1008 1006 1002 1001 1010 1011 1010 1010 1010 1012 1010 1011
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1  920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
      920  920  920  920  920  920  920  920  920  920  920  920  920
PO 2  820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
PO 3  970  970  970  970  970  970  970  970  970  970  970  970  970
      970  970  970  970  970  970  970  970  970  970  970  970  970
      970  970  970  970  970  970  970  970  970  970  970  970  970
      970  970  970  970  970  970  970  970  970  970  970  970  970
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5  820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
      820  820  820  820  820  820  820  820  820  820  820  820  820
PO 6  740  740  740  740  740  740  740  740  740  740  740  740  740
      740  740  740  740  740  740  740  740  740  740  740  740  740
      740  740  740  740  740  740  740  740  740  740  740  740  740
      740  740  740  740  740  740  740  740  740  740  740  740  740
PO 7  960  960  960  960  960  960  960  960  960  960  960  960  960
      960  960  960  960  960  960  960  960  960  960  960  960  960
      960  960  960  960  960  960  960  960  960  960  960  960  960
      960  960  960  960  960  960  960  960  960  960  960  960  960
LC S 0  34  11  27  12  16
   1  770  772  718  718  719  826 1106 1106  898  826  826  826
      826  826  808  898 1006 1078 1132 1491 1734 1797 1401  892
   2  944  786  699  699  699  805 1049 1049  874  804  804  804
      804  805  856  874 1049 1049 1101 1451 1748 1748 1363 1136
   3  985  990  990  990  995 1020  978  946  966 1050 1058 1063
     1031 1031 1013 1008  991 1002 1002 1001  981  991  959  959
   4  772  700  700  701  722  828 1081 1085 1001 1029  876  829
      829  829  819  829 1009 1081 1135 1495 1802 1812 1405  631
   5  781  601  611  611  631  829 1126 1126  982  965  908  908
      908  908  758  829 1010 1082 1136 1496 1803 1803 1206  982
```

Table D.5 Load Modulation Coefficients in Base Year - Household/Service (cont.)

```
LC S 1  34  11  27  12  16
   1  770  770  720  715  722  726  826  898 1106 1206  826  826
      826  826  808  898  906 1078 1232 1491 1734 1797 1401  892
   2  989  888  889  889  889  997 1048 1048 1059 1050 1049 1049
     1030 1030 1000 1050 1050 1041 1030 1020  978  989  970  968
   3  987 1000 1000 1000 1000 1020  980  966  966 1002 1055 1063
     1021 1031 1010  990  988  997  997 1032  978  969  968  980
   4  770  770  715  720  722  726  826  898 1106 1206  826  826
      826  826  808  898  906 1078 1232 1491 1734 1797 1401  892
   5  881  781  611  611  631  829 1226 1226  902  830  758  758
      758  758  693  829 1010 1082 1136 1496 1803 1903 1406 1082
LC S 2  34  11  27  12  16
   1  770  770  720  715  722  726  826  898 1106 1206  826  826
      826  826  808  898  906 1078 1232 1491 1734 1797 1401  892
   2  954  796  699  689  689  705 1049 1059  984  914  914  914
      914  915  964  976  959  959 1001 1351 1648 1648 1263 1036
   3  981  964  960  970  998 1098 1004 1109 1108 1121 1121 1110
      984  984  880  992  992  995  964  968  935  934  914  914
   4  990  847  753  753  753  866  930  930  902  809  873  873
      866  866  852  866  942  942  998 1158 1455 2083 1469 1224
   5 1009  841  747  748  748  804  921  921  903  960  960  960
      960  860  860  860  934  934 1091 1091 1346 1869 1458 1215
LC S 3  34  11  27  12  16
   1  770  772  718  718  719  826 1006 1106  998  926  926  926
      976  976  808  898 1006 1078 1132 1491 1634 1597 1001  992
   2  644  586  499  499  599 1005 1009 1049  974  904  900  904
      908  945  874  856 1049 1049 1201 1551 1748 1748 1363 1136
   3  985  958  958  956  990  994 1003 1001 1011 1020 1033 1033
     1023 1031 1011 1003 1009 1009 1009 1002 1005 1006  995  955
   4  400  400  391  400  442  676  841  918 1106 1156  846  826
      826  826  808 1098 1056 1278 1482 1791 1843 2097 1601  892
   5  709  701  620  620  698  728 1001 1053 1103 1103 1060 1060
      860  860  840  866  964  974  991 1031 1316 1869 1558 1415
LC S 4  35  65   0   0   0
   1  700  700  700  700  700  790 1020 1170 1190 1260 1260 1190
     1070 1115 1220 1195 1090 1120 1120 1190 1170  820  770  740
   2 1090  890  700  680  700  680  730  970 1060  970  740  700
      685  790  810  810  760  740 1055 1250 1700 2060 1850 1580
LC S 5  35  65   0   0   0
   1  700  700  700  700  700  790 1020 1170 1190 1260 1260 1190
     1070 1115 1220 1195 1090 1120 1120 1190 1170  820  770  740
   2 1090  890  700  680  700  680  730  970 1060  970  740  700
      685  790  810  810  760  740 1055 1250 1700 2060 1850 1580
LC S 6  35  65   0   0   0
   1  700  700  700  700  700  790 1020 1170 1190 1260 1260 1190
     1070 1115 1220 1195 1090 1120 1120 1190 1170  820  770  740
   2 1090  890  700  680  700  680  730  970 1060  970  740  700
      685  790  810  810  760  740 1055 1250 1700 2060 1850 1580
LC S 7  35  65   0   0   0
   1  700  700  700  700  700  790 1020 1170 1190 1260 1260 1190
     1070 1115 1220 1195 1090 1120 1120 1190 1170  820  770  740
   2 1090  890  700  680  700  680  730  970 1060  970  740  700
      685  790  810  810  760  740 1055 1250 1700 2060 1850 1580
LC W 0  13   6  27  37  17
   1  739  674  624  509  674  772 1201 1266 1086  986  854  838
      821  719  719  894 1314 1643 1626 1610 1511 1265  851  804
   2  738  673  623  509  673  771 1130 1167  984  934  903  837
      820  788  788  902 1312 1641 1624 1608 1509 1263  950  853
   3 1000 1000 1000 1000 1000 1000  961  987 1011 1058 1068 1068
     1047 1036  961 1036 1036 1005  959  959  956  972  961  919
   4  639  574  524  509  772  986  986 1051 1216  874  854  838
      821  739  739  904 1314 1643 1626 1710 1511 1265 1051  854
   5  719  655  607  607  619  878 1038 1198 1214 1000  868  732
      798  750  719  878 1277 1565 1581 1579 1469 1330 1022  897
LC W 1  13   6  27  37  17
   1  739  674  600  533  772  874  951 1116 1086  886  854  838
      839  821  739  804 1214 1643 1626 1610 1511 1365 1151  754
   2  738  673  623  509  673  771 1050 1247  984  984  853  837
      820  738  738  902 1312 1641 1624 1608 1509 1263 1050  853
   3  915  926  936  936  936  993  961 1011 1032 1058 1068 1068
     1047 1036 1015 1086 1086 1092 1061 1061  919  919  919  919
   4  593  574  524  509  772  932 1051 1216  986  874  854  838
      821  739  739 1004 1314 1643 1726 1710 1511 1265 1051  754
   5  719  605  557  607  719 1038 1088 1198 1214  928  830  814
      798  750  719  878 1277 1581 1597 1565 1469 1230 1022  797
LC W 2  13   6  27  37  17
   1  318  318  318  506  843 1123 1117 1161 1155 1155 1067 1043
     1005 1160 1111 1592 1779 1873 1592 1311  936  693  506  318
   2  758  693  653  600  700  884  950 1147  984  915  853  837
      820  750  730  900 1212 1581 1620 1600 1510 1400 1050  853
   3 1001 1000 1000 1000 1000 1000  995  959  969 1001 1001 1001
     1000 1000  990 1040 1020  988  998  999  978 1010 1020 1030
   4  732  667  488  504  764  876  903  903  976  878  845  821
      813  740  732  994 1401 1776 1760 1693 1496 1252 1041  945
   5  728  663  615  502  760  971 1097 1097  971  980  891  859
      859  778  728  890 1294 1618 1702 1686 1389 1146 1035  741
LC W 3  13   6  27  37  17
   1  308  308  308  516  853 1022 1117 1171 1155 1155 1067  943
      905 1049 1311 1592 1779 1873 1592 1322  936  693  506  519
   2  638  423  409  563  741 1084 1150 1247  984  873  853  837
      820  788  788  902 1312 1641 1624 1608 1509 1263  990  953
   3  815  926  936  936  936  993  961 1061 1082 1058 1068 1068
     1047 1036 1015 1086 1086 1061 1069 1069 1019  919  911  842
   4  582  517  518  504  764 1026 1203 1203  976  978  945  821
      813  740  732  894 1321 1626 1610 1593 1496 1252 1041  845
   5  578  513  500  517  760 1021 1197 1197 1121  980  941  809
      809  728  728  890 1294 1618 1602 1589 1586 1346  935  741
```

Table D.5 Load Modulation Coefficients in Base Year - Household/Service (cont.)

```
LC W 4  35  65   0   0   0
   1  690  690  690  690  690  930 1140 1220 1300 1300 1230 1170
     1050 1130 1190 1140 1100 1080 1170 1080  970  910  750  690
   2  730  650  610  560  610  720  870  950  970  910  920  750
      700  660  790  950 1100 1500 1890 2020 1750 1510 1060  820
LC W 5  35  65   0   0   0
   1  690  690  690  690  690  930 1140 1220 1300 1300 1230 1170
     1050 1130 1190 1140 1100 1080 1170 1080  970  910  750  690
   2  730  650  610  560  610  720  870  950  970  910  920  750
      700  660  790  950 1100 1500 1890 2020 1750 1510 1060  820
LC W 6  35  65   0   0   0
   1  690  690  690  690  690  930 1140 1220 1300 1300 1230 1170
     1050 1130 1190 1140 1100 1080 1170 1080  970  910  750  690
   2  730  650  610  560  610  720  870  950  970  910  920  750
      700  660  790  950 1100 1500 1890 2020 1750 1510 1060  820
LC W 7  35  65   0   0   0
   1  690  690  690  690  690  930 1140 1220 1300 1300 1230 1170
     1050 1130 1190 1140 1100 1080 1170 1080  970  910  750  690
   2  730  650  610  560  610  720  870  950  970  910  920  750
      700  660  790  950 1100 1500 1890 2020 1750 1510 1060  820
```

** LOAD COEFFICIENTS FOR HOUSEHOLDS/SERVICES SECTOR FOR ROMANIA **

Table D.6 Input Data for Additional Parameters for All Sectors for Remaining Years of study

```
PRINT OUTPUT OPTION     0
INPUT DATA FOR:      1989
 1ST JAN 7 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
 ENERGY      3544.7  GROWTH      1.000
IOPT (I)      1   2   3   4
SUBOPT (3)    1   2
SUBOPT (4)    1   2
HOUSEHOLDS/SERVICE SECTOR:
 ENERGY      1568.9  GROWTH      0.200
IOPT (I)      1   2   3   4
SUBOPT (3)    1   2
SUBOPT (4)    1   2
INPUT DATA FOR:      1992
 1ST JAN 3 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
IOPT (I)      1   2   3   4
SC  990  990 1010 1042 1020 1000  990  980  955 1000 1030 1000 1000
14  955  970  950  980  990  985  980 1010  956 1000  943  970  965
27 1010 1010 1005 1004 1000 1000  980  990  990  950  975  950  985
40 1000 1080 1050 1050 1050 1060 1070 1080 1070 1020  980 1000  980
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)    1   0
LC S 0  68  13   7   3   9
LC S 1  68  13   7   3   9
LC S 2  68  13   7   3   9
LC S 3  68  13   7   3   9
LC S 4   9   3  63  22   3
LC S 5   9   3  63  22   3
LC S 6   9   3  63  22   3
LC S 7   9   3  63  22   3
```

Table D.6 Input Data for Additional Parameters for All Sectors (cont.)

