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Developmental Study for the Electricity Industry: Links and Synergies with other Branches of Industry

Draft

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written by

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Content

List of the Abbreviations used

a	Year (anno)
BIH	Bosnia and Herzegovina
BiH	Federation Bosnia-Herzegovina (Entity)
GDP	Gross Domestic Product
EP BiH	Elektroprivreda BiH, Sarajevo
EP HZHB	Elektroprivreda Hrvatske Zajednice Herzeg-Bosne d.o.o., Mostar
EP RS	Elektroprivreda Republika Srpska
Hz	Hertz, Measuring Unit for the Frequency of Three-Phase Current
ISO	Independent System Operator
KM	convertible Mark = 1 DM
KWh	Kilowatt hour
MWh	Megawatt hour= 1000 kWh
GWh	Gigawatt hour= 1000 MWh
SPS	Speicherprogrammierbare Steuerung = Programmable Controls
UCTE	European Union for the Coordination of Transmission of Electricity

1 Introduction

1.1 Definition of Sectors

Bosnia and Herzegovina (BiH) borders on Croatia to the north and the west, on Serbia to the east and on Montenegro to the south. The country covers a surface area of 51,129 km² and has a population of 3.838 million, in which means a population density of 75.1 persons per square kilometre. The economic health of the country is still affected by the clean-up operations in the wake of the massive damage done during the war (1992-1995), as well as burdened by the changes wrought during the slow transition from a monopolistic planned economy into a liberal western-style free market economy. The long-term goal here is to become a full member of the European Union (EU).

Energy and the water supply are two important pillars of a functioning economy, indeed of life generally. The damage done during the war was immense, but international aid has ensured the rapid reconstruction of supply networks. It is important to note here that the country has a relatively high level of precipitation of about 1,700 mm/a and many clean, high-volume rivers and mountain lakes exist for the supply of drinking water and power.

By the electricity industry sector, we mean the power supply for all voltages from the power station down to the customer's electric meter. Within the framework of the planned liberalisation, we describe the core divisions which are partly already in place in electricity utilities: Generation (power stations, electricity imports), Transmission (electricity distribution, network transmission) and Distribution (marketing, sales, accounting, export). As far as contributing to the Gross Domestic Product (GDP) is concerned, the import and export of power, and the specific technical components of power supply and service are taken into account.

1.2 Trends in the global electricity industry

The amount of electricity produced globally in 1997 was 13.949 billion kilowatt hours (kWh). This represents an increase of 18% in relation to the 1990 figure. Some European countries such as Germany, France, Sweden and Norway have stagnated as far as consumption is concerned whereas others, like China, Indonesia, South Korea and Thailand, have roughly doubled their consumption within the space of just 8 years. Austria, Great Britain, Italy and especially Turkey have shown increases in the same period of between 11 and 45% (source: IEA Energy Balances,1999; Lit 12). Electricity consumption increases as a result of growing population levels and rising income. In Germany approximately 6500 kWh power is consumed per person, per year, meaning that each individual German household uses a mere 1500 kWh.

Electricity tariffs show great global variation; within European households (1998), rates ranged between 0.097 and 0.183 US-$/kWh. The most expensive countries were Italy and Spain; the cheapest Switzerland and Britain. The process of liberalisation in the electricity markets over the last few years has meant reductions of up to 35%, especially for industrial customers.

Within the EU, a decision has been taken to open up all the networks. Different countries have adapted to this new legislation to varying degrees. Great Britain and Norway were the most advanced; France and Italy are currently opening up for large customers; and Germany has seen full-scale competition for all customers for two years now. Austria will open up its electricity market completely in September 2001. In some countries the process of opening up national grids or networks in a non-discriminatory fashion is supervised by government regulatory bodies. This makes it necessary to calculate transmission fees (often published on the Internet) resulting from separately administered network costs for all voltage levels. The increasing demand for precision in the timing of calculations makes electronic data processing a must. For large customers, the use of electronic meters with a remote sampling facility on constant call is essential for load management and modelling power transmission. Feed-through transmission allows the bundling of several purchasers, e.g. a chain of stores. The new method of calculating consumption for bundled clients and billing their consumption on a single invoice has become prevalent over the last few years in liberalised countries and has revolutionised the old market, while at the same time making life difficult for small, local providers.

