kpmg

Hidroelectrica SA

CO_2 reduction by modernization of 3 hydro units at Portile de Fier I

Baseline Study

Environmental Services

July 2002

This report contains 36 pages and 3 annexes

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1 Project information

1.1 Project characteristics

Supplier's name and address:

Company name: HIDROELECTRICA S.A.

Address: 3, Constantin Nacu Street, sector 2

Zip code + city address: Ro - 70219, Bucureşti

Postal address: 3, Constantin Nacu Street, sector 2

Zip code + city postal address: Ro – 70219, Bucureşti

Country: Romania

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Telephone number: + 40 1 303 25 60

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1.2 Local contact

Company name: Hidroelectrica, Portile de Fier subsidiary

Address: Strada I. G. Bibescu, nr. 2 Drobeta Turnu Severin

Zip code + city address: RO-1500

Postal address: Strada I. G. Bibescu, nr. 2 Drobeta Turnu Severin

Zip code + city postal address:

Country: Romania

Contact person: Cristian Cazanacli

Job title: director

Telephone number: +40 252 311 313

Fax number: +40 252 311 514

E-mail address: *ccazanacli@irongates.ro*

1.3 Other parties involved (co-investor, owner, operator, user, etc.)

Not applicable

1.4 Project Abstract

1.4.1 Project Title

The project is entitled: Modernisation of 3 hydro units within the Porţile de Fier I hydro power plant.

1.4.2 Abstract

The project consists in the modernisation of 3 hydro units (Unit 1, Unit 2 and Unit 3) out of 6 within the Porţile de Fier I hydropower plant. The aim of the project is to increase the unitary active power from 175 MW to 194,5 MW, in the expansion of the ancillary services offered and in the extension of the hydro units life duration with 30 years. The project development benefits from the solution that has already been successfully applied for the modernisation of the other 3 hydro units of the plant (Unit 4, Unit 5 and U 6) by the company VA TECH HYDRO LTD. Further information on the project is presented in Annex 1.

Project location: The Portile de Fier hydropower plant is located on the Danube River, close to Drobeta Turnu Severin town, Mehedinti County, Romania. A map including company location is presented in Annex 2.

Project starting date: 2003 (for one unit) and 2006 (for all 3 hydro units)

Construction starting date: 2002

Construction finishing date: 2006

1.5 Background and justification

The Hydropower and Navigation System in Porţile de Fier I, in operation since 1970, was built on the river Danube by Romania and Yugoslavia under the Agreement concluded in 1963.
Each of these countries owns one hydropower plant, which has an installed power of 1050 MW and is equipped with 6 hydro units. SC Hidroelectrica SA was set up on 1 August 2000 through the Governmental Decision HGR 627/2000 and it operates the Romanian hydro power plants.
The hydro units have been intensively operated in the last years - average 6,500 hours/year/unit, in severe flow and heat conditions. They operate under the conditions of "The Convention between the Government of Romania and the Federal Government of Federal Republic of Yugoslavia concerning the operation and maintenance of the Hydropower and Navigational Systems for Portile de Fier I and Portile de Fier II".

The Joint Romanian Yugoslav Commission approved the conclusions/findings of the studies developed in 1991, demonstrating that it is possible for the hydropower units in Portile de Fier I to be upgraded from 175 MW to 194,5 MW. According to the decisions of the joint Commission in the period 1995-1997, the technical documentation regarding modernisation solutions was prepared in collaboration with the Yugoslav representatives.

Through the Governmental Decision HGR 474/1997, the company Sulzer Hydro Ltd., at present VA TECH HYDRO Ltd was chosen to perform the modernisation works.

The modernisation works take place in accordance with the stipulations of the contract no. 16636/1997, "Modernisation and Upgrading of the six hydro units within Porţile de Fier I for Safety Improvement". The activities performed for two hydro units have already been finalised. For the

third unit the final tests are being performed. For the hydro units U3, U2 and U1, according to the contractual stipulations, the work will be performed in the period 2002-2005.

1.5.1 Goals

The project goals are:

- Reduction of air emissions by replacing the electricity produced by fuel fired power plants;
- Usage of clean energy production (the project has low environmental impact both in the construction and in the operation phases);
- Production of 418.81 MWh/year additional electricity.

1.5.2 Purpose

The main purpose of the project is to supply additional electricity to the National Electricity Sector.

1.5.3 Results

The expected result of the project is an increase of the installed capacity from 175 MW to 194,5 MW for three hydro units of the hydropower plant. This leads to additional electricity generated and to the improvement of the national electricity supply system.

1.5.4 Activities

The modernization of the hydro units includes the following main activities:

1. Turbine and associated installation:

- Turbine refurbishment: replacement of the rotor blades, seals and blade bearings with new components.
- Refurbishment of the control system including: speed regulator modernization (replacing controls and drives, newly equipped with electronic regulators and spinning reserve regulators), pressure oil electro pump and measuring and control instrumentation replacement.

2. Generators, auxiliary installations and excitation system:

- Generator rehabilitation by: stator casing repair, stator magnetic core and stator winding replacement, rotor crown remedy works, rotor pole coil replacement, rotor static and dynamic balancing, generator thrust and radial bearings refurbishing.
- Improvement of the air-cooling system by new coolers and additional electric breaking system.
- Replacing the existing warning and fire extinguishing systems by installing a water spray system in conformity with the European standards.
- Replacing static excitation systems for both main and auxiliary generator and providing the auxiliary one with new microprocessor based systems.

3. Automation and electric protection system

Complete equipment replacement (both classic and numerical ones) as associated with automation, electric insulation and unit 0.4kV distributor. New equipment is compatible with current technical characteristics, fitting into existing locations and ensuring absolute safety in unit operation valid for a new 30-year life cycle.

2 GHG sources and sinks and project boundaries

This section is aimed to identify the GHG emission sources and sinks relevant for the project boundaries in order to make a distinction between emissions that will and will not need to be estimated in the baseline study and in the monitoring phase. An important issue is to show that reductions in emissions are additional to any other reduction that would have occurred in the absence of the project activity. This chapter represents an introduction for the quantification of GHG emission reduction related to Portile de Fier I project.

2.1 Project boundaries

System boundaries are theoretically the margins around the project, within which the project impact is to be assessed. Consequently, all project effects on GHG emissions within the system boundaries should be considered. The system boundaries for the project are also used for baseline scenarios.

The ERUPT Guidelines set two principles for determining the project boundaries:

a) Principle of control – which means that project boundaries should include all relevant emission that can either be controlled or influenced by the project;

b) In any case the relevant GHG emissions related to activities one step upstream and one step downstream the project should be included within project boundaries.

According to the ERUPT Guidelines the GHG emissions are classified in on-site and off-site emissions which both fall into direct and indirect emissions.

2.2 Direct on-site emissions

These emissions include emissions from production of electricity (from fuel combustion and process) on project site. Hydropower is a clean energy source and no GHG emissions will result from this type of electricity production. For this reason direct emissions for the project are considered zero.

2.3 Indirect on-site emissions

The indirect on site emissions are the emissions resulted from changes in energy production of other facilities generated by the project. This is considered as being a baseline situation because it shows what would happen if the project were not implemented. Additionally, the emissions resulting from other plants operations are not within the control of the project developer.

However, to some extent, the Portile de Fier I project will affect the investment decisions in other plants, but this is beyond project developer control. Consequently, the emissions related to changes in other plants electricity production will be taken into account in the baseline scenarios and they are not considered as project emissions.

Other indirect on site emissions are considered to be on site electricity losses, which represent the difference between power production (gross) and the electricity delivered to the grid (net). The estimated output of 418.81 GWh/year of the Portile de Fier I Project represents the net electricity output. In this case the differences between gross and net electric output are already taken into account.

Grid losses (the difference between electricity supplied to the grid and the electricity supplied to the customer) are excluded from the system boundaries. The reason is that these losses affect all electricity production (hydro, nuclear or thermal) and they are the same before and after project implementation.

2.4 Direct off-site emissions

Direct off-site emissions include emissions up-stream (e.g. connected with the production, transport and distribution of fuels used for the project) and down-stream (e.g. connected with electricity produced by the project that replaces off-site electricity generation) the project that are directly influenced by the activity of the project.

As described in chapter 1.4, the present project consists in modernization and up grading of 3 hydro units within the Portile de Fier I hydropower plant. Therefore, the one-step up-stream emissions can be considered zero. Besides the emissions resulted from the equipment transport (which are not within the control of the project developer and they are significantly lower than 1% of the emissions within the project boundaries – details in annex 4) no other up-stream emissions can be considered in this study.

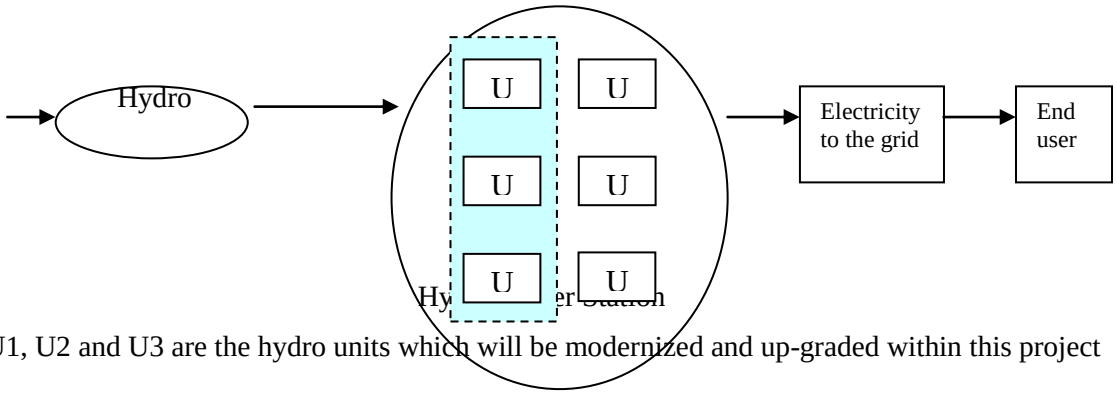
Downstream emissions cannot be considered within the control of the project developer. There is no control of the electricity flows generated by each plant after entering the grid.

Direct off-site emissions of the project are considered zero.