```
SUBOPT (4)    1   0
LC W 0  68  13   7   3   9
LC W 1  68  13   7   3   9
LC W 2  68  13   7   3   9
LC W 3  68  13   7   3   9
LC W 4   9   3  63  22   3
LC W 5   9   3  63  22   3
LC W 6   9   3  63  22   3
LC W 7   9   3  63  22   3
HOUSEHOLDS/SERVICE SECTOR:
IOPT (I)      1   2   3   4
SC 1060 1050 1050 1030 1050 1060 1070 1080 1080 1070 1030 1050 1050
14 1080 1000 1050 1020 1020  995 1000  985 1005  925 1030 1030  955
27  895  880  920  900  920  910  940  910  920  970  950  945  925
40  980  970  980 1020 1000 1040  990  995 1015 1060 1090 1080  970
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)    1   0
LC S 0  29   6  21  17  27
LC S 1  30   6  20  17  27
LC S 2  28   6  22  17  27
LC S 3  29   6  21  17  27
LC S 4  35  65   0   0   0
LC S 5  35  65   0   0   0
LC S 6  35  65   0   0   0
LC S 7  35  65   0   0   0
SUBOPT (4)    1   0
LC W 0  11   3  17  42  27
LC W 1  11   3  17  42  27
LC W 2  11   3  17  42  27
LC W 3  11   3  17  42  27
LC W 4  35  65   0   0   0
LC W 5  35  65   0   0   0
LC W 6  35  65   0   0   0
LC W 7  35  65   0   0   0
INPUT DATA FOR:      1995
 1ST JAN 7 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
IOPT (I)      1   2   3   4
SC  960  970  970 1020  980 1010 1040  895 1015 1060 1010 1080 1280
14  965 1380  950  980  910  960  935  940  850  930  900  880  845
27  950 1060 1290 1050 1010  905 1040 1005  985  970  950  900  885
40  900 1080 1280 1000 1120  990  970  980  990 1010 1055 1000  910
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1  950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
PO 2  850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
PO 3  980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
```

Table D.6 Input Data for Additional Parameters for All Sectors (cont.)

```
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)    1   0
LC S 0  66  14   7   4   9
LC S 1  66  14   7   4   9
LC S 2  66  14   7   4   9
LC S 3  66  14   7   3  10
LC S 4   9   3  63  22   3
LC S 5   9   3  63  22   3
LC S 6   9   3  63  22   3
LC S 7   9   3  63  22   3
SUBOPT (4)    1   0
LC W 0  66  14   7   3  10
LC W 1  66  14   7   4   9
LC W 2  66  14   7   4   9
LC W 3  66  14   7   3  10
LC W 4   9   3  63  22   3
LC W 5   9   3  63  22   3
LC W 6   9   3  63  22   3
LC W 7   9   3  63  22   3
HOUSEHOLDS/SERVICE SECTOR:
IOPT (I)      1   2   3   4
SC  960  970  960 1020  980 1010 1090  975 1015 1060 1090 1100 1140
14  965  930  980  980  990  960  905  950 1000  940  950 1000  945
27 1000 1060 1080 1050 1010  895 1040 1085 1055  920  800  910 1005
40  900 1080 1160 1000 1120  990  970  980  990 1010 1055 1000  970
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1  950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
PO 2  850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
PO 3  980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)    1   2
LC S 0  28   5  23  18  26
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 1  28   5  23  18  26
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 2  28   5  23  18  26
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
```

Table D.6 Input Data for Additional Parameters for All Sectors (cont.)

```
LC S 3  28   5  23  18  26
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 4  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 5  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 6  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC S 7  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (4)   1   2
LC W 0  10   3  19  41  27
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 1  10   3  19  41  27
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 2  10   3  19  41  27
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 3  10   3  19  41  27
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 4  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 5  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 6  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
LC W 7  35  65   0   0   0
   1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
   2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
```

Table D.6 Input Data for Additional Parameters for All Sectors (cont.)

```
INPUT DATA FOR:      2000
 1ST JAN 5 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
IOPT (I)      1    2    3    0
SC  860  900  920  925 1265 1010  990  975 1015 1060 1090 1050  980
14  945  930  930  880  860  940  905  900  900  920  950 1300  945
27 1080 1060 1000 1270 1010  995 1000 1005  975 1000 1000 1000 1005
40  950 1080 1220 1000 1100  990  970  980  990 1010 1055 1000  910
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1  950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
      950  950  950  950  950  950  950  950  950  950  950  950  950
PO 2  850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
      850  850  850  850  850  850  850  850  850  850  850  850  850
PO 3  980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
      980  980  980  980  980  980  980  980  980  980  980  980  980
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)    1    0
LC S 0  66  14   7   4   9
LC S 1  66  14   7   4   9
LC S 2  66  14   7   4   9
LC S 3  66  14   7   3  10
LC S 4   9   3  63  22   3
LC S 5   9   3  63  22   3
LC S 6   9   3  63  22   3
LC S 7   9   3  63  22   3
HOUSEHOLDS/SERVICE SECTOR:
IOPT (I)      1    0    3    4
SC  860  870  960  920 1250 1010  890  875 1015 1060 1090 1080  980
14  965  930  930  980  990  960  905  900 1000  920  950 1050  945
27 1080 1060 1000 1140 1010  995 1040 1085 1055 1020 1000 1020 1005
40  900 1080 1250 1000 1120  950  970  980  990 1010 1055 1000  900
SUBOPT (3)    1    0
LC S 0  28   5  23  18  26
LC S 1  28   5  23  18  26
LC S 2  28   5  23  18  26
LC S 3  28   5  23  18  26
LC S 4  35  65   0   0   0
LC S 5  35  65   0   0   0
LC S 6  35  65   0   0   0
LC S 7  35  65   0   0   0
SUBOPT (4)    1    0
LC W 0  10   3  19  41  27
LC W 1  10   3  19  41  27
LC W 2  10   3  19  41  27
LC W 3  10   3  19  41  27
LC W 4  35  65   0   0   0
LC W 5  35  65   0   0   0
LC W 6  35  65   0   0   0
LC W 7  35  65   0   0   0
INPUT DATA FOR:      2005
 1ST JAN 5 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
IOPT (I)      1    0    0    0
SC  860  872  940  916 1010 1010  990  975 1010 1060 1090 1080 1255
14  915  930  930  980  900  900  905  900  900  920  950 1300  905
27 1080 1060 1000 1290 1010  952  940  945 1000 1020 1000  990 1005
40  950 1080 1210 1000 1120 1020 1070  880  990 1010 1055 1000  920
HOUSEHOLDS/SERVICE SECTOR:
IOPT (I)      1    0    0    0
SC  860  870 1060 1020  980 1010  890  875 1015 1060 1090 1080 1280
14  965  930  930  980  920  960  905  900 1000  820  850 1100  945
27 1080 1060 1000 1140 1010  995 1040  965  955 1020 1000  990 1005
40  900 1080 1300 1000 1120  950  970 1080 1090 1010 1055 1000  890
INPUT DATA FOR:      2010
 1ST JAN 4 SUM START 0401 SUM END 0930 FES START 0101 FES END 0102
INDUSTRY SECTOR:
IOPT (I)      1    2    3    4
SC  860  940  950 1000 1080 1010  985  975 1009 1060 1090 1080 1279
14  865  930  930  930  940  925  905  910  925  920  950 1325  920
27 1000 1000 1000 1320 1000  981  940  970  946  900 1000  920 1000
40 1000 1080 1245 1000 1000 1020 1070  980  985 1010  980 1020  940
```

Table D.6 Input Data for Additional Parameters for All Sectors (cont.)

```
PO 0 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 1 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 2 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 3 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 4 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 5 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 6 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
PO 7 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
     1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000
SUBOPT (3)   1   0
LC S 0  67  15   7   4   7
LC S 1  66  14   7   4   9
LC S 2  66  14   7   4   9
LC S 3  67  15   7   4   7
LC S 4   9   3  63  22   3
LC S 5   9   3  63  22   3
LC S 6   9   3  63  22   3
LC S 7   9   3  63  22   3
SUBOPT (4)   1   0
LC W 0  67  15   7   4   7
LC W 1  66  14   7   4   9
LC W 2  66  14   7   4   9
LC W 3  67  15   7   4   7
LC W 4   9   3  63  22   3
LC W 5   9   3  63  22   3
LC W 6   9   3  63  22   3
LC W 7   9   3  63  22   3
HOUSEHOLDS/SERVICE SECTOR:
IOPT (I)     1   0   0   0
SC  860  870 1060 1020  980 1010  890  875 1015 1060 1090 1080 1280
14  965  930  930  980  920  960  905  900 1000  820  850 1100  945
27 1080 1060 1000 1140 1010  995 1040  965  955 1020 1000  990 1005
40  900 1080 1300 1000 1120  950  970 1080 1090 1010 1055 1000  890
```

** ADDITIONAL INPUT DATA TO CONTROL EXECUTION OF MODULE 2 FOR ROMANIA **

Table D.7 Printed Output of Module 2

```
ELECTRIC POWER DEMAND ON AN HOUR-BY-HOUR BASIS FOR

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF GENERAL INPUT DATA FOR THE RUN
*****************************************

NUMBER OF SECTOR(S) CONSIDERED:          2

NUMBER OF YEAR(S) CONSIDERED:            6

PRINTED OUTPUT OPTION SELECTED:          0
(.EQ. 0  MINIMUM OUTPUT)
(.NE. 0  MAXIMUM OUTPUT)

INPUT DATA FOR THE YEAR:          1989
************************

FIRST DAY OF THE YEAR IS:         7
(MONDAY=1, TUESDAY=2,..)

SUMMER  PERIOD  STARTS:   401   ENDS:   930

SPECIAL PERIOD  STARTS:   101   ENDS:   102



INDUSTRIAL SECTOR (INCLUDING TRANSPORTATION)

INPUT DATA FOR THE YEAR:          1989
************************

ELECTRICITY DEMAND        63971.100  GWH
AVERAGE GROWTH RATE           1.000   %


ENERGY-GROWTH TREND COEFFICIENTS  T(I):
---------------------------------------

 .9952   .9954   .9956   .9958   .9960   .9962   .9964   .9966   .9968   .9969   .9971   .9973   .9975
 .9977   .9979   .9981   .9983   .9985   .9987   .9989   .9990   .9992   .9994   .9996   .9998  1.0000
1.0002  1.0004  1.0006  1.0008  1.0010  1.0011  1.0013  1.0015  1.0017  1.0019  1.0021  1.0023  1.0025
1.0027  1.0029  1.0031  1.0033  1.0035  1.0036  1.0038  1.0040  1.0042  1.0044  1.0046  1.0048  1.0050


WEIGHTED LOAD COEFFICIENTS FOR EACH DAY TYPE
--------------------------------------------

SUMMER VALUES

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   0

 .9630   .9571   .9610   .9661   .9660   .9687   .9581  1.0099  1.0298  1.0471  1.0254  1.0152
1.0314  1.0320  1.0131  1.0172  1.0334  1.0297  1.0148  1.0170  1.0080   .9903   .9802   .9656

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   1

 .8930   .8931   .9030   .8987   .8960   .9687   .9767  1.0211  1.0403  1.0403  1.0221  1.0166
1.0334  1.0320  1.0131  1.0172  1.0264  1.0906  1.0848  1.0870  1.0780  1.0652   .9649   .9378

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   2

 .9122   .9203   .9119   .9215   .9534  1.0604  1.1495  1.1236  1.1142  1.0821  1.0548  1.0396
 .9874   .9634   .9299   .9467   .9433  1.0225  1.0087  1.0002  1.0053  1.0238  1.0285   .8968

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   3

 .8921   .8842   .8883   .8946   .8887  1.0334  1.0297  1.0815  1.1068  1.0444  1.0270  1.0891
1.0350  1.0320  1.0131  1.0172  1.0334  1.0297  1.0148  1.0170  1.0080   .9942   .9802   .9656