The pan-European standardisation of electricity as a product has made it possible to purchase it at electricity market places, e.g. Amsterdam, London, Frankfurt/Main or Leipzig. The current tariff is instantly accessible via the Internet. The orders can be placed at a click of the mouse after payment of an “entrance fee” and completion of a quick induction course. This has greatly improved the purchasing situation for a lot of utilities. On the other hand, overcapacity in the generation of electricity means that utilities that own expensive power stations are suddenly at a disadvantage compared with simple electricity traders.

The liberalisation of the electricity market has greatly altered the situation in Germany, for instance. Many small local stations (there are about 900 in Germany) are afraid they might have to close down despite laying off staff and modernising. The abolition of the monopoly for power supply and power line construction in a specified region means that sales volume is no longer guaranteed. Nevertheless, these local power stations are structured in a decentralised pattern and are close to the customer, which is something that no large-scale utility, even with marketing and favourable tariffs, can achieve. The large pre-suppliers are merging in an unprecedented fashion with the permission of the Monopolies and Mergers Authorities into mammoth suppliers such as EON, RWE/VEW, ENBW or HEW/VEAG/Bewag. At the same time the Americans (e.g. Enron), Norwegians (Fortum), Swedes (Vattenfall), or French (EDF) are buying up whole networks or shares in utilities on the German market.

Large companies or purchasing co-operatives also need large amounts of material at once at favourable discounts. Small suppliers, e.g. of power cables and standard meters, cannot compete in this arena. This means that the number of each of these component suppliers in Europe can be counted on the fingers of one hand.

In competition, a utility must carefully watch its costs. For customers, factors such as voltage stability and rapid renewal of supply after a power outage are perceived as minor factors to the extent that they are unwilling to pay more for these benefits. This means that non-essential network expansion or conversions are shelved and power stations which are not running at full capacity or need high levels of personnel or maintenance are shut down

rapidly. This policy of running networks with no back-ups has led to long power outages with dramatic consequences in the USA and New Zealand, as has been widely reported in the press.

Last but not least, competition and additional expenditure for renewable energies are strange bedfellows. In many European countries protective legislation on regenerative and rational energy (district heating/CHP stations) exists or is in the process of being passed. The only way to ensure the expansion of environmentally-friendly energy is through compulsory minimum fees and legal quotas. Germany and Denmark have achieved prominent positions in this regard through the construction of wind-powered stations. The wind-powered branch employs 15,000 people in Germany alone with a turnover of over 2 billion DM and a 14% export share in 2000 (Lit 11).

2. Analysis of the Current State of the Electricity Branch in Bosnia and Herzegovina

The largest power utility in BiH is still Elektroprivreda, although it is currently fragmented in line with the dual entities of the country and the Croatian region into a Serbian division (Republika Srpska, EP RS), a Bosnian division (Federation of Bosnia-Herzegovina, EP BiH), and a Croatian division (headquarters in Mostar, EP HZHB). Although the Croats were not awarded their own entity, they are in control of a set part of the country as a whole and are responsible for the operation of the network operation at all voltage levels. Each of these utilities, which in pre-war times were unified, is autonomously administered and organised, pursuing first and foremost its own regional agenda (c.f. Illustration 1,next page: whole of BiH with 3 large sections: light brown = EP RS, blue/purple = EP BiH, light blue = EP HZHB and the special area Brcko (orange). Source: Lit 3). The illustration shows the route of the 400, 220 and 110 kV power lines, the location of the power stations (dark blue dots are hydroelectric plants, dark green dots are brown coal-fired plants) and the position of sub-stations (small empty circles). The unbroken lines show the reactivated power lines whereas the dotted lines show the still damaged overhead power lines (400kV).