2.5 Indirect off-site emissions

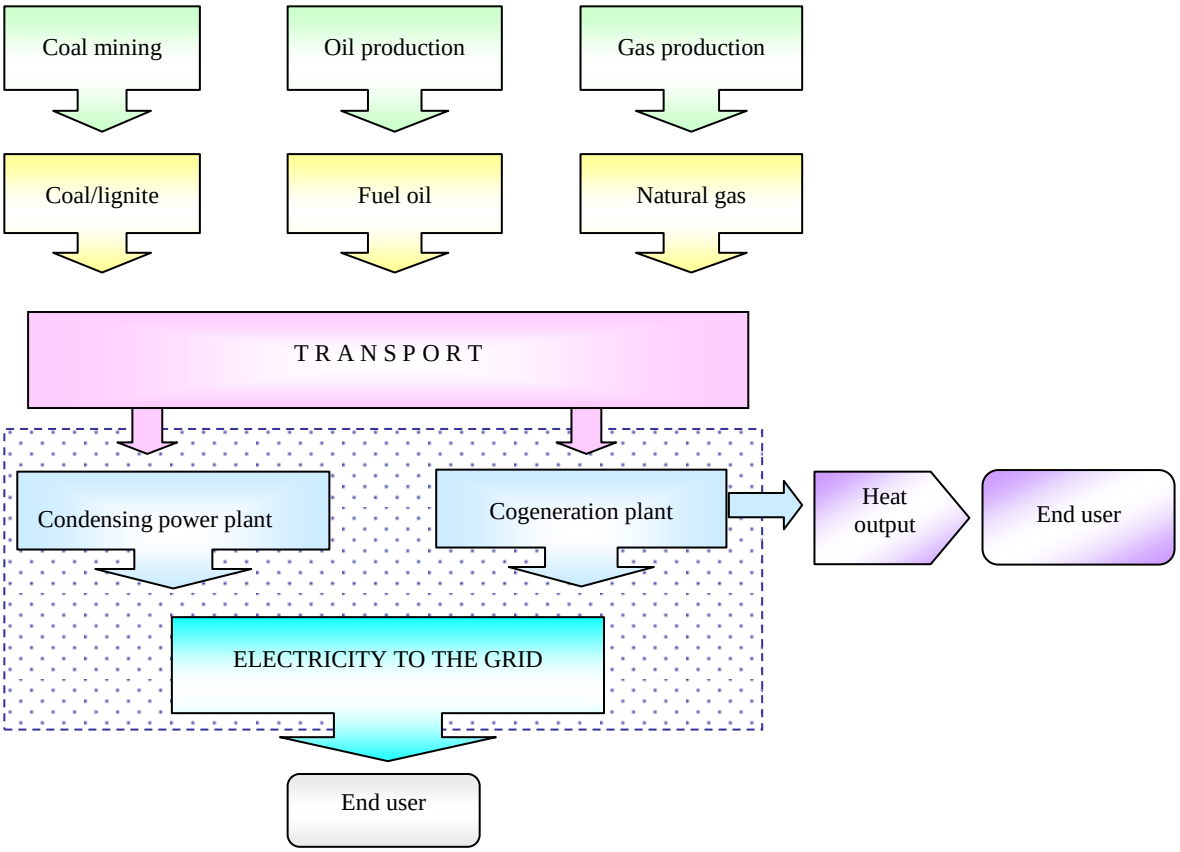
The indirect effects are usually referred to as leakages. These are not taken into account (see item 2.3).

Flow chart of the project with its main components and connections



U1, U2 and U3 are the hydro units which will be modernized and up-graded within this project

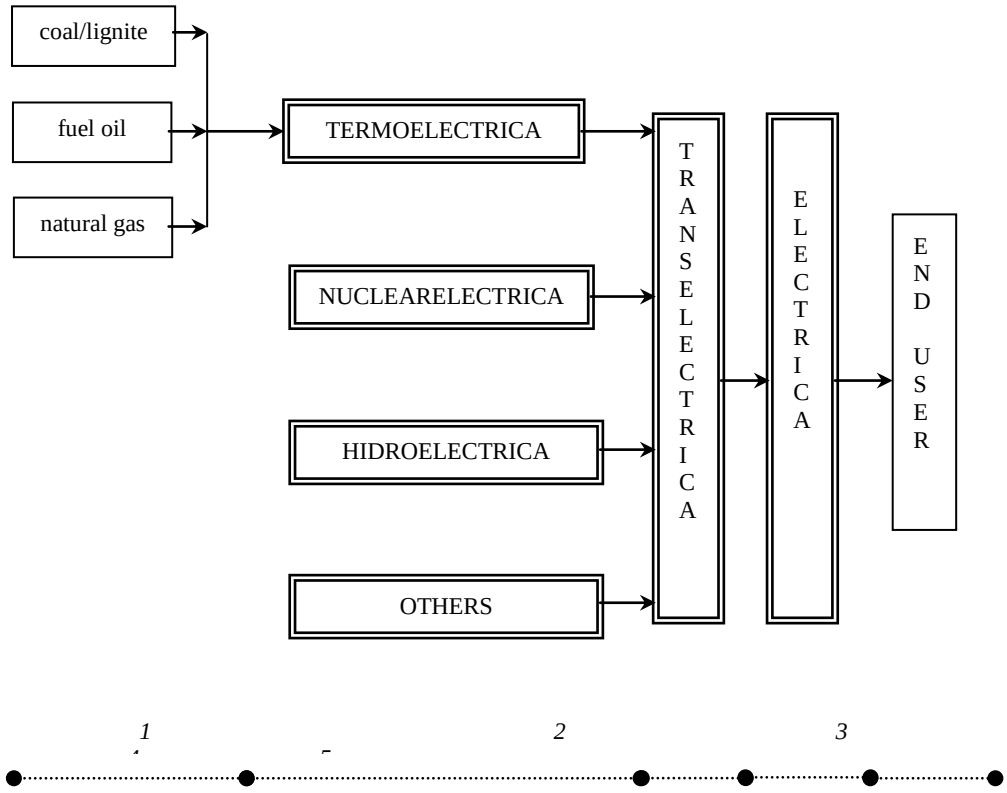
As the electricity generated by the project is assumed to replace only the electricity produced by fossil fuel fired plants, the flow chart below presents the current delivery system including only thermal power plants.



As for the baseline scenarios it was assumed that the Portile de Fier I project output would replace the electricity produced by fuel fired plants, for these plants only direct on site emissions will be taken into account. The GHG emissions resulted from fossil fuels production, transport, etc. as well as downstream emissions are not taken into account.

3 Description of the current delivery system

The flowchart illustrating the main components and connections of the current Romanian energy delivery system is presented below:



1- Fuel consumption;
2- Power generation;
3- Operation of the transmission system and infrastructure;
4- Distribution and supply of electricity;
5- Energy consumption.

Status and adequacy of the current delivery system.

Short description of the power delivery system in Romania

The energy sector is under the supervision of the Ministry of Industry and Resources, which formulates the policy and the strategy in this field.
In 1990 two types of autonomous state enterprises in the energy sector were set up:

- Regis Autonomous (RAs) for the production and supply of energy products;
- Commercial Companies (CCs) for support services and activities.

The RAs are state-owned companies operating in sectors considered strategic by the Government of Romania: electric power, oil, natural gas, lignite, and coal. The CCs are joint stock companies. The RAs and the CCs have operational responsibilities.
In June 1998, the Romanian Electricity Authority (RENEL) adopted a restructuring

program, creating CONEL, the National Electricity Company. In October 1998, the National Electric and Heat Regulatory Authority (ANRE) was set up as an independent institution to regulate the electricity market.
On 31 July 2000, the Romanian government published a decision to divide CONEL into four companies:

- *Transelectrica S.A.* is the national company for electricity transmission, power system operation and dispatching. Transelectrica operates the National Power Transmission System. The company's mission is to develop and operate open access to the wholesale electricity market, to ensure the cross boundary electricity connections and to provide the required infrastructure for performing these activities.
- *Termoelectrica S.A.* is the national company for the production of electrical and thermal energy. It is the main electricity producer in Romania. The main activities are: generation of electricity from thermal power plants, district heating and related fuel supply. The electric energy is produced in thermal plants including groups that use coal as fuel and groups that use hydrocarbons as fuel, as well as in cogeneration plants that also produce thermal energy.
- *Hidroelectrica S.A* is the commercial company for production and delivery of hydroelectric power. It is the second electricity producer in Romania. The company's mission is to generate electricity from hydropower, to provide ancillary technological services in order to ensure operational safety of the national power system and to provide water management services of national and regional interest (flood protection, water sources, water management services).
- *Electrica S.A.*is a commercial company for electricity distribution and supply.

The evolution of electricity generation capacity (in thousands MW) between 1990 and 2000 is presented in Table 1.

Table 1

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Hydroelectric	5.58	5.67	5.72	5.69	5.87	5.91	5.87	5.84	5.93	5.93	5.93
Nuclear	n/a	n/a	n/a	n/a	n/a	n/a	0.71	0.71	0.71	0.71	0.71
Geothermal/Solar/ Wind/Biomass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Conventional Thermal	17.32	16.81	16.55	16.58	16.39	16.12	16.28	16.11	15.28	15.56	15.56
Total Capacity	22.90	22.48	22.27	22.27	22.26	22.04	22.85	22.66	21.91	22.19	22.20

Source: Energy Information Administration (EIA)

The Ministry of Industry and Resources coordinates the restructuring programme for the energy sector and plans to turn the state-owned electricity monopoly into a competitive energy market.