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   4

 .9910   .9910   .9928   .9928   .9928   .9970  1.0033  1.0033  1.0045  1.0042  1.0042  1.0015
1.0003  1.0033  1.0051  1.0051  1.0051  1.0041  1.0041  1.0018  1.0009   .9994   .9985   .9940

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   5

 .9910   .9910   .9928   .9928   .9928   .9970  1.0033  1.0033  1.0045  1.0042  1.0042  1.0015
1.0003  1.0033  1.0051  1.0051  1.0051  1.0041  1.0041  1.0018  1.0009   .9994   .9985   .9940

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   6

 .9910   .9910   .9928   .9928   .9928   .9970  1.0033  1.0033  1.0045  1.0042  1.0042  1.0015
1.0003  1.0033  1.0051  1.0051  1.0051  1.0041  1.0041  1.0018  1.0009   .9994   .9985   .9940

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   7

 .9910   .9910   .9928   .9928   .9928   .9970  1.0033  1.0033  1.0045  1.0042  1.0042  1.0015
1.0003  1.0033  1.0051  1.0051  1.0051  1.0041  1.0041  1.0018  1.0009   .9994   .9985   .9940
```

Table D.7 Printed Output of Module 2 (cont.)

WINTER VALUES

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 0

.9378	.9395	.8645	.9304	.9881	.9866	1.0089	1.0284	1.0330	1.0489	1.0393	1.0400
1.0460	1.0418	1.0202	1.0351	1.0541	1.0464	1.0374	1.0338	1.0433	.9729	.9022	.9213

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 1

.9308	.9247	.9272	.9230	.9601	.9870	1.0195	1.0186	1.0401	1.0524	1.0504	1.0673
1.0698	1.0474	1.0202	1.0771	1.0541	1.0370	1.0016	.9962	.9819	.9701	.9237	.9195

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 2

.9088	.8895	.9118	.9425	.9466	1.0393	1.0781	1.0842	1.0707	1.0735	1.0995	1.0778
1.0675	1.0215	.9893	.9513	.9687	1.0212	1.0015	.9766	.9848	.9956	.9951	.9045

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 3

.9064	.8853	.8754	.8861	.9161	.9269	1.0199	1.0351	1.0118	1.0511	1.0551	1.0958
1.1103	1.0525	1.0247	1.0897	1.0709	1.0487	1.0218	1.0103	.9923	1.0209	.9446	.9483

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 4

.9171	.9163	.9222	.9567	.9871	1.0150	1.0235	1.0230	1.0294	1.0386	1.0250	.9881
.9995	1.0260	1.0342	1.0698	1.0632	1.0821	1.0559	1.0159	.9820	.9652	.9431	.9210

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 5

.9171	.9163	.9222	.9567	.9871	1.0150	1.0235	1.0230	1.0294	1.0386	1.0250	.9881
.9995	1.0260	1.0342	1.0698	1.0632	1.0821	1.0559	1.0159	.9820	.9652	.9431	.9210

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 6

.9910	.9910	.9928	.9928	.9928	.9970	1.0033	1.0033	1.0045	1.0042	1.0042	1.0015
1.0003	1.0033	1.0051	1.0051	1.0051	1.0041	1.0041	1.0018	1.0009	.9994	.9985	.9940

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 7

.9910	.9910	.9928	.9928	.9928	.9970	1.0033	1.0033	1.0045	1.0042	1.0042	1.0015
1.0003	1.0033	1.0051	1.0051	1.0051	1.0041	1.0041	1.0018	1.0009	.9994	.9985	.9940

TOTAL NUMBER OF WORKING DAYS 350.272

ANNUAL ELECTRICITY DEMAND = 63971.123 GWH ANNUAL GROWTH RATE = 1.000 %

ERROR SUMMATION IN ANNUAL DEMAND = .0225 GWH FOR SECTOR : 1

ANNUAL DEMAND GIVEN AS INPUT DATA= 63971.1000 GWH
CALCULATED FROM THE COEFFICIENTS = 63971.1225 GWH

HOUSEHOLD AND SERVICE SECTOR

INPUT DATA FOR THE YEAR: 1989
****

ELECTRICITY DEMAND 7672.400 GWH
AVERAGE GROWTH RATE .200 %

ENERGY-GROWTH TREND COEFFICIENTS T(I):

.9990	.9991	.9991	.9992	.9992	.9992	.9993	.9993	.9993	.9994	.9994	.9995	.9995
.9995	.9996	.9996	.9997	.9997	.9997	.9998	.9998	.9998	.9999	.9999	1.0000	1.0000
1.0000	1.0001	1.0001	1.0002	1.0002	1.0002	1.0003	1.0003	1.0003	1.0004	1.0004	1.0005	1.0005
1.0005	1.0006	1.0006	1.0007	1.0007	1.0007	1.0008	1.0008	1.0008	1.0009	1.0009	1.0010	1.0010

WEIGHTED LOAD COEFFICIENTS FOR EACH DAY TYPE

SUMMER VALUES

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 0

.8492	.7964	.7701	.7702	.7776	.8768	1.0654	1.0572	.9395	.9307	.9053	.9010
.8924	.8925	.8620	.9057	1.0077	1.0553	1.0945	1.3556	1.5514	1.5768	1.2468	.9200

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 1

.8704	.8468	.7962	.7950	.8009	.8517	.9560	.9853	1.0304	1.0736	.9015	.9036
.8902	.8929	.8653	.9285	.9606	1.0527	1.1310	1.3161	1.4578	1.5015	1.2375	.9545

HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY 2

.9118	.8458	.7908	.7908	.8008	.8534	.9263	.9802	1.0362	1.0639	.9424	.9394
.9046	.8887	.8582	.9220	.9438	1.0031	1.0836	1.2304	1.4132	1.5934	1.2716	1.0053

Table D.7 Printed Output of Module 2 (cont.)

```
                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   3

.7600   .7458   .7038   .7043   .7424   .8574   .9849  1.0403  1.0286  1.0049   .9639   .9619
.9446   .9509   .8752   .9406  1.0108  1.0635  1.1258  1.3280  1.4509  1.5576  1.2003  1.0535

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   4

.9535   .8235   .7000   .6870   .7000   .7185   .8315  1.0400  1.1055  1.0715   .9220   .8715
.8198   .9038   .9535   .9448   .8755   .8730  1.0777  1.2290  1.5145  1.6260  1.4720  1.2860

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   5

.9535   .8235   .7000   .6870   .7000   .7185   .8315  1.0400  1.1055  1.0715   .9220   .8715
.8198   .9038   .9535   .9448   .8755   .8730  1.0777  1.2290  1.5145  1.6260  1.4720  1.2860

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   6

.9535   .8235   .7000   .6870   .7000   .7185   .8315  1.0400  1.1055  1.0715   .9220   .8715
.8198   .9038   .9535   .9448   .8755   .8730  1.0777  1.2290  1.5145  1.6260  1.4720  1.2860

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   7

.9535   .8235   .7000   .6870   .7000   .7185   .8315  1.0400  1.1055  1.0715   .9220   .8715
.8198   .9038   .9535   .9448   .8755   .8730  1.0777  1.2290  1.5145  1.6260  1.4720  1.2860

                              WINTER VALUES

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   0

.7690   .7217   .6856   .6582   .7889   .9307  1.0247  1.0936  1.1295   .9633   .9171   .8820
.8780   .8214   .7959   .9338  1.2325  1.4574  1.4381  1.4658  1.3539  1.1968   .9897   .8723

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   1

.7290   .6933   .6567   .6441   .8013   .9493  1.0199  1.1465  1.0501   .9410   .9076   .8960
.8804   .8317   .8101   .9726  1.2330  1.4836  1.5054  1.4910  1.3439  1.1785  1.0234   .8118

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   2

.7517   .7124   .6356   .6436   .8335   .9582   .9915   .9993   .9970   .9668   .9243   .9059
.8967   .8719   .8501  1.0608  1.3177  1.5373  1.5142  1.4492  1.2660  1.1048   .9653   .8462

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   3

.6120   .5939   .5940   .6280   .8199  1.0192  1.1223  1.1621  1.0530  1.0166   .9879   .9025
.8879   .8609   .8864  1.0364  1.3120  1.5051  1.4611  1.4165  1.3105  1.1061   .9153   .7906

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   4

.7160   .6640   .6380   .6055   .6380   .7935   .9645  1.0445  1.0855  1.0465  1.0285   .8970
.8225   .8245   .9300  1.0165  1.1000  1.3530  1.6380  1.6910  1.4770  1.3000   .9515   .7745

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   5

.7160   .6640   .6380   .6055   .6380   .7935   .9645  1.0445  1.0855  1.0465  1.0285   .8970
.8225   .8245   .9300  1.0165  1.1000  1.3530  1.6380  1.6910  1.4770  1.3000   .9515   .7745

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   6

.7160   .6640   .6380   .6055   .6380   .7935   .9645  1.0445  1.0855  1.0465  1.0285   .8970
.8225   .8245   .9300  1.0165  1.1000  1.3530  1.6380  1.6910  1.4770  1.3000   .9515   .7745

                    HOURLY LOAD CURVE COEFFICIENTS FOR TYPE OF DAY   7

.7160   .6640   .6380   .6055   .6380   .7935   .9645  1.0445  1.0855  1.0465  1.0285   .8970
.8225   .8245   .9300  1.0165  1.1000  1.3530  1.6380  1.6910  1.4770  1.3000   .9515   .7745

                       TOTAL NUMBER OF WORKING DAYS      349.711

            ANNUAL ELECTRICITY DEMAND =    7672.399 GWH      ANNUAL GROWTH RATE =    .200  %

                       TOTAL RESULTS FOR THE POWER GENERATING SYSTEM
                       *********************************************

                       TOTAL ELECTRICITY CONSUMPTION =      71643.522 GWH
                       ANNUAL AVERAGE GROWTH RATE    =           .914  %
```

D.4 Input Data and Printout for Module 3

The input data and results of the execution of Module 3 of MAED for the Basic scenario are presented in a similar fashion as to those of Module 2. Table D.8 corresponds to the listing of the input data file used and Table D.9 shows the listing of the printed output produced by the program.

Table D.8 Input Data to Control Execution of Module 3

```
THIS IS - MEDIUM SCENARIO    - FOR ROMANIA
DEBUGGING OPTION        0
NUMBER OF PERIODS       4
MONTHS PER PERIODS      3
INTERVAL DELTA          0.0200

****     ADDITIONAL INPUT DATA TO CONTROL EXECUTION OF MODULE 3    ****
```

Table D.9 Printed Output of Module 3

```
LOAD DURATION CURVE IN PER UNIT SYSTEM FOR

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF GENERAL INPUT DATA FOR THE RUN
*****************************************

TOTAL NUMBER OF YEARS CONSIDERED          6

PRINTOUT OPTION SELECTED                  0
(.EQ. 0  MINIMUM OUTPUT)
(.NE. 0  MAXIMUM OUTPUT)