The concentrations of lines and circles clearly indicate the larger consumer centres (clusters, industrial parks) around Sarajevo, Mostar, Tuzia, and Trebinje. The shape of the entities is so jagged and irregular as to make supply via separate transmission networks totally uneconomical. The old power lines that were previously in place to the right and left of the main lines are also to be reinstalled and so there will be a great deal of accounting work necessary to keep track of all the power transmission and power exchanges taking place.

The power networks are linked at the borders of each network but the current flows are gauged in both directions by the corresponding Elektroprivredas and monitored and registered by the corresponding dispatching centre. The geography of the Serbian and Bosnian area necessitates a great many gauging stations. In order to cross from the western to the eastern border of the country, the current might have to pass through 5 separate gauging stations, each performing double measurements. This might have been suitable in the restructuring phase immediately after the war, but it now constitutes an obstacle to efforts

to optimise the operations of all the power stations in the country, as well as making the process of power transmission more difficult. An example demonstrates this clearly. The distributing centre of Elektroprivreda BiH in Sarajevo owns and controls 3 hydroelectric plants on the River Neretva (Jablanica, Grabovica and Salakovac) but does not receive any data about water storage volumes at Rama, the plant upstream, or from the hydroelectric plant downstream in Mostar. No information is exchanged about the general annual operating procedures, as these plants belong to Elektroprivreda HZHB (Mostar) and all such data is held there. This means that the task of managing the water supplies in this area, which is naturally difficult, is impossible to complete in an economical, mutually beneficial way. Just 5% waste via inadequately used water represents an annual loss of approximately 4.3 m. Euro.

The World Bank is supporting a project that has been up and running for 2 years, designed to build a central dispatching centre in Sarajevo in the facilities of the formerly state-owned company Energoinvest. Within the framework of Power 3, the SCADA (Supervisory Control and Data Acquisition) project phase will contain an investment of roughly US$ 44.2 m. (Lit 2). General acceptance of an Independent System Operator (ISO) will be the deciding factor if a centralised system is to be effectively implemented.