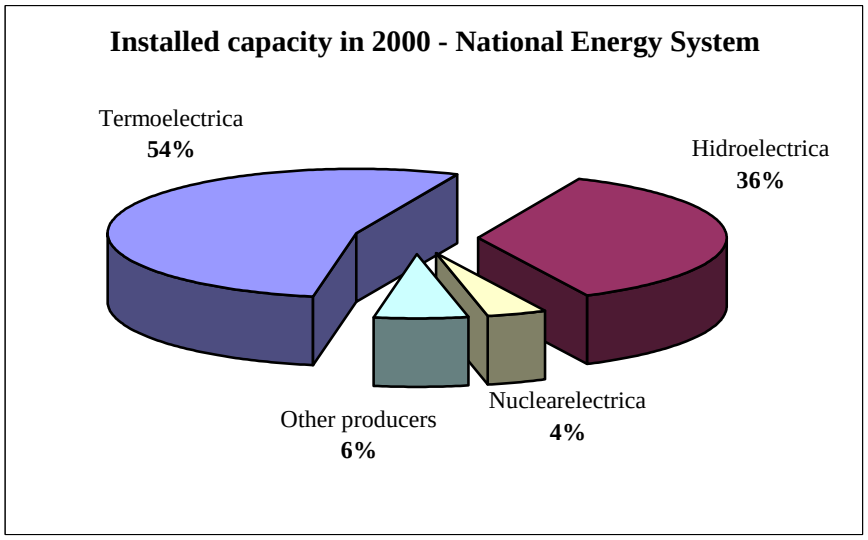
The Romanian agency that regulates the power market is the National Electric and Heat Regulating Authority (ANRE). In February 2000, ANRE opened 10% of the Romanian electricity market by allowing ten large industrial companies to select their electricity suppliers and granting electricity supply licenses to five independent electricity producers. In October 2000, the degree of liberalization was increased to 15%. In this

way, companies using more than 100 gigawatt-hours (GWh) annually were given the possibility to choose their electricity suppliers. ANRE plans to further open the energy market in the next few years.
Recently, Romania has initiated reforms to restructure the electrical power field in order to attract foreign investment for equipment upgrade. Price ceilings were removed in 1997, but prices for electricity in Romania are still lower comparing with the electricity prices in the other countries in Europe. Current prices in Romania represent 70% of the average electricity prices in EU member states.

Adequacy of the current delivery system
Many thermal and hydro capacities built before revolution became redundant after 1989 as a result of the decline in electricity consumption and of the lack of financing resources. However, many large thermal and hydro units have been in service beyond their designed life span and they require urgent rehabilitation. According to EIA (2000), approximately 60% of the current power capacity is more than 20 years old and about 10 GW (which is about 44% of the total installed capacity) will need to be rehabilitated or replaced by 2010 (EIA, 2000).
According to the National Energy Development Strategy on Medium Term (2001-2004) of the Ministry of Industry and Resources, the production capacities and transportation infrastructure need urgent modernisation. It is necessary to rehabilitate thermal facilities, to introduce low power cogeneration and to install modern and efficient equipment. These measures will contribute to integrating Romanian energy industry into European structures and to ensuring the sustainable development of the energetic sector.
According to the National Energy Development Strategy on Long Term (2002-2015) of the Ministry of Industry and Resources, the Romanian energetic safety has been and still is affected by the lack of cash availability for the energetic companies. Actions have already been taken in order to prevent deterioration of the energetic infrastructure and to implement investment and repairing programs in due time.

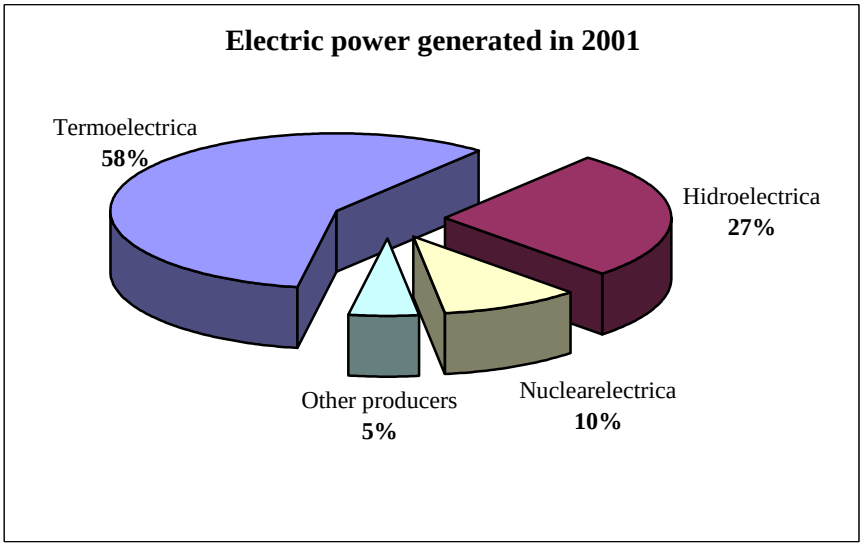
Operation modes of the current delivery system

As already presented in the previous chapter, the main sources for electricity production are: thermal (lignite, coal, heavy oil, natural gas), hydro and nuclear. The installed capacity for each energy producer is presented in the following diagram:



Source: National Energy Development Strategy on medium term (2001-2004) of the Ministry of Industry and Resources

The electric power generated in 2001 had the following structure:



Source: Environmental Report, Hidroelectrica, 2001

Thermal power plants

As shown in the above diagrams, the main electricity producer is Termoelectrica. At the end of 2000, the total capacity of the company Termoelectrica was 13,946 MW.

The operational thermal plants use lignite, hard coal, natural gas, fuel oil or a combination of gas and fuel oil for producing electricity. Part of these plants can produce only electricity and they are called condensation groups and the other part produce both thermal and electric power and they are called cogeneration groups. Details regarding the main power plants within Termoelectrica, the installed power, the fuel used, the energy produced by each plant in 1999 and the respective carbon emission factors are presented in Table 2.

Table 2

Run. No.	Thermal Plant	Total MW	Plant Type	Fuel used	Energy produced in 1999 (MWh)	Carbon Emission Factor (tCO_2/MWh)
1	Turceni	1980	condensing	lignite	3,467,326	1.025
2	Rovinari	1320	condensing	lignite	2,802,365	1.061
3	Mintia	1260	cogeneration	hard coal	3,746,289	0.900
4	Brăila	960	cogeneration	gas and fuel oil	908,102	0.570
5	Iernut	800	condensing	gas	1,976,647	0.120
6	Işalniţa	630	condensing	lignite	2,156,686	1.195
7	Bucureşti Sud	550	cogeneration	gas and fuel oil	1,260,286	1.463
8	Galaţi	535	cogeneration	gas and fuel oil	958,595	0.893
9	Borzeşti K	420	condensing	gas and fuel oil	235,062	0.065
10	Doiceşti	400	cogeneration	lignite	570,762	0.962
11	Brazi T	360	cogeneration	gas and fuel oil	850,272	1.290
12	Craiova II	300	cogeneration	lignite	990,871	0.152
13	Paroşeni	300	cogeneration	hard coal	260,796	1.958
14	Bucureşti Vest	250	cogeneration	gas and fuel oil	817,470	0.816
15	Palas	250	cogeneration	fuel oil	213,826	3.375
16	Oradea I	205	cogeneration	lignite	422,664	1.938
17	Progresul	200	cogeneration	gas and fuel oil	554,639	0.929
18	Oradea II	150	cogeneration	lignite	292,667	2.062
19	Iaşi H	150	cogeneration	gas and fuel oil	428,059	1.355
20	Piteşti Sud	136	cogeneration	gas and fuel oil	200,443	2.106
21	Borzeşti T	110	cogeneration	gas and fuel oil	392,651	1.205
22	Giurgiu	100	cogeneration	lignite	58,611	2.926
23	Iaşi II	100	cogeneration	lignite and hard coal	247,061	1.917
24	Suceava	100	cogeneration	lignite and hard coal	206,481	1.824
25	Braşov	100	cogeneration	lignite	237,520	2.334
26	Grozăveşti	100	cogeneration	gas and fuel oil	345,722	1.430
27	Arad C	50	cogeneration	lignite	225,575	2.184
28	Bacău	50	cogeneration	lignite	151,943	2.160
29	Zalău	24	cogeneration	lignite	45,402	0.960
30	Reşiţa	12	cogeneration	gas and fuel oil	56,356	2.367
31	Titan	8	cogeneration	gas and fuel oil	20,950	4.739
32	Piteşti Găvana	6	cogeneration	gas and fuel oil	32,521	6.278
33	Timişoara Centru	4	cogeneration	gas and fuel oil	15,653	16.154

Source: S.C. Termoelectrica S.A.

Hydro power plants

Hidroelectrica represents the second electricity producer in Romania. In 2001, the total capacity of the company Hidroelectrica was 5,928 MW. The energy production in a medium hydrologic year is 16,000 GWh.

The company administrates 127 hydroelectric plants and 4 pumping stations. These plants are grouped in 10 hydroelectric plants subsidiaries.

Details regarding the above-mentioned subsidiaries within Hidroelectrica, the installed power

and the energy produced annually by each subsidiary are presented in Table 3.

Table 3

Run. No.	Subsidiary	Number of plants and pumping stations	Installed Power (MW)	Energy Produced Annually (GWh/year)
1	Râmnicu Vâlcea	34	1625	3795
2	Porţile de Fier	3	1354	6561
3	Bistriţa	21	636	1656
4	Cluj	17	539	997
5	Curtea de Argeş	27	525	964
6	Haţeg	12	485	683
7	Sebeş	4	346	606
8	Târgu Jiu	6	193	449
9	Caransebeş	3	148	164
10	Buzău	4	77	203

Source: S.C. Hidroelectrica S.A-Environmental Report 2001

Nuclear power plants

Romania has one nuclear plant in Cernavodă operated by the company Nuclearelectrica. Only one of the five units was commissioned in 1996. This unit has a capacity of 750 MW and ensures 10% of the total energy production in Romania.

In April 2001, Nuclearelectrica, announced that it was close to concluding a $700-million deal with Italy's Ansaldo and Atomic Energy of Canada Limited (AECL) to finance completion of the 700-MW second reactor at Cernavoda. The two companies were involved in building and commissioning the first reactor in 1996. Romania's share of the costs for the completion of the second reactor, which is approximately 40% complete, is estimated at $400 million. In case construction starts in 2002, Nuclearelectrica envisages completion and test operations at the reactor sometime around 2005. The remaining three reactors, whose construction is far behind, could become the object of international tenders to be built and operated.

(Source: EIA, November 2001)

National Strategy

According to the National Strategy for the Energetic Development of Romania on Medium Term 2001-2004, the main objective is to create an efficient energy market in order to ensure sustainable development, safe energy supply, observing the EU standards related to efficient energy usage and environmental protection. The following objectives derive from the main objective:

- using specific market economy mechanisms in energy sector;
- interconnecting the national electro-energetic system with the system of the Organisation for Coordinating the Electricity Transporters;
- ensuring safe and diversified supply resources and stocks for the secure operation of the energetic system;
- minimising the negative environmental impacts of the energetic processes;
- completing and improving the legislative framework in energy field.