NUMBER OF PERIODS PER YEAR                4

NUMBER OF MONTHS PER PERIOD               3

INTERVAL BETWEEN POINTS OF L.D.C.         .020
```

LOAD DURATION CURVE IN PER UNIT SYSTEM FOR
ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

YEAR OF INPUT DATA 1989
PERIOD NUMBER 1
MONTH(S) OF PERIOD JAN. FEB. MAR.
MAXIMUM LOAD (MW) 10539.60
ENERGY (GWH) 18838.24
LOAD FACTOR (%) 82.75
TOTAL NO. OF HOURS 2160

LOAD (0/1)	DURATION (0/1)	ENERGY (0/1)
1.000000	.000000	1.000000
.980000	.062963	.999239
.960000	.097685	.997298
.940000	.126389	.994590
.920000	.141204	.991356
.900000	.191667	.987333
.880000	.262500	.981845
.860000	.402315	.973811
.840000	.477778	.963175
.820000	.545833	.950805
.800000	.626852	.936633
.780000	.675463	.920895
.760000	.777315	.903339
.740000	.839815	.883796
.720000	.865278	.863191
.700000	.909259	.841746
.680000	.937500	.819428
.660000	.965741	.796428
.640000	.975463	.772969
.620000	.987037	.749253
.600000	.999074	.725251
.580000	1.000000	.701093
.560000	1.000000	.676923
.540000	1.000000	.652754
.520000	1.000000	.628584
.500000	1.000000	.604415
.480000	1.000000	.580245
.460000	1.000000	.556076
.440000	1.000000	.531906
.420000	1.000000	.507737
.400000	1.000000	.483567
.380000	1.000000	.459398
.360000	1.000000	.435228
.340000	1.000000	.411059
.320000	1.000000	.386889
.300000	1.000000	.362720
.000000	1.000000	.000177

LOAD DURATION CURVE IN PER UNIT SYSTEM FOR
ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

YEAR OF INPUT DATA 1989
PERIOD NUMBER 2
MONTH(S) OF PERIOD APR. MAY JUNE
MAXIMUM LOAD (MW) 10378.00
ENERGY (GWH) 18810.56
LOAD FACTOR (%) 82.99
TOTAL NO. OF HOURS 2184

LOAD (0/1)	DURATION (0/1)	ENERGY (0/1)
1.000000	.000000	1.000000
.980000	.047619	.999426
.960000	.051282	.998235
.940000	.078297	.996673
.920000	.095238	.994582
.900000	.139194	.991757
.880000	.245421	.987123
.860000	.347985	.979973
.840000	.509158	.969645
.820000	.581960	.956498
.800000	.663004	.941497
.780000	.816850	.923665
.760000	.833333	.903782
.740000	.863553	.883335
.720000	.875000	.862387
.700000	.907051	.840914
.680000	.958333	.818437
.660000	.983517	.795039
.640000	.999084	.771150
.620000	1.000000	.747063
.600000	1.000000	.722964
.580000	1.000000	.698865
.560000	1.000000	.674766
.540000	1.000000	.650667
.520000	1.000000	.626569
.500000	1.000000	.602470
.480000	1.000000	.578371
.460000	1.000000	.554272
.440000	1.000000	.530174
.420000	1.000000	.506075
.400000	1.000000	.481976
.380000	1.000000	.457877
.360000	1.000000	.433779
.340000	1.000000	.409680
.320000	1.000000	.385581
.300000	1.000000	.361482
.000000	1.000000	.000001

Table D.9 Printed Output of Module 3 (cont.)

LOAD DURATION CURVE IN PER UNIT SYSTEM FOR
ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

YEAR OF INPUT DATA	1989
PERIOD NUMBER	3
MONTH(S) OF PERIOD	JULY AUG. SEP.
MAXIMUM LOAD (MW)	10499.90
ENERGY (GWH)	19079.92
LOAD FACTOR (%)	82.30
TOTAL NO. OF HOURS	2208

LOAD (0/1)	DURATION (0/1)	ENERGY (0/1)
1.000000	.000000	1.000000
.980000	.021739	.999736
.960000	.048913	.998877
.940000	.070199	.997430
.920000	.090580	.995476
.900000	.116395	.992961
.880000	.205616	.989049
.860000	.311141	.982770
.840000	.471014	.973266
.820000	.551630	.960840
.800000	.629982	.946482
.780000	.772645	.929439
.760000	.829257	.909975
.740000	.846467	.889613
.720000	.874094	.868707
.700000	.888587	.847289
.680000	.948370	.824968
.660000	.971467	.801640
.640000	.992754	.777773
.620000	1.000000	.753559
.600000	1.000000	.729258
.580000	1.000000	.704956
.560000	1.000000	.680654
.540000	1.000000	.656353
.520000	1.000000	.632051
.500000	1.000000	.607749
.480000	1.000000	.583447
.460000	1.000000	.559146
.440000	1.000000	.534844
.420000	1.000000	.510542
.400000	1.000000	.486240
.380000	1.000000	.461939
.360000	1.000000	.437637
.340000	1.000000	.413335
.320000	1.000000	.389033
.300000	1.000000	.364731
.000000	1.000000	.000205

LOAD DURATION CURVE IN PER UNIT SYSTEM FOR
ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

YEAR OF INPUT DATA	1989
PERIOD NUMBER	4
MONTH(S) OF PERIOD	OCT. NOV. DEC.
MAXIMUM LOAD (MW)	10563.10
ENERGY (GWH)	19307.38
LOAD FACTOR (%)	82.78
TOTAL NO. OF HOURS	2208

LOAD (0/1)	DURATION (0/1)	ENERGY (0/1)
1.000000	.000000	1.000000
.980000	.067029	.999190
.960000	.098279	.997193
.940000	.126359	.994480
.920000	.139493	.991268
.900000	.190217	.987285
.880000	.265399	.981781
.860000	.408514	.973641
.840000	.478261	.962928
.820000	.545743	.950558
.800000	.625000	.936416
.780000	.675725	.920703
.760000	.779438	.903125
.740000	.839221	.883571
.720000	.862772	.863011
.700000	.910326	.841592
.680000	.935688	.819292
.660000	.966486	.796314
.640000	.974638	.772865
.620000	.987319	.749165
.600000	1.000000	.725158
.580000	1.000000	.700998
.560000	1.000000	.676838
.540000	1.000000	.652678
.520000	1.000000	.628518
.500000	1.000000	.604358
.480000	1.000000	.580198
.460000	1.000000	.556038
.440000	1.000000	.531878
.420000	1.000000	.507718
.400000	1.000000	.483558
.380000	1.000000	.459398
.360000	1.000000	.435238
.340000	1.000000	.411078
.320000	1.000000	.386918
.300000	1.000000	.362758
.000000	1.000000	.000358

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 1989
****

ANNUAL MAXIMUM LOAD (MW)	10563.10
ANNUAL ENERGY (GWH)	76036.10
ANNUAL LOAD FACTOR (%)	82.17
TOTAL NUMBER OF HOURS	8760

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	10539.6	10378.0	10499.9	10563.1
REL. TO ANNUAL PEAK	.998	.982	.994	1.000
ENERGY (GWH)	18838.2	18810.6	19079.9	19307.4
LOAD FACTOR (%)	82.75	82.99	82.30	82.78
NUMBER OF HOURS	2160	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .1016 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 76036.0 GWH
CALCULATED FROM THE L.D.C. POINTS = 76036.1 GWH

Table D.9 Printed Output of Module 3 (cont.)

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 1992
****

ANNUAL MAXIMUM LOAD (MW) 8755.70
ANNUAL ENERGY (GWH) 58299.98
ANNUAL LOAD FACTOR (%) 75.80
TOTAL NUMBER OF HOURS 8784

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	8755.7	8652.5	8098.5	8493.4
REL. TO ANNUAL PEAK	1.000	.988	.925	.970
ENERGY (GWH)	15222.8	14420.8	14001.1	14655.3
LOAD FACTOR (%)	79.61	76.31	78.30	78.15
NUMBER OF HOURS	2184	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .0156 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 58300.0 GWH
CALCULATED FROM THE L.D.C. POINTS = 58300.0 GWH

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 1995
****

ANNUAL MAXIMUM LOAD (MW) 9226.60
ANNUAL ENERGY (GWH) 60660.02
ANNUAL LOAD FACTOR (%) 75.05
TOTAL NUMBER OF HOURS 8760

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	9109.2	8923.5	8976.7	9226.6
REL. TO ANNUAL PEAK	.987	.967	.973	1.000
ENERGY (GWH)	15280.8	14479.0	15204.4	15695.7
LOAD FACTOR (%)	77.66	74.29	76.71	77.04
NUMBER OF HOURS	2160	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .0195 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 60660.0 GWH
CALCULATED FROM THE L.D.C. POINTS = 60660.0 GWH

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 2000
****

ANNUAL MAXIMUM LOAD (MW) 11669.70
ANNUAL ENERGY (GWH) 76370.04
ANNUAL LOAD FACTOR (%) 74.50
TOTAL NUMBER OF HOURS 8784

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	11542.5	11159.9	11376.9	11669.7
REL. TO ANNUAL PEAK	.989	.956	.975	1.000
ENERGY (GWH)	18684.5	18047.0	19816.5	19822.0
LOAD FACTOR (%)	74.12	74.04	78.89	76.93
NUMBER OF HOURS	2184	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .0391 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 76370.0 GWH
CALCULATED FROM THE L.D.C. POINTS = 76370.0 GWH

Table D.9 Printed Output of Module 3 (cont.)

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 2005
****

ANNUAL MAXIMUM LOAD (MW) 14839.70
ANNUAL ENERGY (GWH) 95800.03
ANNUAL LOAD FACTOR (%) 73.69
TOTAL NUMBER OF HOURS 8760

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	14694.2	14284.5	14461.8	14839.7
REL. TO ANNUAL PEAK	.990	.963	.975	1.000
ENERGY (GWH)	23440.6	22535.1	24644.8	25179.5
LOAD FACTOR (%)	73.85	72.23	77.18	76.85
NUMBER OF HOURS	2160	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .1328 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 95799.9 GWH
CALCULATED FROM THE L.D.C. POINTS = 95800.0 GWH

ROM/0/002/IAEA-MEDIUM SCENARIO-FOR ROMANIA

SUMMARY OF RESULTS FOR THE YEAR: 2010
****

ANNUAL MAXIMUM LOAD (MW) 18969.80
ANNUAL ENERGY (GWH) 121000.10
ANNUAL LOAD FACTOR (%) 72.81
TOTAL NUMBER OF HOURS 8760

PERIOD NO.:	1	2	3	4
MAXIMUM LOAD:				
ABSOLUTE (MW)	18668.5	18184.7	18454.5	18969.8
REL. TO ANNUAL PEAK	.984	.959	.973	1.000
ENERGY (GWH)	29887.1	28454.3	30813.9	31844.7
LOAD FACTOR (%)	74.12	71.65	75.62	76.03