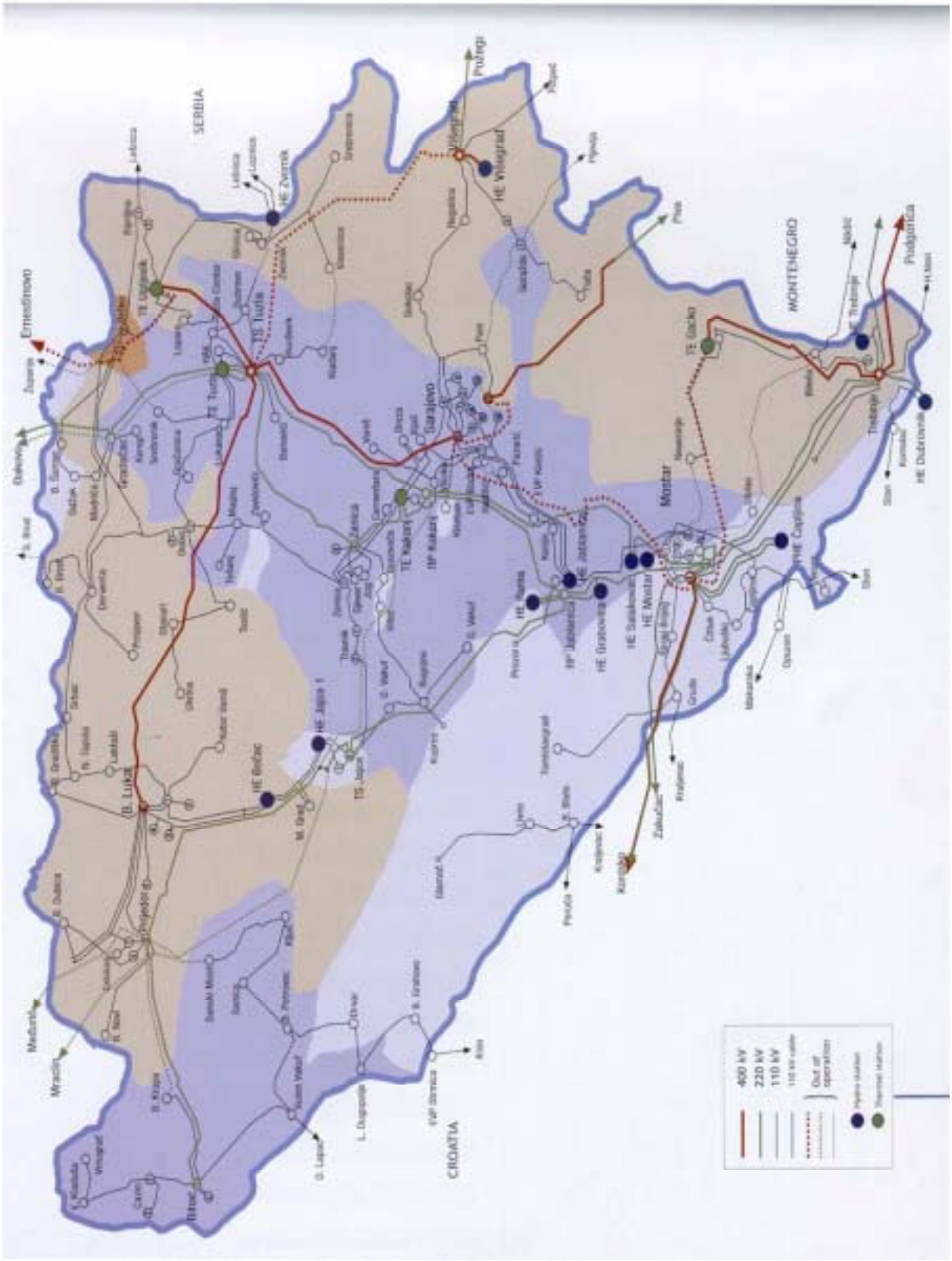

Illustration 1

2.1 Significance of the Sector at a National Economic Level

According to the estimates of the GTZ (Lit 1), the Gross Domestic Product of the whole country in the year 2000 will be US$1,170 per capita. Based on a population of 3,838,000 (Source: www.erdkunde-online.de/0241.htm) this results in a total Gross Domestic Product of DM 9.610 billion or EUR 4.914 billion (DM 2.14 =KM 2.14 = US$1 = EUR 1.094).

This consultant has estimated the share of the power supply at a considerable 9.7% of GDP, based on the currently published reports of the three power utilities and with the help of details given by the World Bank on the large-scale Power 1, 2 and 3 projects (see Lit.2). With the gradual recovery of the national economy and the fall in investment due to war damage in the power supply branch, the proportion of power supply within the total GDP is expected to fall in spite of increases in electricity consumption.

Employment

One of the biggest employers in the energy branch before privatisation was the company Energoinvest, which had about 28 Development and Production Divisions and approximately 37,000 staff. Energoinvest used to be Elektroprivreda's partner. As one can tell from the name, in the days before privatisation no significant investment could be made in the energy branch without the agreement of Energoinvest. Today, the expertise which surely exists within Energoinvest is hardly used. The best planning and project experts have found other positions within industry or have gone to work abroad. The production facilities are 60% obsolete for several reasons: there is a lack of planners, builders and marketing experts; a technological lag due to the war exists; buildings and machines have been damaged; and previous clients are now being supplied by western companies such as Siemens, ABB, Alcatel, Raychem, Andritz etc., who already have their own sales and service centres within the country.

In spite of this, there has luckily been a spate of company start-ups by people willing to take the bull by the horns, and initial successes have already been achieved. Thus, this consultant, with the help of Mr Sacir Sosevic of the Regional Centre for Strategic Planning and Investments, has tried to analyse start-ups in the field of power supply to utilities according to different criteria, including the number of employees. This aspect will be elaborated upon in Chapter 3 of the study.