The following actions must be taken in order to implement the above mentioned energetic strategy for the next 4 years and the respective action plan:

- to import maximum 40% of energy fuel (natural gas, fuel oil and coal) in order to ensure security in electric and thermal energy supply;
- to finalize the second unit of the Cernavoda plant as a priority of the energetic system development;
- to invest about 1 billion USD in finalising hydro energetic capacities of more than 900 MW;
- to implement the investment programs (more than 2.8 billion USD) in the sector of electric and thermal energy production;
- to rehabilitate and modernise the national electricity transportation system and building the connection systems with the Organisation for Coordinating the Electricity Transporters (450 million USD);
- to develop and modernise the electricity distribution system (335 million USD) and to implement the program for village area electrification (150 million USD);
- to implement the program for efficient energy use, adopting the EU regulations in this field (3 million USD);
- to privatise the electricity production and distribution systems in order to obtain financing sources, to ensure efficient management and to enter new markets;
- to create a market for energetic services in order to increase energy efficiency;
- to improve international cooperation in energy field;
- to improve environmental protection in energy field;
- to consolidate the restructuring process for the companies operating in energetic field;
- to apply EU policies and to harmonise the energetic policy and the respective legislation with the "acquis communitaire".

According to the National Energy Development Strategy on Long Term (2002-2015) of the Ministry of Industry and Resources, the energetic strategy of Romania is part of the general Romanian strategy: Romania will be part of the European Union, being fully compliant with the "acquis communitaire". Romanian energetic policy will be harmonised with the EU policy in this field and will be focused on the following aspects: safety, efficiency, environmental protection, customer rights and competitive market mechanisms.

4 Key factors influencing the baseline and the project

Legal

The current government policy is to develop an energy sector that promotes a market-oriented economy. Legislation, either currently under development, or in the process of being passed to help implement this policy, includes:

- a new petroleum law;
- regulations for electricity and heat with respect to technical standards and the relationship between suppliers and customers;
- a new electricity law for regulating the activity of the electricity generating companies, the access to the electricity transmission system and investment in the electricity sector;
- new regulations or standards for electricity use;
- a law on energy conservation.

According to the National Energy Development Strategy on Medium Term (2001-2004) of the Ministry of Industry and Resources, the following trends can be identified in the legislative field:

- the existing legislation in energetic field will be completed and improved by the Ministry of Industry and Resources . Also, the new legislation will clarify ownership status;
- the energetic policy and the respective legislation will be harmonised with the “acquis communitaire”;
- the efficiency of the Romanian State bodies will be increased (the corruption will be decreased, the legislation will be adequately enforced, etc.).

GHG policies in Romania

According to information provided by the Regional Environmental Centre, after 1989 greenhouse gas emissions decreased mostly due to the reduction of the economical activities, especially in heavy industry.
In Romania the emissions mentioned by the Kyoto Protocol are monitored: carbon dioxide, nitrogen oxides and methane. Other gases included in the protocol such as fluoridation hydrocarbons, perfluorocarbons and sulphur hexafluorid will be also inventoried in the future.
The carbon dioxide emission in 1989 (considered to be a reference value) was of 194,826 Gg and in 1994 was of 125,597 Gg.
Romanian signed the Kyoto Protocol, which establishes the terms and the rules of monitoring the gases that determine the greenhouse effect for the Earth and ratified it through the Law no 3/2001. Romania ratified the Kyoto Protocol and committed itself to reduce the level of GHG emissions with 8% comparing with the emission level in 1989.

Economic and political factors

Romania has made considerable progress towards the development of democratic institutions and of market economy. Romania's private sector represents more than 50% of the country's GDP and it has become the engine of economic growth. The centrist coalition government, elected in 1996, was very well received by western institutions and implemented a far-reaching economic reform program. The reform package focuses on

eliminating price controls, freeing the exchange rate, eliminating subsidies, allowing bank privatisation, encouraging foreign investment, and speeding up the process of industry restructuring and privatisation. The program was intended to enable Romania to make a rapid transition to market economy. However, despite the market reforms, Romania suffered a three-year recession from 1997 to 1999. In 2000, the reform government was voted out of office and the voters brought back the Party of Social Democracy. Although the ruling party changed, economic reforms in energy sector have proceeded.

Any political regime that ruled the country after 1990 expressed interest in Romania joining the European Union. Therefore, it is very likely that any party elected in the future will support the improvement and rehabilitation of the energy sector, as well as the implementation of various projects for reducing GHG emissions.

Since 1991, Romania's growth rate has generally been low and inflation has remained higher than 30%. The Table 4 below presents the evolution of Romania's GDP and inflation between 1990 and 2000. The GDP growth rate is compared with the previous years.

Table 4

Component	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Annual GDP Growth Rate* (percent)	-5.6	-12.9	-13.8	1.3	3.3	6.3	4.1	-6.5	0	-4.8	2.2
End-of-Year Inflation (percent)	5.1	174	211	256	131	32.3	38.2	153	70	44	45.7

Sources: United Nations Economic Commission for Europe (UN/ECE) - 1990-99; CIA World Factbook - 2000

The Romanian energetic strategy is closely linked with the national strategy of economic development of Romania. The level of economic growth ensures the necessary financial resources for the energetic development at national level, as well as a living standard that allows population to socially accept the electricity prices. Successful European integration influences both the economic and energetic strategies.

In order to establish the National Energy Development Strategy on Long Term (2002-2015), the Ministry of Industry and Resources estimated that both the GDP and the level of electricity production would grow. In this case it is desirable that the growth should be covered by producing more hydro and nuclear electricity in order to avoid increasing the GHG emissions associated with thermal electricity production.

Socio-demographic

The main socio-demographic characteristics according to a report developed by the World Health Organization, within the Tobacco or Health Programme are presented in Table 5:

Population	1990	1995	2025
Total	23,207,000	22,835,000	21,735,000
Adult (15+)	17,736,000	18,166,000	18,260,000
% Urban	53.3	55.4	71.3
% Rural	46.7	44.6	28.7

Health Status

Life expectancy at birth, 1990-1995: 66.6 (males), 73.3 (females)
Infant mortality rate in 1990-1995: 23 per 1,000 live births.

According to the preliminary results of the census performed in Romania on 18 March 2002, processed by the National Institute for Statistics[1] the Romanian population is 21,698,182. The total figure has decreased with 4.2% comparing with the same figure in 1992. The population living in urban area is 52.7% (54.3% in 1992) and the population living in rural area is 47.3% (45.7% in 1992).

Environmental

The Ministry of Waters and Environmental Protection (MWEP) is the central environmental authority and within each of the 42 counties (including Bucharest as municipality) there is an Environmental Protection Inspectorate (EPI), which represents the local environmental authority. MWEP is responsible for adoption of the Aquis Communitaire in the environmental protection field. In this process it is working closely with other ministries.

The Ministry of Industry and Resources intends to harmonise the Romanian regulations regarding the environmental impact of energetic processes with EU regulations, both on medium and long term. In order to reduce the environmental impact in energetic field taking into account the EU regulations, the following actions will be taken:

- implementation of rehabilitation and modernisation projects;
- building ecological landfills for storing the slag and ash resulted from thermal processes;
- monitoring the quality of environment in the areas where important energy producers are located;
- rehabilitation of contaminated soils and reuse of those areas for agricultural purposes.

According to the medium term strategy in energetic field, the Ministry of Industry and Resources considers that Romania should take advantage of the opportunity offered through the flexible mechanisms promoted by the Kyoto Protocol to reduce the level of GHG emissions. The "joint implementation" projects represent an important financing source for the energetic sector to become more efficient. These financing sources will also contribute to the sustainable development of the energetic field.

On 12.10.2001, Hidroelectrica obtained the environmental agreement no. 180 for the upgrading and refurbishment of six hydro units within the company Portile de Fier I. The agreement was issued by the local Environmental Protection Inspectorate and it represents a guaranty that the project will be developed in compliance with the applicable Romanian regulations.

[1] B-dul Libertatii, nr. 16, secor 5, Bucuresti

Technical

Most of the technology in Romanian industry is old and needs to be modernized or replaced. The Government policy is to attract potential investors in order to facilitate the purchase of new clean technologies or the modernization of the existing ones.

Within electricity sector, approximately 60% of Romania's existing power capacity is more than 20 years old, and about 8 GW will need to be rehabilitated or replaced by 2010. According to the government's medium-term energy strategy, Romania is planning to rehabilitate 10 thermal power stations, with a combined capacity of 1.36 GW, between 2000 and 2005. Rehabilitation of these units will cost an estimated $460 million, while power-generating units with a total capacity of 5.9 GW are planned to be shut down. In addition, technical losses in Romania's inefficient power transmission and distribution system means that an estimated 13% of all electricity dispatched is lost before it reaches any customers.

(Source: EIA, November 2001)

5 Identification of the most likely baseline and the associated GHG emissions

Baselines scenarios are images of the future, or alternative futures. They are neither predictions nor forecasts. Each scenario is one alternative image of how the future might unfold. They are hypothetical and therefore they are very unlikely to occur exactly as predicted. The baseline scenarios are usually based on an internally consistent set of assumptions about the key relationships and driving forces of change, which are derived from our understanding of both history and the current situation. The assumptions for the Portile de Fier I project baseline scenarios are presented below.

Assumptions applied to all scenarios

- *The Portile de Fier I project output of 418.81 GWh/year is used as input data for baseline scenarios;*
- *The crediting lifetime of the project is 2008 – 2012.*
- *The project output will not be changed during the crediting lifetime (2008 – 2012);*
- *On site electricity losses and grid losses are excluded from the system boundaries;*
- *The project will replace the electricity produced by fossil fuel power plants;*
- *The emissions taken into account are only related to electricity generation;*
- *The direct off-site and indirect off-site and on-site emissions are not included within the system boundaries;*
- *The electricity produced by "other producers" (independent power producers) is not included within the system boundaries;*
- *The electricity exported (around 1%) is not taken into account within the system boundaries;*
- *The data used in the baseline scenarios consist in characteristics of the Romanian electricity sector at national level;*
- *No data on a plant's installed capacity were used for calculation. Only data on generated output were considered input data;*
- *Data related to electricity supplied into the grid (net amount) were used. On site losses are not taken into account as they have already been considered;*
- *Only CO2 emissions are considered GHG emissions. Including other emissions (as CH4 and N2O) means higher average Carbon Emission Factor. Consequently the applied approach is more conservative.*

Besides the above-mentioned general assumptions, for each scenario some specific assumptions were also applied.