NUMBER OF HOURS	2160	2184	2208	2208

ERROR SUMMATION IN ANNUAL DEMAND = .1797 GWH

ANNUAL ENERGY GIVEN AS INPUT DATA = 120999.9 GWH
CALCULATED FROM THE L.D.C. POINTS = 121000.1 GWH

Table D.10 Electricity Generation Requirements (Ewbank Preece Forecast)

Year	Peak		Energy		Load factor
	MW	% Growth	GWh	% Growth	%
1989	10560	-	76036	-	82.20
1990	9564	-9.43	66145	-13.00	78.95
1991	8816	-7.82	57774	-12.65	74.81
1992	8534	-3.20	55317	-4.25	73.99
1993	8464	-0.82	53992	-2.39	72.82
1994	8589	1.48	54147	0.29	71.97
1995	8961	4.33	55975	3.37	71.31
1996	9503	6.05	58880	5.19	70.73
1997	10069	5.95	61777	4.92	70.04
2000	11464	4.42	68950	3.73	68.66
2005	13956	4.01	82718	3.71	67.66
2010	17653	4.81	103478	4.58	66.92

D.5 Results from other Forecasting Studies

Table D.10 shows the results of the electricity demand forecasting made within Ewbank Preece study and which were compared with the results obtained by running the MAED model.

Appendix E

INPUT DATA AND RESULTS OF THE WASP-III ANALYSIS

The relevant information related to the WASP-III analyses is summarized in this appendix, starting with the list of the existing power plants at the beginning of the study period (1992), followed by input data for the FIXSYS, VARSYS and DYNPRO modules.

These input data are based on the output report of the REPROBAT module of WASP for the optimal solution of the Basic scenario (this information is the same for the other scenarios).

The last tables show the optimal expansion plans found by the DYNPRO module for each of the three scenarios, and for the discount rate of 10% and 8%.

All the information is presented in the Tables E.1-E.11, as follows:

Table E. 1 Existing Power System - List of Power Plants of Romania (beginning of 1992)

Table E. 2 General Input Information for WASP List of Plant Types

Table E. 3 Input Data for FIXSYS

Table E. 4 Input Data for VARSYS

Table E. 5 Input Data for DYNPRO

Table E. 6 Optimal Expansion Plan from DYNPRO
Low Scenario - Discount Rate 10%

Table E. 7 Optimal Expansion Plan from DYNPRO
Low Scenario - Discount Rate 8%

Table E. 8 Optimal Expansion Plan from DYNPRO
Basic Scenario - Discount Rate 10%

Table E.9 Optimal Expansion Plan from DYNPRO
Basic Scenario - Discount Rate 8%

Table E.10 Optimal Expansion Plan from DYNPRO
High Scenario - Discount Rate 10%

Table E.11 Optimal Expansion Plan from DYNPRO
High Scenario - Discount Rate 8%

Table E.1 Existing Power System - List of Power Plants of Romania (beginning of 1992)

Power Plants	Nr Units x Unit Size (No x MW)	Gross Capacity (MW)
Total		21485
Thermal		15916
-condensation		9584
Işalniţa (lignite)	2x315+2x100	830
Deva (coal)	6x210	1260
Rovinari (lignite)	2x200+4x330	1720
Paroşeni (coal)	1x150	150
Doiceşti (lignite)	3x20+2x200	460
Turceni (lignite)	7x330	2310
Ovidiu (coal)	2x12	24
Brăila (oil+nat gas)	2x210+1x330	960
Luduş (nat gas)	4x100+2x200	800
Brazi (oil+nat gas)	2x200	400
Borzeşti (oil+nat gas)	2x210	420
Fîntînele (nat gas)	1x100+1x50+4x25	250
-cogeneration		6332
Işalniţa (lignite)	3x50+1x55	205
Oradea I (lignite)	1x55+3x50	205
Comăneşti (coal)	2x12	24
Ovidiu (coal)	1x12	12
Zalău (lignite)	2x12	24
Borzeşti II, et II (lignite)	3x50	150
Giurgiu (lignite)	3x50	150
Govora II (lignite)	2x50	100
Drobeta Tr Severin (lignite)	4x50	200
Iaşi II (lignite)	2x50	100
Craiova II (lignite)	2x210	240
Suceava (lignite)	2x50	100
Oradea II (lignite)	3x50	150
Braşov (lignite)	1x50	50
Paroşeni (coal)	3x50	150
Bucureşti Sud (oil+nat gas)	2x125+2x100+2x50	550
Brazi (oil+nat gas)	6x50+2x105	510
Galaţi (oil+nat gas)	3x105+1x100+2x60	535
Borzeşti I (oil+nat gas)	1x60+2x50+3x25	235
Borzeşti II (oil+nat gas)	2x50	100
Govora 1 (oil+nat gas)	4x50+1x7 5	207 5
Bucureşti Vest (oil+nat gas)	2x125	250
Palas (oil)	1x120+2x50	220
Iaşi I (oil+nat gas)	2x50+2x25	100
Grozăveşti (oil+nat gas)	2x50	150
Piteşti Sud (nat gas)	2x50+3x12	136
Tîrnăveni (nat gas)	1x12	12
Arad (nat gas)	1x12	12
Reşiţa (nat gas)	1x12	12
23 August (oil+nat gas)	2x4	8
Piteşti Găvana (nat gas)	1x6	6
Timişoara (nat gas)	1x4	4
Năvodari (oil)	3x50	150
F Z Buzău (oil+nat gas)	2x6	12
F Z Timişoara (oil+nat gas)	2x1 75	3 5
F T Botoşani (oil+nat gas)	1x2 5	2 5
Progresul (oil+nat gas)	3x50	150
Focşani (oil+nat gas)	2x4	8
Self Producers		1099

Table E.1 Existing Power System of Romania (beginning of 1992) (cont.)

Power Plants	Nr Units x Unit Size (No x MW)	Gross Capacity (MW)
Hydro		5569
Porţile de Fier 1	6x175	1050
Porţile de Fier 2	8x27	216
Someş-Mărişelu	3x73 3	220
Someş-Tarniţa	2x22 5	45
Someş-Downstream (6HPP)		35
Bistriţa-Cobiliţa	1x21	21
Drăgan-Remeţi-Munteni	2x50+2x29	158
Criş-Downstream (2Hpp)	2x9+2x9	36
Sebeş-Gîlceag	2x75	150
Sebeş-Sugag	2x75	150
Sebeş-Downstream (2HPP)	2x2+2x21	46
Rîul Mare-Retezat	2x167 5	335
Rîul Mare-Downstream (10HPP)		140
Cerna-Motru-Tismana	2x25+2x53	156
Lotru-Ciunget	3x170	510
Lotru-Mălaia	2x9	18
Lotru-Brădişor	2x57 5	115
Sadu-Sadu V	2x7 85+1x10	25 7
Olt-Voila	2x7 1	14 2
Olt-Vişţea	2x7 1	14 2
Olt-Arpaşu	1x7 1	7 1
Olt-Gura Lotrului	2x12 45	24 9
Olt-Turnu	2x35	70
Olt-Călimăneşti	2x19	38
Olt-Dăieşti	2x18 5	37
Olt-Rm Vîlcea	2x23	46
Olt-Rîureni	2x24	48
Olt-Govora	2x22 5	45
Olt-Băbeni	2x18 5	37
Olt-Ioneşti	2x19	38
Olt-Zăvideni	2x19	38
Olt-Drăgăşani	2x22 5	45
Olt-Străjeşti	2x25	50
Olt-Arceşti	2x19	38
Olt-Slatina	1x13	13
Olt-Ipoteşti	4x13 25	53
Olt-Drăgăneşti	4x13 25	53
Olt-Frunzaru	4x13 25	53
Olt-Rusăneşti	3x13 25	39 75
Argeş Corbeni	4x55	22
Argeş Downstream (15HPP)		187
Dîmboviţa-Clăbucet	2x32	64
Rîul Tîrgului-Lereşti	1x19	19
Doftana-Paltinul	2x5 2	10 4
Ialomiţa-Scropoasa	2x6	12
Ialomiţa-Dobreşti	4x4	16
Ialomiţa-Moroieni	2x7 5	15
Bistriţa-Stejarul	4x27 5+2x50	210
Bistriţa-Downstream (12HPP)		244
Siret-Downstream (3HPP)		119
Buzău-Nehoiaşu	2x21	42
Buzău-Downstream		35
Prut-St Costeşti	1x15	15
Other Hydro Power Plants (≤ 10 MW)		132

Table E. 2 General Input Information for WASP List of Plant Types

THIS IS A LIST OF THE DIFFERENT TYPES OF ELECTRIC POWER PLANTS
USED IN THE STUDY.
THE NUMERIC CODES ARE USED BY THE COMPUTER PROGRAMS

0	DOHI	DOMESTIC HIDROCARB.
1	DOCO	DOMESTIC COAL
2	IMHI	IMPORT HIDROCARB.
3	IMCO	IMPORT COAL
4	NUCL	NUCLEAR FUEL
	LONG	LONG TERM STORAGE
	SHRT	SHORT TERM STORAGE

Table E. 3 Input Data for FIXSYS

FIXED SYSTEM
SUMMARY DESCRIPTION OF THERMAL PLANTS IN YEAR 1992

NO.	NAME	NO. OF SETS	MIN. LOAD MW	CAPA CITY MW	HEAT RATES KCAL/KWH BASE LOAD	HEAT RATES KCAL/KWH AVGE INCR	FUEL COSTS CENTS/ MILLION DMSTC	FUEL COSTS CENTS/ KCAL FORGN	FUEL TYPE	FAST SPIN RES %	FOR %	DAYS SCHL MAIN	MAIN CLAS MW	O&M (FIX) $/KWM	O&M (VAR) $/MWH
3	TH25	45	18.	18.	1930.	1930.	1270.0	.0	0	0	2.5	35	50.	.71	.00
4	TH50	25	40.	40.	1780.	1780.	1270.0	.0	0	0	3.5	40	50.	.71	.00
5	50TH	6	35.	35.	1220.	1220.	1270.0	.0	0	0	3.5	40	50.	.71	.00
6	TH00	14	80.	80.	2080.	2080.	1270.0	.0	0	0	6.0	47	100.	.71	.00
7	TC12	5	6.	6.	2395.	2395.	1042.0	.0	1	0	8.0	42	50.	2.03	.00
8	TC25	2	18.	18.	2555.	2555.	1042.0	.0	1	0	8.0	42	50.	2.03	.00
9	TC50	14	35.	35.	2395.	2395.	1042.0	.0	1	0	10.0	49	50.	2.03	.00
10	50TC	13	30.	30.	1516.	1516.	1042.0	.0	1	0	10.0	49	50.	2.03	.00
11	TC00	2	85.	85.	2998.	2998.	1042.0	.0	1	0	6.0	47	100.	2.03	.00
12	25-F	0	13.	21.	3417.	2934.	1189.0	.0	0	0	3.0	36	50.	.70	.00
13	50-F	0	23.	46.	3133.	2805.	1189.0	.0	0	0	3.0	36	50.	.70	.00
14	100F	1	42.	83.	3028.	2503.	1189.0	.0	0	10	6.0	46	100.	.70	.00
15	100L	4	43.	95.	2615.	2286.	1189.0	.0	0	10	6.0	46	100.	1.33	.00
16	200L	2	80.	189.	2490.	2180.	1189.0	.0	0	10	7.0	51	200.	1.33	.00
17	20BZ	2	80.	188.	2995.	2313.	1270.0	.0	0	10	7.0	51	200.	.55	.00
18	20BO	2	79.	186.	3082.	2430.	1270.0	.0	0	10	7.0	51	200.	.75	.00
19	20BL	3	80.	189.	2587.	2190.	1270.0	.0	0	10	7.0	51	200.	1.09	.00
20	33BL	1	142.	284.	2520.	2233.	1270.0	.0	0	10	6.0	55	300.	1.09	.00
21	12OV	0	4.	6.	8630.	7670.	891.0	.0	1	0	10.0	44	50.	.77	.00
22	DO20	0	9.	13.	4982.	3788.	891.0	.0	1	0	10.0	44	50.	3.27	.00
23	100I	2	40.	65.	4661.	3200.	1008.0	.0	1	0	10.0	46	100.	1.95	.00
24	150P	1	50.	84.	5083.	3833.	853.0	.0	1	0	10.0	46	100.	2.20	.00
25	20DO	2	72.	98.	5268.	3611.	891.0	.0	1	0	20.0	53	200.	3.27	.00
26	20DE	6	77.	145.	3070.	2696.	932.0	.0	1	0	7.0	53	200.	2.35	.00
27	315I	2	135.	233.	3671.	2966.	1008.0	.0	1	0	6.0	47	300.	1.95	.00
28	330R	4	137.	197.	3710.	3311.	823.0	.0	1	0	45.0	47	300.	2.40	.00
29	330T	5	134.	192.	4187.	3722.	932.0	.0	1	0	45.0	47	300.	2.12	.00
30	200R	2	78.	105.	4219.	3301.	823.0	.0	1	0	35.0	53	200.	2.40	.00

FIXED SYSTEM
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	HYDROCONDITION 1 PROB.: .20 CAPACITY PEAK	HYDROCONDITION 1 PROB.: .20 ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	HYDROCONDITION 2 PROB.: .80 CAPACITY PEAK	HYDROCONDITION 2 PROB.: .80 ENERGY