The three Elektroprivredas employ approximately14,000 staff today. Liberalisation has led to the usual tripartite division into core activities (c.f. Chapter 1.1). The company reports (c.f. Lit 3 and 4) and conversations with the CEOs have afforded us a relatively good insight into the situation. Generally, a drastic cutback in staff is planned over the next 2 to 3 years. The target is to cut back to 2/3 of the present personnel. The core division with the highest numbers of employees is Distribution, where 50 to 57% of personnel can be found. It is clear that areas such as meter reading, invoicing and accounting are crippled by a high degree of manual activities. Typewriters can often be found in offices sitting next to PCs. There are high numbers of "buffer" personnel such as porters, mail messengers, filing assistants, janitors, gardeners, some cleaning and canteen personnel, and chauffeurs, who are all helpful and polite but who probably will soon lose their jobs due to rationalisation. But there is a lack of staff capable of handling power transmission tasks and selling power in a

competitive market. This does not yet exist, but the legal preparations are currently being made (Draft of the New Electricity Bill, Lit 6 and Electricity Policy Statement, Lit 7)

The proportion of women workers is about 18.5% within the utility area and is thus clearly smaller than the proportion of female employees in total, e.g. in the Federation BiH the figure was approximately 32% in 1999 (Annual Report of the State Bureau of the Federation).

Similarly, in the Generation division in the Elektroprivreda BiH utility, 2,181 staff are employed, or 34.1% of all personnel. The employment figures reflect the old philosophy of covering as many tasks as possible with as great a number of directly employed staff as possible in order to be less dependent on bad service and logistics provided by third parties. On a spot visit to two hydroelectric plants on the river Neretva, both plants appeared to be extremely well-cared for; clean and tidy buildings, well-finished steel tanks and pipes, good labelling of all important components and well-organised paperwork on technical issues. The CEO of the 3rd plant deserves a special mention for his high level of motivation. He spontaneously offered to show us round the plant and answer our questions on Sunday following a brief telephone call. A staff of 432 is responsible for the operation of the 3 BiH power stations alone, although the real operation only requires 2 people per plant rotating on a three-shift basis. There are some modernisation measures currently being taken, e.g. on the turbine and generator unit 5, in which the company‘s own personnel are being well deployed. In Konjic on the River Neretva the construction of a hydroelectric plant with 121.7 MW nominal output will soon be completed. It is expected to generate 290 GWh/a. A further three hydroelectric plants are on the drawing board in EP BiH. As the construction of new hydroelectric plants has already begun within Elektroprivreda Hrvatske Zajednice Herzeg-Bosne d.o.o. Mostar (EP HZHB), the decision to send over experts can now be considered. A lot of staff cutbacks in the Generation Division can be accomplished through outsourcing and so a basis for new, privatised service companies may be created.

The total balance of the EP RS shows a quite dramatic loss of EUR 8.7 m for 2000. Any feasible cost-cutting measures involving personnel reduction should be immediately implemented here, even though this step alone will not help improve the situation. Even more importantly, steps must be taken to reduce non-technical power losses (electricity theft, meter tampering, collecting outstanding bills). Action must be taken here immediately (e.g. cutting off power). EP RS now wants to take steps to address these issues. Political support is necessary here, although past history has pointed policy-makers in the opposite direction (the state is responsible for supplying sufficient electricity, the consumer has a social/moral claim to this service). This is a problem endemic to all EPs but not to such a high extent. In Chapter 5.1, possible measures to address this problem will be proposed.

However, an employee in the electricity utilities branch earns on average DM 976 gross per month. The working period of eight hours normally begins between 7 and 7.30 am and finishes at around 3 pm. The breaks are paid and count as working time. The employees, as well as some executives of the utility company, showed little flexibility time-wise in the afternoon. Apparently, overtime is not paid, or at least not well-paid, so there is little incentive to work longer. The utilities sector, after overcoming the damage due to the war, is set to be in the black again in line with the gradual recovery of the economy, and so short-term personnel cutbacks need only be undertaken when wage and salary increases cannot be financed by raising electricity tariffs. On being awarded their Power 3 loans, all three

Elektroprivredas gave assurances to the World Bank that they will not allow any wage or salary increases for the next few years. Over the next three years, however, the energy tariffs for private households as well as industrial consumers should not be raised, as this serves to stimulate general development. Potential power suppliers will therefore see no opportunities of doing business in the market when it opens later, and so will ignore the electricity market in BiH.