5.1 Description of the baseline scenarios

According to ERUPT guidelines requirements, some future baseline scenarios have to be developed. The recommendation is to consider the current situation as starting point. Because the most recent information on the thermal part of the electricity sector in Romania is from 1999, this year has been selected as starting point for all baseline scenarios of the Portile de Fier I project.

The following scenarios have been developed:

- Scenario 1 (S1): unchanged current (1999) situation of the national electricity sector;
- Scenario 2 (S2): predefined baseline scenario for Romania (ERUPT Guidelines, Volume 2a, Annex B, October 2001);
- Scenario 3 (S3): Replacement of thermal electricity based on existing performance of fossil fuel plants;
- Scenario 4 (S4): Replacement of thermal electricity based on existing performance of fossil fuel plants but taking into account correction for operations at margin; the efficiency of thermal plants remain constant in the future;
- Scenario 5 (S5): Replacement of thermal electricity taking into account the CO_2 emissions related only to electricity (produced in cogeneration thermal power plants) and IPCC carbon emission factor (CEF).
- Scenario 6 (S6): the existing fossil fuel fired plants will gradually switch to natural gas as the only fuel used in the next 30 years (2030).

5.1.1 Scenario 1 (S1): unchanged current (1999) efficiencies of the electricity plants

S1 baseline scenario is developed on the assumption that the performance of existing electricity system and the fuel mix will be the same during the future years. The Table 6 presents the average performance of electricity facilities in 1999.

Table 6

Electricity (fuel) source	Output (GWh)	Output (%)	Average CEF (t CO_2/GWh)
Hydro	18,214.00[2]	37.5	0
Nuclear	5,198.00[2]	10.7	0
Lignite and Hard Coal	15,883.02[3]	32.7	1105
Gas	1,976.65[3]	4.1	120[4]
Fuel oil	213.83[3]	0.4	3375[5]
Gas and Fuel	7,076.78[3]	13.0	1121
Total	**48,562.28**		

Average CEF for "Lignite and Hard Coal" and "Gas and Fuel" was calculated as following:

[2] Data from Hidroelectrica Operational Technical Report 1999

[3] Data from Environmental Report, CONEL, 1999

[4] CEF for Iernut TPP which is only plant operating on gas (Termoelectrica data)

[5] CEF for Palas TPP the only plant operating on only fuel oil (termoelectrica data)

Table 7 and Table 8 present the electricity produced and CEF for thermal power plants (TPP) on Lignite and Hard Coal and respective on Oil and Gas.

Lignite and hard coal fired plants

Table 7

Name of plant	Type of plant	Electricity generated in 1999 (GWh)	CEF (t CO2/MWh)	Emissions (t CO2)
Turceni	Condensing	3467.33	1.025	3554013.30
Rovinari	Condensing	2802.36	1.061	2973304.00
Mintia	Cogeneration	3746.29	0.900	3371661.00
Isalnita	Condensing	2156.69	1.195	2577244.60
Doicesti	Cogeneration	570.76	0.962	549071.12
Craiova2	Cogeneration	990.87	0.152	150612.24
Paroseni	Cogeneration	260.80	1.958	510646.40
Oradea I	Cogeneration	422.66	1.938	819115.08
Oradea II	Cogeneration	292.67	2.062	603485.54
Giurgiu	Cogeneration	58.61	2.926	171492.86
Iasi II	Cogeneration	247.06	1.917	473614.02
Suceava	Cogeneration	206.48	1.824	376619.52
Brasov	Cogeneration	237.52	2.334	554371.68
Arad C	Cogeneration	225.58	2.184	492666.72
Bacau	Cogeneration	151.94	2.160	328190.40
Zalau	Cogeneration	45.40	0.960	43584.00
Total		**15883.02**		**17549692.00**

Average CEF $_{\text{Lignite and Hard Coal}}$ = Total CO_2 emissions/Electricity generated

Average CEF $_{\text{Lignite and Hard Coal}}$ = 1105 t CO_2/GWh

Gas and fuel oil fired plants

Table 8

Name of plant	Type of plant	Electricity generated in 1999 (GWh)	CEF (t CO2/MWh)	Emissions (t CO2)
Braila	Cogeneration	908.10	0.570	517617.00
Bucuresti Sud	Condensing	1260.29	1.463	1843804.30
Galati	Cogeneration	958.60	0.893	856029.80
Borzesti K	Cogeneration	235.06	0.065	15278.90
Brazi T	Cogeneration	850.27	1.290	1096848.30
Bucuresti Vest	Cogeneration	817.47	0.816	667055.52
Progresul	Cogeneration	554.64	0.929	515260.56
Iasi H	Cogeneration	428.06	1.355	580021.30
Pitesti Sud	Cogeneration	200.44	2.106	422126.64
Borzesti T	Cogeneration	392.65	1.205	473143.25
Grozavesti	Cogeneration	345.72	1.430	494379.60
Resita	Cogeneration	56.36	2.367	133404.12
Titan	Cogeneration	20.95	4.739	99282.05
Pitesti Gavana	Cogeneration	32.52	6.278	204160.56
Timisoara Centru	Cogeneration	15.65	16.154	252810.1
Iernut	Condensing	1976.65	0.120	237198
Palas	Cogeneration	213.83	3.375	721676.25
Total		**9267.26**		**9130096.20**

As we can see for Timisoara Centru TPP CEF is 16.154, which means it is too high comparing to other CEF's for oil and gas fuel plants. For this reason in the calculation of weighted average of $CEF_{Oil\ and\ gas}$ it was not considered.

Additionally, the Iernut TPP and Palas TPP are not considered in calculations of average $CEF_{Oil\ and\ gas}$ because they operate only on gas and respectively only on fuel oil and they have already been taken into account for the calculation of the weighted average CEF (see table 6).

Average $CEF_{Oil\ and\ gas}$ = CO_2 emissions/Electricity generated

The values in the above-mentioned formula do not include the CO_2 emissions and electricity related to Timisoara Centru, Iernut and Palas TPPs.

Average $CEF_{Oil\ and\ gas}$ = 1,121 t CO_2/GWh

The weighted average CEF for 1999 is then calculated as following:

$CEF_{weighted\ average}$=Σ Energy share x Average CEF

The values of energy share and average CEF for each type of energy (hydro, nuclear, coal, gas, fuel oil and combination of gas and fuel oil) are taken from table no.6.

(0.375*0)+(0.107*0)+(0.327*1105)+(0.041*0.120)+(0.004*3375)+(0.13*1121)

CEF = 520 t CO_2/GWh

The Project output is 418.81 GWh/year. The ERU's for the crediting period calculated according to S1 are presented in Table 9.

Table 9

Crediting Period	**2008**	**2009**	**2010**	**2011**	**2012**
CEF (tCO_2/GWh)	**520**	**520**	**520**	**520**	**520**
ERU's (S1) (t CO_2)	217,781	217,781	217,781	217,781	217,781

Total S1: 1,088,905 t CO_2

5.1.2 Scenario 2 (S2): predefined baseline scenario for Romania (ERUPT Guidelines, Volume 2a, Annex B, October 2001)

In the Table 10 are presented the standardized emission factors as predefined by the ERUPT Guidelines, Volume 2a, Annex B, October 2001. These factors are related to all fossil fired plants and take into account the grid losses.

Table 10

Crediting Period	**2008**	**2009**	**2010**	**2011**	**2012**
CEF (ERUPT) tCO_2/GWh	584	575	565	556	547
ERU's (S2) (t CO_2)	244,585	240,816	236,628	232,858	229,089

Total S2: 1,183,976 t CO_2.

A.1.1 Scenario 3 (S3): Replacement of thermal electricity based on existing performance of fossil fuel plants

Comparing with scenarios S1, where it was considered the output of the project would replace the electricity produced based on the existing (1999) fuel mix, for scenario S3 the project output will replace the electricity produced only by the thermal power plants. The efficiency of thermal plants will be kept unchanged during the next years. The project will not replace any hydropower and nuclear power plants output. Based on the most recent (1999) data on TPP from Table 7 and Table 8 it can be stated:

- Total electricity output of TPP's in 1999 was 25,150 GWh, out of which 63% was generated by TPP's operating on lignite and hard coal and 37% was generated by TPP's operating on fuel oil and natural gas;
- The $CEF_{Lignite\ and\ hard\ coal}$ = 1105 t CO_2/GWh;
- The $CEF_{Fuel\ oil\ and\ natural\ gas}$ = 960 t/GWh. (CEF for TPP working on gas, fuel oil or gas and fuel oil)

In this case the average CEF for fossil fuel plants in 1999 is:

$CEF = energy\ share_{coal} \times CEF_{coal} + energy\ share_{fuel\ oil\ and\ gas} \times CEF_{fuel\ oil\ and\ gas}$

CEF = (0.63*1105)+(0.37*960) = 1,051 t CO_2/GWh.

Table 11 presents the resulted ERU's based on scenario S3.

Table 11

Crediting Period	2008	2009	2010	2011	2012
CEF (tCO_2/GWh)	**1051**	**1051**	**1051**	**1051**	**1051**
ERU's (S3) (t CO_2)	440,169	440,169	440,169	440,169	440,169

Total S3: 2,200,845 t CO_2.

5.1.3 Scenario 4 (S4): Replacement of thermal electricity applying correction for operations at margin

The baseline scenario S6 assumes that the Portile de Fier I project output replaces only the electricity produced by TPP and the efficiency of thermal plants remains constant in the future. A correction factor in shares between electricity produced by TPP operating on lignite and hard coal and TPP operating on fuel oil and gas is applied for the fact that TPP's need modernization and generally these are operating at the margin (ERUPT Guidelines 2001, Volume 2a, Annex B).

In practice, the plants with high variable cost (gas-fired) are more frequently operating at the margin than power plants with low or medium variable cost (coal-fired) power (ERUPT Guidelines 2001, Volume 2a, Annex B).