1992	12	1	8.	2990.	1429.	8.	2990.	1135.
		2	11.	2986.	1809.	6.	2991.	1282.
		3	4.	2968.	1532.	1.	2971.	1145.
		4	5.	2992.	2309.	0.	2997.	1577.
		INST.CAP.	3455.					
		TOTAL ENERGY			7079.			5139.
1993	13	1	19.	3084.	1494.	20.	3083.	1203.
		2	24.	3083.	1879.	17.	3090.	1347.
		3	13.	3059.	1587.	7.	3065.	1190.
		4	12.	3090.	2359.	5.	3097.	1617.
		INST.CAP.	3577.					
		TOTAL ENERGY			7319.			5357.

Table E. 3 Input Data for FIXSYS (cont.)

FIXED SYSTEM

SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE SHRT

*** CAPACITY IN MW * ENERGY IN GWH ***

FIXED O&M COSTS : .500 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	PEAK	ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	PEAK	ENERGY
1992	4	1	510.	1525.	2317.	765.	1163.	2812.
		2	651.	1423.	2642.	458.	1561.	2213.
		3	404.	1640.	1936.	191.	1772.	1263.
		4	487.	1538.	2247.	138.	1887.	1141.
		INST.CAP.	2236.					
		TOTAL ENERGY			9142.			7429.
1995	5	1	520.	1525.	2339.	775.	1163.	2834.
		2	661.	1423.	2664.	469.	1561.	2235.
		3	414.	1640.	1958.	201.	1772.	1285.
		4	498.	1538.	2269.	148.	1887.	1163.
		INST.CAP.	2249.					
		TOTAL ENERGY			9230.			7517.

FIXED SYSTEM
THERMAL ADDITIONS AND RETIREMENTS

NUMBER OF SETS ADDED AND RETIRED(-)
1992 TO 2015

YEAR: 19.. (200./20..)

NO.	NAME	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7	8	9	10
3	TH25	-4	-3	-5	-4	-1	-1	-2	-4	*	*	-1	*	-1	-1	-2	-2	-1	-2
4	TH50	-2	-1	-2	-2	*	*	-1	-3	-1	-1	*	*	-4	-1	-1	*	-1	*
5	50TH	1	*	*	*	*	*	*	*	*	*	*	*	*	*	-1	*	*	*
6	TH00	*	*	*	*	-1	-1	-1	*	*	*	-2	*	-1	*	*	*	*	-4
7	TC12	*	*	*	*	*	*	*	*	-1	*	*	*	*	*	*	*	*	*
8	TC25	*	*	*	-2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9	TC50	1	1	-1	2	-1	*	*	*	*	*	-1	*	*	-2	*	*	*	*
10	50TC	*	*	*	-1	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14	100F	*	*	-1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15	100L	-1	-2	*	-1	*	*	*	*	*	*	*	*	*	*	*	*	*	*
17	20BZ	*	*	*	*	*	*	*	*	*	-2	*	*	*	*	*	*	*	*
18	20BO	*	*	*	*	*	*	*	-2	*	*	*	*	*	*	*	*	*	*
19	20BL	*	*	*	*	*	*	*	*	*	*	-1	-2	*	*	*	*	*	*
23	100I	*	*	-1	-1	*	*	*	*	*	*	*	*	*	*	*	*	*	*
24	150P	*	*	*	*	*	*	-1	*	*	*	*	*	*	*	*	*	*	*
26	20DE	*	*	*	*	*	*	-1	-1	-2	*	*	*	*	*	*	*	*	*
27	315I	*	*	*	*	*	-1	*	-1	*	*	*	*	*	*	*	*	*	*
29	330T	*	1	*	*	*	*	*	*	-1	-1	*	*	*	*	*	*	*	*
30	200R	*	*	*	*	*	*	*	*	*	*	*	*	*	*	-1	-1	*	*

FIXED SYSTEM
SUMMARY OF INSTALLED CAPACITIES
(NOMINAL CAPACITIES (MW))

YEAR	HYDROELECTRIC LONG PR.	LONG CAP	SHRT PR.	SHRT CAP	THERMAL FUEL TYPE 0 DOHI	1 DOCO	2 IMHI	3 IMCO	4 NUCL	TOTAL
1992	12	3455.	4	2236.	5580.	4820.	0.	0.	0.	16091.
1993	13	3577.	4	2236.	5368.	4855.	0.	0.	0.	16036.
1994					5084.	5082.	0.	0.	0.	15979.
1995	13	3577.	5	2249.	4831.	4982.	0.	0.	0.	15639.
1996					4584.	4921.	0.	0.	0.	15331.
1997					4486.	4886.	0.	0.	0.	15198.
1998					4388.	4653.	0.	0.	0.	14867.
1999					4232.	4424.	0.	0.	0.	14482.
2000					3668.	4046.	0.	0.	0.	13540.
2001					3628.	3558.	0.	0.	0.	13012.
2002					3212.	3366.	0.	0.	0.	12404.
2003					2845.	3331.	0.	0.	0.	12002.
2004					2467.	3331.	0.	0.	0.	11624.
2005					2209.	3331.	0.	0.	0.	11366.
2006					2151.	3261.	0.	0.	0.	11238.
2007					2040.	3156.	0.	0.	0.	11022.
2008					2004.	3051.	0.	0.	0.	10881.
2009					1946.	3051.	0.	0.	0.	10823.
2010					1590.	3051.	0.	0.	0.	10467.

Table E. 4 Input Data for VARSYS

VARIABLE SYSTEM
SUMMARY DESCRIPTION OF THERMAL PLANTS

NO.	NAME	NO. OF SETS	MIN. LOAD MW	CAPA CITY MW	HEAT RATES KCAL/KWH BASE LOAD	HEAT RATES KCAL/KWH AVGE INCR	FUEL COSTS CENTS/ MILLION DMSTC	FUEL COSTS CENTS/ KCAL FORGN	FUEL TYPE	FAST SPIN RES %	FOR %	DAYS SCHL MAIN	MAIN CLAS MW	O&M (FIX) $/KWM	O&M (VAR) $/MWH
1	BL20	0	80.	189.	2587.	2190.	1218.0	.0	0	10	7.0	51	200.	1.75	3.00
2	BL33	0	142.	284.	2520.	2233.	1218.0	.0	0	10	6.0	55	300.	1.70	3.00
3	BZ20	0	80.	188.	2995.	2313.	1218.0	.0	0	10	7.0	51	200.	1.80	3.00
4	BO20	0	79.	186.	3082.	2430.	1218.0	.0	0	10	7.0	51	200.	1.80	3.00
5	I315	0	135.	258.	3214.	2669.	996.0	.0	1	0	8.0	47	300.	2.13	4.00
6	DE20	0	80.	175.	2960.	2600.	996.0	.0	1	0	7.0	53	200.	2.35	4.00
7	DOI2	0	80.	156.	3447.	2765.	996.0	.0	1	0	8.0	53	200.	2.70	4.00
8	A3TR	0	135.	258.	3057.	2841.	996.0	.0	1	0	20.0	47	300.	2.13	4.00
9	A2TR	0	135.	243.	4187.	3722.	996.0	.0	1	0	30.0	47	300.	2.20	4.10
10	CC 6	0	258.	646.	1930.	1710.	.0	1319.0	2	0	4.0	34	600.	1.73	1.60
11	NUC1	0	127.	633.	3257.	2887.	69.9	.0	4	0	10.0	33	600.	3.74	.39
12	NUC2	0	127.	633.	3257.	2887.	69.9	.0	4	0	10.0	33	600.	3.74	.39

VARIABLE SYSTEM
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	HYDROCONDITION 1 PROB.: .20 CAPACITY PEAK	HYDROCONDITION 1 PROB.: .20 ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	HYDROCONDITION 2 PROB.: .80 CAPACITY PEAK	HYDROCONDITION 2 PROB.: .80 ENERGY
1994	1	1	0.	170.	90.	0.	170.	90.
		2	0.	172.	93.	0.	172.	85.
		3	0.	170.	85.	0.	170.	60.
		4	0.	170.	82.	0.	170.	55.
		INST.CAP.		182.				
		TOTAL ENERGY			350.			290.
1995	2	1	3.	225.	130.	0.	228.	128.
		2	4.	225.	135.	0.	229.	120.
		3	0.	228.	113.	0.	228.	85.
		4	0.	226.	112.	0.	226.	78.
		INST.CAP.		249.				
		TOTAL ENERGY			490.			411.
1996	3	1	7.	351.	200.	4.	354.	198.
		2	9.	350.	205.	2.	357.	185.
		3	0.	358.	173.	0.	358.	130.
		4	1.	355.	177.	0.	356.	118.
		INST.CAP.		388.				
		TOTAL ENERGY			755.			631.
1997	4	1	19.	409.	240.	15.	413.	238.
		2	21.	408.	247.	11.	418.	220.
		3	8.	418.	205.	3.	423.	150.
		4	9.	414.	209.	2.	421.	136.
		INST.CAP.		464.				
		TOTAL ENERGY			901.			744.

Table E. 4 Input Data for VARSYS (cont.)

VARIABLE SYSTEM (CONTD.)
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	PEAK	ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	PEAK	ENERGY
1998	5	1	24.	564.	300.	19.	569.	293.
		2	29.	562.	321.	16.	575.	280.
		3	17.	573.	285.	10.	580.	220.
		4	19.	568.	294.	11.	576.	211.
		INST.CAP.	630.					
		TOTAL ENERGY			1200.			1004.
1999	6	1	24.	642.	350.	19.	647.	341.
		2	31.	640.	376.	16.	655.	325.
		3	17.	653.	333.	10.	660.	260.
		4	19.	648.	344.	11.	656.	251.
		INST.CAP.	712.					
		TOTAL ENERGY			1403.			1177.
2000	7	1	24.	757.	415.	19.	762.	391.
		2	31.	758.	441.	16.	773.	370.
		3	17.	768.	393.	10.	775.	300.
		4	19.	766.	414.	11.	774.	316.
		INST.CAP.	832.					
		TOTAL ENERGY			1663.			1377.
2001	8	1	24.	807.	445.	19.	812.	421.
		2	31.	808.	471.	16.	823.	398.
		3	17.	818.	418.	10.	825.	315.
		4	19.	816.	435.	11.	824.	330.
		INST.CAP.	884.					
		TOTAL ENERGY			1769.			1464.

VARIABLE SYSTEM (CONTD.)
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	PEAK	ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	PEAK	ENERGY
2002	9	1	30.	884.	500.	26.	888.	479.
		2	34.	887.	521.	20.	901.	446.
		3	21.	896.	468.	12.	905.	355.
		4	22.	893.	480.	11.	904.	360.
		INST.CAP.	969.					
		TOTAL ENERGY			1969.			1640.
2003	10	1	30.	964.	551.	26.	968.	526.
		2	34.	967.	571.	20.	981.	491.
		3	21.	976.	518.	12.	985.	395.
		4	22.	971.	525.	11.	982.	392.
		INST.CAP.	1052.					
		TOTAL ENERGY			2165.			1804.
2004	11	1	30.	1089.	626.	26.	1093.	591.
		2	34.	1092.	651.	20.	1106.	551.
		3	21.	1101.	613.	12.	1110.	458.
		4	22.	1096.	625.	11.	1107.	467.
		INST.CAP.	1182.					
		TOTAL ENERGY			2515.			2067.
2005	12	1	30.	1154.	661.	26.	1158.	623.
		2	34.	1157.	681.	20.	1171.	576.
		3	21.	1166.	648.	12.	1175.	484.
		4	22.	1161.	660.	11.	1172.	487.
		INST.CAP.	1249.					
		TOTAL ENERGY			2650.			2170.

Table E. 4 Input Data for VARSYS (cont.)

VARIABLE SYSTEM (CONTD.)
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	PEAK	ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	PEAK	ENERGY
2006	13	1	45.	1189.	701.	41.	1193.	663.
		2	52.	1190.	726.	30.	1212.	606.
		3	36.	1201.	688.	22.	1215.	514.
		4	35.	1196.	695.	19.	1212.	512.
		INST.CAP.	1302.					
		TOTAL ENERGY			2810.			2295.
2007	14	1	50.	1319.	776.	45.	1324.	733.
		2	56.	1321.	796.	32.	1345.	666.
		3	41.	1331.	763.	23.	1349.	569.
		4	39.	1327.	765.	19.	1347.	562.
		INST.CAP.	1445.					
		TOTAL ENERGY			3100.			2530.
2008	15	1	50.	1537.	876.	45.	1542.	813.
		2	56.	1539.	906.	32.	1563.	746.
		3	41.	1549.	873.	23.	1567.	639.
		4	39.	1545.	885.	19.	1565.	657.
		INST.CAP.	1665.					
		TOTAL ENERGY			3540.			2855.
2009	16	1	50.	1727.	966.	45.	1732.	883.
		2	56.	1729.	1016.	32.	1753.	826.
		3	41.	1739.	973.	23.	1757.	724.
		4	39.	1735.	985.	19.	1755.	747.
		INST.CAP.	1865.					
		TOTAL ENERGY			3940.			3180.

VARIABLE SYSTEM (CONTD.)
SUMMARY DESCRIPTION OF COMPOSITE HYDROELECTRIC PLANT TYPE LONG
*** CAPACITY IN MW * ENERGY IN GWH ***
FIXED O&M COSTS : .400 $/KW-MONTH

YEAR	PROJ	PER	HYDROCONDITION 1 PROB.: .20 CAPACITY BASE	PEAK	ENERGY	HYDROCONDITION 2 PROB.: .80 CAPACITY BASE	PEAK	ENERGY