The calculation was made as following:

- Total electricity output of TPP's in 1999 was 25,150 GWh, out of which 63% (D) was generated by TPP's operating on lignite and hard coal and 37% (C) was generated by TPP's operating on fuel oil and natural gas;

- Correction in shares for the fact that gas and oil fired power plants operate more frequently at the margin is done using formulas (ERUPT Guidelines 2001, Volume 2a, Annex B):

$$C_{corrected} = C + 0.5*D \text{ and } D_{corrected} = 1 - C_{corrected}$$

$$C_{corrected} = 0.68$$

$$D_{corrected} = 0.32$$

- The baseline emission factor is then:

$$CEF = CEF_{Lignite\ and\ hard\ coal} * D_{corrected} + CEF_{Fuel\ oil\ and\ natural\ gas} * C_{corrected}$$

$$CEF = 1005\ t\ CO_2/GWh$$

1) Consequently, the actual average CEF for TPP in 1999 is represented by the corrected CEF of 1005 t CO_2/GWh. This correction takes into account the fact that fuel oil/natural gas fired plants are operating more at the margin.

Table 12 presents the emissions reduction for scenario S4.

Table 12

Crediting Period	**2008**	**2009**	**2010**	**2011**	**2012**
CEF (tCO_2/GWh)	**1005**	**1005**	**1005**	**1005**	**1005**
ERU's (S4) (t CO_2)	420,904	420,904	420,904	420,904	420,904

Total emissions reduction S4: 2,104,520 t CO_2

5.1.4 Scenario 5 (S5): Replacement of thermal electricity taking into account the CO_2 emissions related only to electricity

The baseline scenario S5 assumes that the Portile de Fier I project output replaces only the electricity produced by TPP. A practical and reasonably conservative estimate of baseline emissions is done according to ERUPT Guidelines. The paragraphs bellow describes the applied procedure for CO_2 emissions calculation. Because most of the TPP are producing electricity but also heat a correction of the CEF was done taking into account this situation.

In 1999 Termoelectrica produced a quantity of 116 000 TJ heat (1999, Environmental Report Conel) out of which 25 172 TJ were produced in lignite and coal fired plants, 41 412 TJ in fuel oil fired plants and 48 256 TJ in gas fired plants.

The total fuel consumption for electricity and heat generation in 1999 was 389 300 TJ (1999, Environmental Report, Conel) out of which 184 139 TJ lignite and hard coal, 74 356 TJ fuel oil and 127 301 TJ gas.

The amount of fuel for electricity alone is calculated[6] as following:

Fuel for electricity = total fuel – (heat production/0.90) all expressed in TJ

Table 13 below presents this calculation.

Table 13

[6] ERUPT Guidelines, Volume 2a, October 2001, Annex B

Fuel type	Total fuel (TJ)	Heat production (TJ)	Fuel for electricity (TJ)	CEF[7] (t C/TJ)	CEF[7] (tCO_2/TJ)	Total CO_2(t) related to electricity
Lignite and hard coal	184,139	25,172	156,170	25.85	94.79	14,803,669
Fuel oil	74,356	41,412	28,343	21.1	77.37	2,192,977
Gas	127,301	48,256	73,683	15.3	56.10	4,134,004

From the Termoelectrica data (see S1) a total of 25,150 GWh were produced by TPP in 1999, out of which 63% (D) was generated by TPP's operating on lignite and hard coal and 37% (C) was generated by TPP's operating on fuel oil and natural gas.

It can be stated that for producing 15,883 GWh electricity were released 14,803,669 t CO_2 and for producing 9,276 GWh electricity were released 6,326,982 t CO_2. This means an average $CEF_{\text{lignite and hard coal}}$ = 932 t CO_2/GWh and $CEF_{\text{Oil and gas}}$ = 682 t CO_2/GWh.

Correction in shares for the fact that gas and oil fired power plants operate more frequently at the margin is done using formulas (ERUPT Guidelines 2001, Volume 2a, Annex B):

$$C_{corrected} = C + 0.5*D \text{ and } D_{corrected} = 1 - C_{corrected}$$

$$C_{corrected} = 0.68$$

$$D_{corrected} = 0.32$$

The baseline emission factor is then:

$CEF_{corrected} = CEF_{\text{Lignite and hard coal}} * D_{corrected} + CEF_{\text{Fuel oil and natural gas}} * C_{corrected}$

$CEF_{corrected}$ = 761 t CO_2/GWh

It is assumed that the efficiency of TPP will not be changed.

Table 14 shows the project emissions reduction for baseline scenario S5

Table 14

Crediting Period	2008	2009	2010	2011	2012
CEF (tCO_2/GWh)	**761**	**761**	**761**	**761**	**761**
ERU's (S8) – (t)	318.714	318.714	318.714	318.714	318.714

Total S5: 1 593 570 t CO_2;

5.1.5 Scenario 6 (S6): the existing fossil fuel fired plants will use (gradually) only natural gas in the next 30 years (2030)

The emission estimate is based on a mixture of a current (1999) emission baseline (as calculated in scenario S4) and the emission factor[8] of new high-efficient gas-fired power production. The emission factor for such a plant is 388 t CO_2/GWh.

It is assumed that the new plants (gas-based) will have a reference efficiency of 52% over the whole period and the change from the current situation to the final one (all TPP will be gas-fired) will be

[7] IPCC 1996a

[8] ERUPT Guidelenes, October 2001, Annex B

made gradually. It is also assumed that this replacement of fuel will be done in 30 years. The emission factor for year Z is calculated using the following formula[9]:

$$Z = (30-t)/30*X + t/30*388$$

For the year 2000, t =0 and for 2030, t=30

X is corrected average actual CEF as calculated in scenario S4.

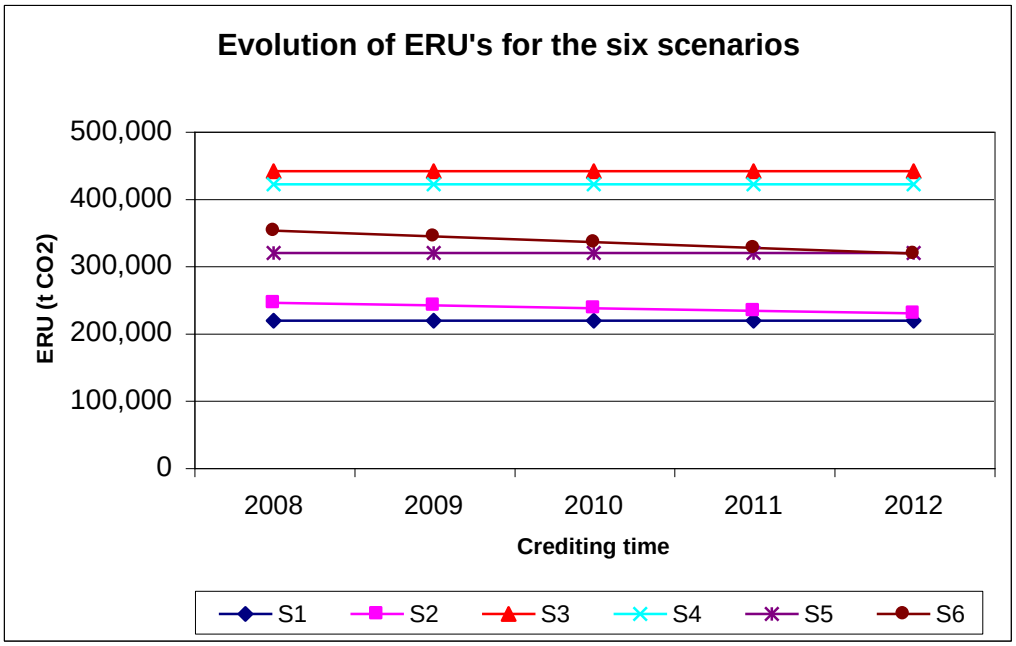
The Table 15 presents the project emissions reduction for baseline scenario S9 based on the assumption that in 30 years from 2000, all TPP will be gas-fired power production.

Table 15

Crediting Period	2008	2009	2010	2011	2012
CEF (t CO_2/GWh)	840	820	799	779	758
ERU's (S6)	351,996	343,382	334,769	326,155	317,542

Total: S6: 1,673,844 t CO_2

The evolution during the crediting period of the ERU's for each of the six scenarios presented above is illustrated in the following chart.



5.2 Identification of the most likely baseline

The selection of the baseline is one of the most crucial elements of the JI project design as it largely determines the size of the emission reduction to be credited. In order to provide certitude and confidence the baseline emission factors, if validated accepted, will not be recalculated during the first crediting period (not before 2012). For this reason, taking into account the key factors (legal, economic, political, socio-demographic, environmental and technical) which could influence the

[9] ERUPT Guidelenes, October 2001, Annex B

future development of Romanian National Electricity Sector, the most conservative baseline scenario is selected as being most likely baseline in the associated GHG emission.

The facts that could affect the future electricity sector in Romania are described in the following paragraphs.

Romania is a contracting party to the UN Framework Convention on Climate Change since the 5th of June 1992. The Convention was ratified by the Romanian Parliament through Law 24 / 1994, which has as primary objective the stabilization of the quantity of GHG in the atmosphere, at a level that would prevent any anthropogenic disorder of the climate.
In November 1996 a National Committee for Climate Change was founded within the Ministry of Waters and Environmental Protection.

Through the Law no 3/2001, Romania ratified the Kyoto Protocol regarding the United Nations framework Convention on climate change, being one of the first states which ratified this international document of a high importance for climate change issues.
In 2000 the implementation of the measures established by the Kyoto Protocol continued, aiming at two essential objectives:

- Observance of the commitment to reduce GHG; Romania committed to reduce the GHG emissions with 8% comparing with emission level in 1989, for the period 2008-2012;
- Adopting a set of market mechanisms, including transferable marketing licenses and the common application of the provisions, in cooperation with other countries.

The Romanian Energy Sector has been and to a large extent still is, plagued by the specific problems[10] faced by most countries in transition:

- Low efficiency of energy production and usage;
- High marginal cost of energy production;
- The poor current status of the power plants, most of them being commissioned in 1960's and 1970's; the required funds for investments and rehabilitation are high;
- Poor legislative, institutional and regulatory infrastructure, plus administrative inefficiency leading to high transaction costs;
- Increases in energy prices that consistently exceed the general rate of inflation;
- Low collection rates especially from industrial users but also from individual consumers because of the high share of energy bills in total household expenditure;
- Poor record on energy conservation and compliance with national environmental requirements.