2010	17	1	56.	1786.	1006.	50.	1792.	921.
		2	61.	1789.	1056.	35.	1815.	856.
		3	45.	1800.	1008.	26.	1819.	754.
		4	41.	1793.	1010.	20.	1814.	767.
		INST.CAP.	1936.					
		TOTAL ENERGY			4080.			3298.
2011	18	1	56.	1866.	1046.	50.	1872.	956.
		2	61.	1869.	1104.	35.	1895.	886.
		3	45.	1880.	1046.	26.	1899.	786.
		4	41.	1873.	1044.	20.	1894.	793.
		INST.CAP.	2019.					
		TOTAL ENERGY			4240.			3421.

Table E. 5 Input Data for DYNPRO

D Y N P R O

SUMMARY OF CAPITAL COSTS OF ALTERNATIVES IN $/KW

PLANT	CAPITAL COSTS (DEPRECIABLE PART) DOMESTIC	FOREIGN	INCLUSIVE IDC %	CONSTR. TIME (YEARS)	PLANT LIFE (YEARS)	CAPITAL COSTS (NON-DEPREC. PART) DOMESTIC	FOREIGN
THERMAL PLANT CAPITAL COSTS							
BL20	75.0	.0	8.08	2.00	10.	.0	.0
BL33	184.0	.0	8.08	2.00	10.	.0	.0
BZ20	98.0	.0	8.08	2.00	10.	.0	.0
BO20	99.0	.0	8.08	2.00	10.	.0	.0
I315	265.0	.0	8.08	2.00	10.	.0	.0
DE20	211.0	.0	8.08	2.00	10.	.0	.0
DOI2	139.0	.0	8.08	2.00	15.	.0	.0
A3TR	295.0	.0	8.08	2.00	15.	.0	.0
A2TR	89.0	.0	8.08	2.00	5.	.0	.0
CC 6	875.0	.0	19.21	5.00	30.	.0	.0
NUC1	1545.0	.0	11.92	3.00	30.	284.0	.0
NUC2	2410.0	.0	19.21	5.00	30.	309.0	.0
LONG - HYDRO PROJECT CAPITAL COSTS, PROJECT LIFE: 50.							
1	1955.0	.0	15.63	5.00			
2	1743.0	.0	15.63	5.00			
3	1841.0	.0	15.63	5.00			
4	2578.0	.0	15.63	5.00			
5	1350.0	.0	15.63	5.00			
6	2863.0	.0	15.63	5.00			
7	2568.0	.0	26.00	7.00			
8	2703.0	.0	26.00	7.00			
9	2946.0	.0	26.00	7.00			
10	2703.0	.0	26.00	7.00			
11	2906.0	.0	26.00	7.00			
12	3378.0	.0	26.00	7.00			
13	3514.0	.0	26.00	7.00			
14	3514.0	.0	26.00	7.00			
15	3378.0	.0	26.00	7.00			
16	3514.0	.0	26.00	7.00			

D Y N P R O (CONTD.)

SUMMARY OF CAPITAL COSTS OF ALTERNATIVES IN $/KW

PLANT	CAPITAL COSTS (DEPRECIABLE PART) DOMESTIC	FOREIGN	INCLUSIVE IDC %	CONSTR. TIME (YEARS)	PLANT LIFE (YEARS)	CAPITAL COSTS (NON-DEPREC. PART) DOMESTIC	FOREIGN
LONG - HYDRO PROJECT CAPITAL COSTS, PROJECT LIFE: 50. (CONTD.)							
17	3649.0	.0	26.00	7.00			
18	3784.0	.0	26.00	7.00			

Table E. 5 Input Data for DYNPRO (cont.)

D Y N P R O

ECONOMIC PARAMETERS AND CONSTRAINTS

ALL COSTS WILL BE DISCOUNTED TO YEAR : 1992
BASE YEAR FOR ESCALATION CALCULATION IS : 1992

1992 INITIAL VALUES : (XX) = INDEX NUMBER; (0) = NO INDEX READ
****

NAME OF ALTERNATIVES :

	BL20	BL33	BZ20	BO20	I315	DE20	DOI2	A3TR	A2TR	CC 6	NUC1	NUC2	LONG
DISCOUNT RATE APPLIED TO ALL DOMESTIC CAPITAL COSTS - %/YR										10.0			
DISCOUNT RATE APPLIED TO ALL FOREIGN CAPITAL COSTS - %/YR										10.0			
ESCALATION RATIOS FOR CAPITAL COSTS (0)													
DOMESTIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FOREIGN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MAXIMUM NUMBER OF UNITS WHICH CAN BE ADDED (6)													
	50	50	50	50	50	50	50	50	50	50	50	50	50
MINIMUM NUMBER OF UNITS WHICH MUST BE ADDED (7)													
	0	0	0	0	0	0	0	0	0	0	0	0	0

D Y N P R O (CONTD.)

ECONOMIC PARAMETERS AND CONSTRAINTS

1992 INITIAL VALUES : (XX) = INDEX NUMBER; (0) = NO INDEX READ
****

FUEL TYPE:	T H E R M A L					HYDROELECTRIC		ENERGY
	DOHI	DOCO	IMHI	IMCO	NUCL	LONG	SHRT	NOT SERVED
DISCOUNT RATE APPLIED TO ALL DOMESTIC OPERATION COSTS - %/YR (14)							10.0	
DISCOUNT RATE APPLIED TO ALL FOREIGN OPERATION COSTS - %/YR (15)							10.0	
ESCALATION RATIOS FOR OPERATING COSTS (0)								
DOMESTIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FOREIGN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MULTIPLYING FACTOR FOR FUEL COSTS (17)								
DOMESTIC	1.00	1.00	1.00	1.00	1.00	.00	.00	1.00
FOREIGN	1.00	1.00	1.00	1.00	1.00	.00	.00	1.00

COEFFICIENTS OF ENERGY NOT SERVED COST FUNCTION (11)		CF1	CF2	CF3
	($/KWH)	1.0000	.0000	.0000
PENALTY FACTOR ON FOREIGN EXPENDITURE	(3)	1.0000		
CRITICAL LOSS OF LOAD PROBABILITY IN %	(12)	100.0000		

DEPRECIATION OPTION (16) : 1 = SINKING FUND

Table E. 6 Optimal Expansion Plan from DYNPRO - Low Scenario - Discount Rate 10%

YEAR------ PRESENT WORTH COST OF THE YEAR (K$)------ OBJ.FUN. LOLP BL20 BZ20 I315 DOI2 A2TR NUC1 LONG

	CONCST	SALVAL	OPCOST	ENSCST	TOTAL	(CUMM.)	%	BL33	BO20	DE20	A3TR	CC 6	NUC2						
2015	0	0	271111	301	271412	18106234	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2014	0	0	298222	332	298554	17834822	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2013	0	0	328044	365	328410	17536268	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2012	0	0	360849	401	361250	17207858	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2011	0	1	396934	441	397374	16846608	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2010	165661	90580	436627	485	512193	16449234	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2009	111832	54078	461544	420	519718	15937041	.130	3	0	2	2	2	4	0	4	0	7	2	0	0
2008	123015	53398	484720	292	554629	15417323	.094	3	0	2	2	2	4	0	4	0	6	2	0	0
2007	139725	52926	510566	129	597493	14862694	.062	3	0	2	2	2	4	0	4	0	5	2	0	0
2006	17166	0	534300	148	551614	14265201	.058	3	0	2	1	2	4	0	4	0	4	2	0	0
2005	9443	0	550049	178	559669	13713587	.048	1	0	1	0	2	4	0	4	0	4	2	0	0
2004	384463	102380	582003	0	864086	13153918	.008	0	0	0	0	2	4	0	4	0	4	2	0	0
2003	250677	50596	614312	624	815018	12289832	.009	0	0	0	0	2	4	0	3	0	2	2	0	0
2002	28472	0	637518	630	666620	11474814	.012	0	0	0	0	2	2	0	2	0	1	2	0	0
2001	268717	46303	659864	0	882278	10808194	.006	0	0	0	0	2	0	0	2	0	1	2	0	0
2000	571998	95842	687109	10	1163274	9925916	.003	0	0	0	0	1	0	0	2	0	0	2	0	0
1999	594113	93069	790817	0	1291861	8762642	.002	0	0	0	0	0	0	0	2	0	0	1	0	0
1998	0	0	881027	0	881028	7470782	.001	0	0	0	0	0	0	0	2	0	0	0	0	0
1997	0	0	927217	24	927241	6589754	.001	0	0	0	0	0	0	0	2	0	0	0	0	0
1996	103968	0	973000	149	1077117	5662514	.000	0	0	0	0	0	0	0	2	0	0	0	0	0
1995	0	0	1008779	66	1008846	4585397	.002	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	1081880	0	1081880	3576552	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	1178663	202	1178865	2494671	.000	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	1315423	384	1315807	1315807	.001	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E. 7 Optimal Expansion Plan from DYNPRO - Low Scenario - Discount Rate 8%

SOLUTION # 1 VARIABLE ALTERNATIVES BY YEAR

YEAR------ PRESENT WORTH COST OF THE YEAR (K$)------ OBJ.FUN. LOLP BL20 BZ20 I315 DOI2 A2TR NUC1 LONG

	CONCST	SALVAL	OPCOST	ENSCST	TOTAL	(CUMM.)	%	BL33	BO20	DE20	A3TR	CC 6	NUC2						
2015	0	0	417269	464	417734	21347306	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2014	0	0	450651	501	451152	20929572	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2013	0	0	486703	541	487244	20478420	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2012	0	0	525639	584	526224	19991176	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2011	0	0	567691	631	568322	19464952	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2010	218592	131551	613106	682	700828	18896630	.161	3	0	2	2	2	4	0	4	0	8	2	0	1
2009	146310	78645	636311	578	704554	18195802	.130	3	0	2	2	2	4	0	4	0	7	2	0	0
2008	158014	77355	656112	395	737166	17491248	.094	3	0	2	2	2	4	0	4	0	6	2	0	0
2007	176343	76352	678531	171	778693	16754082	.062	3	0	2	2	2	4	0	4	0	5	2	0	0
2006	21811	0	697163	194	719167	15975389	.058	3	0	2	1	2	4	0	4	0	4	2	0	0
2005	11779	0	704663	228	716669	15256222	.048	1	0	1	0	2	4	0	4	0	4	2	0	0
2004	459665	145690	732043	0	1046018	14539553	.008	0	0	0	0	2	4	0	4	0	4	2	0	0
2003	295486	71629	758633	771	983261	13493535	.009	0	0	0	0	2	4	0	3	0	2	2	0	0
2002	33720	0	772975	764	807460	12510274	.012	0	0	0	0	2	2	0	2	0	1	2	0	0
2001	304494	64908	785523	0	1025110	11702814	.006	0	0	0	0	2	0	0	2	0	1	2	0	0
2000	646149	137743	803084	11	1311502	10677704	.003	0	0	0	0	1	0	0	2	0	0	2	0	0
1999	658550	133197	907492	0	1432845	9366202	.002	0	0	0	0	0	0	0	2	0	0	1	0	0
1998	0	0	992630	0	992630	7933357	.001	0	0	0	0	0	0	0	2	0	0	0	0	0
1997	0	0	1025676	27	1025703	6940727	.001	0	0	0	0	0	0	0	2	0	0	0	0	0
1996	109990	0	1056751	161	1166903	5915025	.000	0	0	0	0	0	0	0	2	0	0	0	0	0
1995	0	0	1075691	71	1075761	4748122	.002	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	1132665	0	1132665	3672361	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	1211555	207	1211762	2539696	.000	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	1327547	387	1327934	1327934	.001	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E. 8 Optimal Expansion Plan from DYNPRO - Basic Scenario - Discount Rate 10%

SOLUTION # 1 VARIABLE ALTERNATIVES BY YEAR

YEAR	PRESENT WORTH COST OF THE YEAR (K$) CONCST	SALVAL	OPCOST	ENSCST	TOTAL	OBJ.FUN. (CUMM.)	LOLP %	BL20 BL33	BZ20 BO20	I315 DE20	DOI2 A3TR	A2TR CC 6	NUC1 NUC2	LONG
2015	0	0	327552	357	327908	20585418	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2014	0	0	360307	392	360700	20257510	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2013	0	1	396337	432	396768	19896810	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2012	0	0	435971	475	436446	19500042	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2011	0	0	479568	522	480090	19063596	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2010	129043	66397	527525	574	590746	18583506	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2009	223664	108155	546725	221	662454	17992760	.253	3 0	2 2	2 4	0 2	0 12	2 0	2
2008	126100	53804	570016	649	642961	17330306	.381	3 0	2 2	2 4	0 2	0 10	2 0	2
2007	270633	105300	596178	306	761817	16687345	.176	2 0	2 2	2 4	0 2	0 9	2 0	2
2006	188185	63521	623384	612	748659	15925528	.260	2 0	2 2	2 4	0 2	0 7	2 0	2
2005	178535	50922	648395	579	776587	15176869	.237	1 0	1 2	2 4	0 2	0 6	2 0	1
2004	131008	35460	681114	299	776961	14400282	.093	0 0	1 2	2 3	0 2	0 5	2 0	1
2003	415630	97664	702804	127	1020896	13623321	.018	0 0	0 2	2 2	0 2	0 5	2 0	0
2002	239264	47628	727668	123	919428	12602425	.041	0 0	0 1	2 1	0 2	0 3	2 0	0
2001	268717	46303	747970	137	970521	11682997	.030	0 0	0 0	2 0	0 2	0 2	2 0	0
2000	31895	0	776959	61	808915	10712476	.018	0 0	0 0	1 0	0 2	0 1	2 0	0
1999	884175	136312	819618	195	1567677	9903561	.001	0 0	0 0	0 0	0 2	0 1	2 0	0
1998	653524	90018	904847	0	1468353	8335884	.002	0 0	0 0	0 0	0 2	0 0	1 0	0
1997	0	0	995459	0	995459	6867531	.000	0 0	0 0	0 0	0 2	0 0	0 0	0
1996	103968	0	1027521	0	1131489	5872072	.001	0 0	0 0	0 0	0 2	0 0	0 0	0
1995	0	0	1045365	268	1045633	4740583	.000	0 0	0 0	0 0	0 0	0 0	0 0	0
1994	0	0	1137334	280	1137614	3694950	.002	0 0	0 0	0 0	0 0	0 0	0 0	0
1993	0	0	1240619	911	1241530	2557336	.002	0 0	0 0	0 0	0 0	0 0	0 0	0
1992	0	0	1315423	384	1315807	1315807	.001	0 0	0 0	0 0	0 0	0 0	0 0	0

Table E. 9 Optimal Expansion Plan from DYNPRO - Basic Scenario - Discount Rate 8%

SOLUTION # 1 VARIABLE ALTERNATIVES BY YEAR

YEAR	PRESENT WORTH COST OF THE YEAR (K$) CONCST	SALVAL	OPCOST	ENSCST	TOTAL	OBJ.FUN. (CUMM.)	LOLP %	BL20 BL33	BZ20 BO20	I315 DE20	DOI2 A3TR	A2TR CC 6	NUC1 NUC2	LONG
2015	0	1	504138	549	504686	24342822	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2014	0	0	544469	593	545062	23838136	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2013	0	0	588026	640	588666	23293074	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2012	0	0	635068	692	635760	22704408	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2011	0	1	685874	747	686620	22068648	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2010	172919	97065	740744	807	817404	21382028	.466	3 0	2 2	2 4	0 4	0 13	2 0	2
2009	292619	157291	753746	304	889378	20564624	.253	3 0	2 2	2 4	0 2	0 12	2 0	2
2008	162097	77940	771567	879	856602	19675246	.381	3 0	2 2	2 4	0 2	0 10	2 0	2
2007	341311	151919	792308	407	982106	18818644	.176	2 0	2 2	2 4	0 2	0 9	2 0	2
2006	232327	91209	813401	798	955318	17836538	.260	2 0	2 2	2 4	0 2	0 7	2 0	2
2005	217579	72826	830654	742	976149	16881220	.237	1 0	1 2	2 4	0 2	0 6	2 0	1
2004	153523	50648	856705	376	959957	15905071	.093	0 0	1 2	2 3	0 2	0 5	2 0	1
2003	487699	138343	867913	157	1217427	14945114	.018	0 0	0 2	2 2	0 2	0 5	2 0	0
2002	275966	67122	882281	149	1091275	13727687	.041	0 0	0 1	2 1	0 2	0 3	2 0	0
2001	304494	64908	890407	163	1130157	12636412	.030	0 0	0 0	2 0	0 2	0 2	2 0	0
2000	36381	0	908100	72	944552	11506255	.018	0 0	0 0	1 0	0 2	0 1	2 0	0
1999	974421	193133	940542	224	1722055	10561703	.001	0 0	0 0	0 0	0 2	0 1	2 0	0
1998	711234	128287	1019467	0	1602415	8839648	.002	0 0	0 0	0 0	0 2	0 0	1 0	0
1997	0	0	1101165	0	1101165	7237234	.000	0 0	0 0	0 0	0 2	0 0	0 0	0
1996	109990	0	1115965	0	1225955	6136069	.001	0 0	0 0	0 0	0 2	0 0	0 0	0
1995	0	0	1114703	285	1114989	4910114	.000	0 0	0 0	0 0	0 0	0 0	0 0	0
1994	0	0	1190722	293	1191015	3795125	.002	0 0	0 0	0 0	0 0	0 0	0 0	0
1993	0	0	1275239	936	1276176	2604110	.002	0 0	0 0	0 0	0 0	0 0	0 0	0
1992	0	0	1327547	387	1327934	1327934	.001	0 0	0 0	0 0	0 0	0 0	0 0	0

Table E. 10 Optimal Expansion Plan from DYNPRO - High Scenario - Discount Rate 10%

SOLUTION # 1 VARIABLE ALTERNATIVES BY YEAR

YEAR	PRESENT WORTH COST OF THE YEAR (K$)					OBJ.FUN.	LOLP	BL20		BZ20		I315		DOI2		A2TR		NUC1		LONG
	CONCST	SALVAL	OPCOST	ENSCST	TOTAL	(CUMM.)	%	BL33		BO20		DE20		A3TR		CC 6		NUC2		
2015	0	0	382180	303	382484	22894494	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2014	0	0	420398	333	420732	22512010	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2013	0	1	462438	367	462804	22091278	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2012	0	0	508682	403	509086	21628474	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2011	0	0	559550	444	559994	21119388	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2010	304996	164086	615505	488	756902	20559394	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2009	246768	119916	637094	817	764764	19802492	.267	3	0	2	2	2	4	0	4	0	16	2	0	2
2008	246030	106796	659819	1035	800088	19037728	.273	3	0	2	2	2	4	0	4	0	14	2	0	1
2007	270633	105301	683944	1194	850470	18237640	.259	3	0	2	2	2	4	0	4	0	12	2	0	1
2006	250009	87457	708085	1246	871884	17387170	.239	3	0	2	2	2	4	0	4	0	10	2	0	1
2005	331572	101845	731061	1288	962076	16515286	.229	1	0	2	2	2	4	0	4	0	9	2	0	0
2004	216098	52453	765412	1533	930590	15553210	.270	0	0	2	2	2	4	0	4	0	7	2	0	0
2003	250677	50595	783754	1714	985550	14622620	.199	0	0	0	2	2	4	0	3	0	6	2	0	0
2002	272723	47628	801382	1647	1028124	13637070	.139	0	0	0	2	2	2	0	2	0	5	2	0	0
2001	255381	46303	816026	1597	1026701	12608946	.146	0	0	0	0	1	1	0	2	0	4	2	0	0
2000	295589	44846	838869	442	1090054	11582245	.044	0	0	0	0	1	0	0	2	0	3	2	0	0
1999	580125	86485	897441	57	1391138	10492191	.004	0	0	0	0	0	0	0	2	0	2	2	0	0
1998	653524	90018	921714	0	1485220	9101053	.004	0	0	0	0	0	0	0	2	0	0	2	0	0
1997	718876	86662	993477	1	1625693	7615834	.001	0	0	0	0	0	0	0	2	0	0	1	0	0
1996	103968	0	1071378	0	1175347	5990141	.002	0	0	0	0	0	0	0	2	0	0	0	0	0
1995	0	0	1078846	46	1078892	4814795	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	1179494	106	1179600	3735903	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	1235383	1382	1236765	2556303	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	1319498	40	1319538	1319538	.001	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E. 11 Optimal Expansion Plan from DYNPRO - High Scenario - Discount Rate 8%

SOLUTION # 1 VARIABLE ALTERNATIVES BY YEAR

YEAR	PRESENT WORTH COST OF THE YEAR (K$)					OBJ.FUN.	LOLP	BL20		BZ20		I315		DOI2		A2TR		NUC1		LONG
	CONCST	SALVAL	OPCOST	ENSCST	TOTAL	(CUMM.)	%	BL33		BO20		DE20		A3TR		CC 6		NUC2		
2015	0	0	588217	466	588684	27150304	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2014	0	0	635274	504	635778	26561620	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2013	0	0	686096	544	686640	25925842	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2012	0	0	740984	587	741572	25239202	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2011	0	1	800263	634	800896	24497630	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2010	406415	239526	864284	685	1031858	23696734	.213	3	0	2	2	2	4	0	4	0	19	2	0	2
2009	322081	174215	878334	1127	1027326	22664876	.267	3	0	2	2	2	4	0	4	0	16	2	0	2
2008	316029	154709	893124	1401	1055844	21637550	.273	3	0	2	2	2	4	0	4	0	14	2	0	1
2007	341311	151919	908947	1587	1099926	20581706	.259	3	0	2	2	2	4	0	4	0	12	2	0	1
2006	306915	125510	923920	1626	1106952	19481780	.239	3	0	2	2	2	4	0	4	0	10	2	0	1
2005	403248	145652	936556	1650	1195802	18374828	.229	1	0	2	2	2	4	0	4	0	9	2	0	0
2004	259023	74622	962735	1928	1149064	17179026	.270	0	0	2	2	2	4	0	4	0	7	2	0	0
2003	295486	71630	967882	2116	1193855	16029962	.199	0	0	0	2	2	4	0	3	0	6	2	0	0
2002	315513	67122	971657	1997	1222046	14836107	.139	0	0	0	2	2	2	0	2	0	5	2	0	0
2001	289018	64908	971424	1901	1197434	13614061	.146	0	0	0	0	1	1	0	2	0	4	2	0	0
2000	328854	62518	980460	517	1247313	12416627	.044	0	0	0	0	1	0	0	2	0	3	2	0	0
1999	631743	119872	1029847	65	1541783	11169314	.004	0	0	0	0	0	0	0	2	0	2	2	0	0
1998	711234	128287	1038470	0	1621418	9627531	.004	0	0	0	0	0	0	0	2	0	0	2	0	0
1997	768133	122984	1098973	2	1744123	8006114	.001	0	0	0	0	0	0	0	2	0	0	1	0	0
1996	109990	0	1163598	0	1273588	6261991	.002	0	0	0	0	0	0	0	2	0	0	0	0	0
1995	0	0	1150405	49	1150454	4988403	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	1234861	111	1234972	3837949	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	1269857	1420	1271277	2602977	.001	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	1331660	40	1331700	1331700	.001	0	0	0	0	0	0	0	0	0	0	0	0	0

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