These problems have been exacerbated by the poor performance of the economy, particularly over the past few years, high inflation rates and the disappointing level of foreign direct and portfolio investment. The most important single incentive for meaningful reform has been external. Since the political changes of 1989, the Romanian energy sector has benefited from grants, loans and technical assistance programs from the international community. Major donors include political institutions such as the European Commission and various United Nations agencies while loans have been

[10] Policies and measures for GHG emission reduction and mitigation strategies in Romania, (Lavinia Andrei, Sergiu Celac, Mihaela Dupleac, …)

arranged through the major international financial institutions, chiefly European Bank for Reconstruction and Development (EBRD) and the World Bank. In addition to multilateral projects, several individual countries, notably Denmark, the Netherlands, France and the United States are active in the energy and energy efficiency field in Romania with bilateral projects. A significant proportion of those resources has been directed towards improving energy efficiency, thus to reduce GHG emissions.

Romania is in the EU pre-accession period and this implies compliance with environmental EU requirements and liberalization and privatisation of electricity market. Consequently, the current government policy is to develop an energy sector that promotes a market oriented economy. Within the privatisation process in the energy sector the first target of Romanian government is to attract strong companies, acting on the EU market, preferably from big holding type companies, which are born today, through mergers, and which probably will dominate EU power market.

Although a special legal framework related to privatisation has been implemented and several facilities are given to interested investors, at present foreign investment process in Romania is slow. This is generated by the economic situation, common people mentality (who are against privatisation), social issues (restructuring leads to an increase of un-employment rate), corruption, and sometimes by bureaucratic procedures.

The baseline scenario to be applied for the Portile de Fier I project has to reflect the above-mentioned facts and to be the most conservative baseline at the same time. The baseline scenario S4 was selected as a starting point for the project.

The assumptions made for the predefined baseline considers that natural gas fired plants (that operate with a 52% efficiency) will replace all currently operational plants. It was also assumed that the share of natural gas fired plants is likely to increase compared to the share of fuel oil and lignite fired plants. However, it is not very likely that the share of natural gas fired plants will increase as rapidly over the next years because of the facts related to Romanian energy sector presented above.

The realistic and also conservative baseline was selected based on the fuel mix of TPP at 1999 level, the most recent available data on TPP performance. The average CEF related to electricity generation by TPP in 1999 is therefore selected as starting point of the baseline. Although we know that replacement of fuel oil and lignite fire plants is not likely to be completed (because of domestic production), assuming that gas-fired plants will replace all fossil fuel plants gradually in the next 30 years is a very conservative approach. Consequently the baseline scenario S6 was selected as being the most appropriate baseline for the project.

The reasons for excluding the other five baseline scenarios are presented below:

- Scenario S1: it is not likely that any changes will occur in the present fuel mix (for electricity production at national level) and in the plants efficiency. Additionally, the electricity produced by the project will not replace neither hydro nor nuclear electricity;
- Scenario S2: baseline electricity grid CO2 emission factors in ERUPT Guidelines were based on IEA energy database which is much more general. The data on the performance of Romanian TPP's at the level of 1999 are more accurate;
- Scenario S3: it is not likely that any changes will occur in the present fuel mix (for thermal electricity production at national level) and in the plants efficiency. Usually the gas fired TPP operate frequently at the margin because of high operational costs. This aspect has not been taken into account in S3;

- Scenario S4: the efficiency of TPP is not likely to remain unchanged in the future;
- Scenario S5: the available data (1999, Environmental report, Conel) were not detailed for each cogeneration TPPs and the heat electricity ratio is different for each unit.

5.3 Baseline selection, specification and calculation of the associated emissions

As explained in item 5.2, the selected baseline scenario for the project is scenario 6, which was considered the most conservative scenario.

The emission estimate is based on a mixture of the current (1999) emission baseline (as calculated in scenario S4) and the emission factor[11] of new high-efficient gas-fired power production. The emission factor for such a plant is 388 t CO_2/GWh.

For the current situation a correction factor in power shares between electricity produced by TPP operating on lignite and hard coal and TPP operating on fuel oil and gas is applied taking into account that plants with high variable costs (fuel oil and gas fired) operate more frequently at the margin. In this case corrected CEF = 1006 CO_2/GWh (see scenario S2).

It is also assumed that the new plants (gas-based) will have a reference efficiency of 52% over the whole period and that the change from the current situation to the final one (all TPP will be gas-fired) will be made gradually. It is also assumed that this replacement of fuel will be done in 30 years. The emission factor for year Z is calculated using the following formula[12]:

$$Z = (30-t)/30*X + t/30*388$$

For the year 2000, t =0 and for 2030, t=30

X is current (1999) corrected average CEF (1005 t CO_2/GWh) as calculated in scenario S6.

As the project is assumed only to replace fossil fuel fired plants for the baseline situation only on-site direct emissions were taken into account (see chapter 2 for motivations).

The Table 16 presents the baseline emissions based on the assumption that in 30 years from 2000, all TPP will become gradually gas-fired power production.

The project is expected to start 2006 and its output is 418.81 GWh/year.

Table 16

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
CEF (t CO_2/GWh)	882	861	840	820	799	779	758
ERU's (S6)	369,223	360,609	351,996	343,382	334,769	326,155	317,542

[11] ERUPT Guidelenes, October 2001, Annex B

[12] ERUPT Guidelenes, October 2001, Annex B

6 Estimation of project emissions

6.1 Description of factors used for estimation of project emissions

The Portile de Fier I project consists in modernisation of the 3 hydro units (Unit 3, Unit 2, Unit 1) of the hydropower plant which will result in the upgrading and increase of the unitary active power from 175 MW to 194,5 MW, expansion of ancillary services offered, as well as extension of hydro units life duration with 30 years. Therefore, the main output of the project is additional electricity.

The main activities related to the modernization of 3 hydro-units are:

- Turbines refurbishment
- Generators rehabilitation
- Automatic equipment replacing.

As it can be seen only rehabilitation works are done within the existing hydropower plant. These works will lead to an additional non-polluting power as a result of active power increase by 19.5 MW/unit modernisation, respectively 58,5 MW.

The upgrading of the 3 hydro units will also provide all services needed to guarantee the operational safety of the National Power System (secondary adjustment, spinning reserve and reactive control). By the modernisation works the secondary adjustment band for each unit increases from 80 MW to 110 MW.

The key factors for estimating the project emissions are:

- The activities (rehabilitation and refurbishment) performed to implement the project;
- The project output.

The project output is the generation of electricity and expected annual quantity is (as it was presented in Annex 3) 418.81 GWh/year.

The calculation of total output of the project is presented in Annex 3.

6.2 Calculation of direct project emissions

Direct on-site emissions

As stated in chapter 2.2, direct on-site emissions include emissions from production of electricity on the site of the project.

Total direct project emissions/year = Project output *$CEF_{project}$

TDPE = 418.81 GWh/year * 0 t CO_2/GWh = 0 t CO_2

Hydropower is a clean energy source that is emissions free, and there will be no GHG emissions that are directly related to the use of hydropower for electricity production. Consequently, $CEF_{project}$ = 0 t/GWh and total direct project emissions until the end of crediting period is 0 t CO_2.

Direct off-site emissions

Direct off-site emissions are considered zero GHG emissions (see chapter 2.4); 0 t CO_2.

6.3 Calculation of indirect project emission effects (leakage)

As stated in chapters 2.3 and 2.5 indirect (on site and off site) project emissions will not be considered for the project case (as they are considered for the baseline scenarios).

Indirect project emission = 0 t CO_2.

6.4 Calculation of total project emissions

Project emissions are related to the generation of energy. As generation of hydropower is a clean process, the total project emissions during crediting period are assumed to be zero.

7 Crediting time

Start date of the project (all three hydro units)	2006
Life time of the project	30 years
Crediting time of the project (only relevant if the project crediting time will end before 2012)	Five year – commitment period (2008 – 2012)

8 Estimation of emission reduction

The total emission reduction as a result of Portile de Fier I project implementation is calculated by deducting the project emissions from the baseline emissions.

Emission reduction /year = Baseline emissions/year – Project emissions/year

Total emissions reduction (t CO_2) = $\sum$ *Emissionreduction / year*

Table 17 presents net emission reduction for the project

Table17

Year	**2008**	**2009**	**2010**	**2011**	**2012**
Baseline emissions (t CO_2)	351,996	343,382	334,769	326,155	317,542
Project emissions (t CO_2)	0	0	0	0	0
Net emissions reduction (t CO_2)	351,996	343,382	334,769	326,155	317,542
Total ERU's commitment period = 1,673,844 t CO_2					

Reviewed by: Approved by:

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KPMG Partner, Financial Advisory Services

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Annex 1 – Information on the project

Modernisation of the 3 hydro units (Unit 3, Unit 2, Unit 1) of Porţile de Fier I hydropower station will result in the upgrading and increase of the unit active power from 175 MW to 194,5 MW, expansion of availability of ancillary services as well as extension of life duration of hydro units with 30 years. The Project is based on an experience in operation and on the solution successfully applied in modernising the other 3 hydro units of the station (U 6, U 5, U 4) by VA TECH HYDRO Ltd company. Expected date for starting construction is June 2002 and date of completion is March 2005. Project financing: Own sources and bank loans.

The Hydropower and Navigation System of Porţile de Fier I, in operation since 1970, was built on the river Danube by joint efforts of Romania and Yugoslavia under the 1963 Agreement.

Each of these countries owns one hydropower station, with installed power of 1050 MW, equipped with 6 hydro units.

The Romanian power station is operated by **SC Hidroelectrica SA**, created through Governmental Decision HGR 627/2000, on 1, August 2000.

The hydrounits were subject over the past years to an intensive operation (average 6500 hours/year/unit, in severe flow and head conditions), under the conditions of "The Convention between the Government of Romania and the Federal Government of Federal Republic of Yugoslavia concerning the operation and maintenance of Hydropower and Navigational Systems for Portile de Fier I and Portile de Fier II"

The Joint Romanian Yugoslav Commission approved the conclusions/findings of very elaborate studies performed in 1991, demonstrating that hydropower units in Portile de Fier I is feasible to be uprated from 175 MW to 194,5 MW. According to the decisions of the joint Commission in the period 1995-1997 a set of technical documentation was prepared together with the Yugoslav party , focussing on modernisation solutions.

For political and economical reasons only the Romanian part had possibilities to start the repair and modernisation works on the hydro units, based on feasibility studies developed in 1996.

By a Governmental Decision HGR 474/1997 the modernisation works have been awarded to Sulzer Hydro Ltd., actually VA TECH HYDRO Ltd.

The modernisation works are proceeding in accordance with the provisions of the contract no. 16636/1997, " Overhauling and Modernisation for Improving the Safety and Upgrading of six hydro units C.H.E Porţile de Fier I". Works on two hydro units have been finalised, respectively U6 on 8 September 2000 and U5 on 14 August 2001 while works are underway /in progress on unit U4. As for Hydro units U3, U2 and U1, according to contractual clauses, these shall be modernised in the period 2002-2005.

For U6 payments have been entirely covered by Hidroelectrica, out of own sources, whereas for U5 the advance payment partly from own sources and the rest by a CITIBANK NA granted credit. The works are supported by the government through Sovereign guarantees for the credits granted.

Beside the additional non-polluting power as a result of active power increase by 19.5 MW/ unit, modernisation works for three hydro units shall lead to improved unit performance, these having a preferential operation for a secondary adjustment, spinning reserve and reactive control. Altogether the extension of life duration with 30 years for the hydro units is obtained.

The project is realised as a "turn-key" contract, the contractual obligations including activities of design, manufacturing, testing and delivery, disassembly, refurbishment, re-assembly, technological tests, commissioning, operators training and spare parts supply.

Design, selection of materials, performance and testing are made in accordance with international standards. The contract provides programs for quality control and quality assurance in line with EN ISO 9001-9004 provisions during all phases of contract performance, relationship with subcontractors including.

Modernization of hydro units includes mainly the following activities

1. Turbine and associated installation:

- Turbine refurbishment: rotor blades, seals and blade bearings replacement as new components as well as refurbishment and recycling of the old components. In order to meet the 10 months/unit deadline, for the first unit the entire turbine rotor was replaced by a new one.
- Refurbishment of the control system including: speed regulator modernization (replacing controls and drives, newly equipped with electronic regulators and spinning reserve regulators), pressure oil unit electro pump and measuring and control instrumentation replaced.

2. Generators, auxiliary installations and excitation system:

- Generator rehabilitation by: stator casing repair, stator magnetic core and stator winding replacement, remedy works on rotor crown, rotor pole coil replacement, rotor static and dynamic balancing, generator thrust and radial bearings refurbishing.
- Improvement of air cooling system by new coolers and additional electric breaking system.
- Replacing the existing warning and fire extinguishing systems y a water spray system made in line with European standards.
- Replacing static excitation systems both for main and auxiliary generator and the auxiliary one with new microprocessor based systems.

3. Automation and electric protection system

Complete equipment replacement (both classic and numerical ones) as associated with automation, electric protections and unit 0.4kV distributor. New equipment is compatible with actual technical characteristics, fitting into existing locations and assures absolute safety in unit operation valid for a new 30year life cycle.

Main upgrading technical data

LEVELS (metres above Adriatic Sea Level – maASL)

Upstream levels	
Maximum	70.00 maASL
Normal	69.50 maASL
Minimum	63.00 maASL
Downstream levels	
Maximum	46.65 maASL (at flow with 0.01% probability)
Normal	42.52 maASL (12 turbines in operation at maximum discharge)

Minimum	41.00 maASL (2 turbine in operation)
Extremely minim	38.50 maASL
HEADS	
Maximum gross	31.50 m
Nominal	25.50 m (minimum head required at the installed capacity)
For maximum discharge	19.20 m
Normal minimum	18.00 m
Extreme minimum	15.40 m
FLOW	
Multiannual average flow of the Danube	5560 cm/s
Maximum flow of refurbished turbine	840 cm/s per unit
Short duration maximum (about 100 hours/year)	900cm/s per unit
TURBINES	
Nominal output	194 MW
Maximum output	200 MW
Minimum for operation	70 MW
The weighted average efficiency guaranteed	minimum 94.1%.
GENERATORS	
Nominal apparent output	216 MVA
Nominal reactive output	94.15 Vvar
Nominal voltage	15.75 kV
Nominal frequency	50 Hz
Power factor	0.9

Environmental protection

The Environmental Impact Assessment carried out before to start the project highlight that the modernisation works impact on the environment is not significant. The modernisation works are carried out in accordance with Environmental Agreement no. 180/ October 12, 2001, emitted by Environmental Inspectorate Drobeta Turnu Severin.

Environmental protection requirements for suppliers are stipulated by contractual clauses. Hidroelectrica Environmental Management System procedures include prevention pollution actions plan and emergency response.

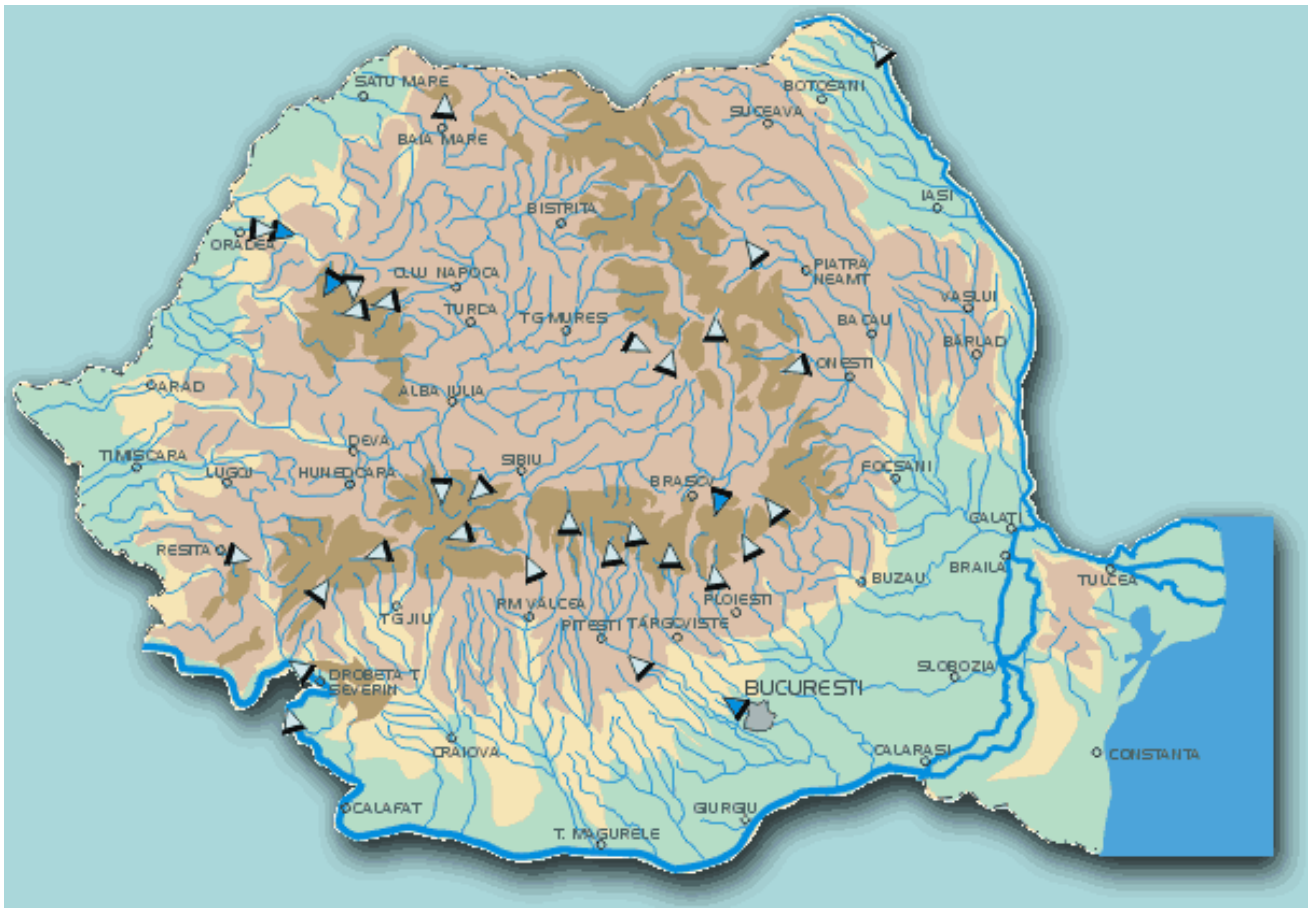
Investment planning

The schedule for performing the modernisation works estimates a duration of 10 months per year, commissioning of the last hydropower plant being scheduled for 31.03.2005.

The Government of Romania is actively backing the finalisation of this project, keeping firm the facilities as given for the Project. Thus, for external loans associated with accomplishment of the works under Governmental Decision HGR 652/1999, the Ministry of Public Finances is capacitated to issue Governmental Guarantees, up to the limited amount of EURO 103,84 mil. Also, in conformity with 14 Jan. 2002 Law, the project has customs tax and VAT exemption incentives.

For financing the last 3 hydro units (U3, U2, U1) the 15% advance payment is supported out of own resources for the first unit (U3) and the loan contract with Union Bank of Switzerland will by signed in August 2002.

Annex 2 – Location of the Portile de Fier I hydropower plant



Annex 3 Project input justification

Project imput justification

1, Supplementary power installed in three units	58.50	MW
2, Working time period for using up the supplementary power (sufficient flow)	3,500	hours/year
3. Maximum supplementary energy	204,750	MWh/year
4, Energy non-generated in Thermo as a result of supplementary electricity produced by project	122,850	MWh/year
5,Increase of Secondary Control Band from 80 to 110 MW/unit	90	MW
6,Utilization time, additional to lower half-band	8,760	hours/year
7.Hydro power generated additionally for secondary control	394,200	MWh/year
8,TOTAL EXCESS HYDROPOWER	517,050	MWh/year
9,Energy generated in thermopower plants in Romania for obtaining a 90MW band with Pmin 65% out of Pn		
-Pn= 90*100/35	257	MW
-Band	90	MW
-Pmin tech	167	MW
Minimal energy supposed to be generated in thermo-pp=Pmin tech.*Tu(see 6 above)	1,464,171	MWh/year
Remarks		
In order to justify capacity non-generated in thermo, the amount of 1464.171GWh/year was not considered; instead the excess 517,050 GWh/year generated hydropower was taken into account with a correction by risk factor Kr=0,81		
10 Equivalent energy = Kr*En hydro (see 8 above)	418,811	MWh/year