Export of electricity and other industrial products

The very high proportion (50% of the total power generated throughout the country) of ecologically valuable hydroelectric power has always made the sale of power surpluses during minimum load periods (nights, summer) a significant factor. In addition to this, the residual power generated from conventional coal-fired stations has to be regulated. An overview of the available power stations with the power amounts generated in 2000 can be seen in Tables 1 and 2 in Chapter 2.2.

To cite a relatively clear example, 5 EP HZHB hydroelectric plants last year generated 1,317 GWh in the Croatian region. No further generation was undertaken. However, the consumption within the same time period was 2,828 GWh minus 40 GWh transport loss (c.f. Lit 4). The difference of 1,509 GWh was covered by deliveries from the Federation BiH, neighbouring Croatia and Switzerland (Entrade). To balance this out, return deliveries and/or exports to Croatia were undertaken at minimum load periods. This export includes surplus power which has been generated cheaply in hydroelectric plants and is sold at a profit at a rate of approx. 4.5 Pfennig/kWh.

In relation to this, it is interesting to examine the power supply to the large aluminium works in Mostar, which also manufactures auto bodywork components and engine casings for Daimler-Chrysler. The aluminium works receive their power (876 GWh/a with a maximum of approx 200MW) contractually from the German subsidiary of Daimler, Debis International Trading, which in turn acts as an electricity trader and procures its electricity from EP BiH. EP HZHB charges EP BiH for high voltage power transmission and for the delivery of peak-time electricity in return.

The expanding aluminium works are planning a new electrolyser which will extend production. As a consequence of Power 3, EP HZHB expects to rapidly rebuild the essential 400kv high-voltage power level as well as to reconstruct the sub-station in Mostar 4/Cule which was totally destroyed in the war. In Mostar there used to be a large aeroplane works (Messrs* Soko, approx. 10,000 employees, of which 70% were Serbian) whose production line was dismantled by the Serbs in 1991 and transported to Belgrade because of its military significance. The empty factory hangars were not destroyed during the war. They are not now in use, although they are ideally suitable as far as the infra-structure is concerned. They would provide a good site for the manufacture of large and small components for power supply such as large, complete, high and low-voltage transformer stations, aluminium cables, power pylons, large windmills, turbines or generators. The customs office and exhibition centre in Mostar are located right next door. We will come back to this point in Chapter 5.2.

The export of power has been a growing business for EP BiH since 1997. The initial volume was nearly 500 GWh/a, and this has today grown to 1,300 GWh/a, whereby, as already stated above, Debis is the largest customer. In addition, there are good business relations with the electricity dealers, such as ELES (Slovenia), HEP (Croatia), EPCG (Montenegro), ENRON(USA), Entrade (Switzerland), Apis (Slovakia) and EFT (England). Within the framework of widened access to the market, deliveries of electricity to Albania and Greece are under consideration as their demand for electricity is steadily growing.

Last year, EP RS produced 4,403 GWh of power, half of which was generated by hydroelectric power and half by the two coal-fired stations (c.f. Lit 5 and Table 2, Chapter

2.2). Consumption for the same period was nearly 3,000 GWh. The surplus served to provide the other two EPs with power and to supply Serbia (the remainder of Yugoslavia*) and Montenegro. The republic Srpska has a difficult shape – long and narrow with deep indentations near Goradze and Brcko - as far as power supply is concerned, and suffers from the lack of a high voltage network which has not been set up there for this reason. An additional disadvantage is the unfavourable distribution of power stations, which are focused in Trebinje/Gacko but provide the region around Banja Luka, with its important metal and cement industry, poorly (c.f. Illustration 1). The export figure here is 1,822 GWh compared to an import figure of 563 GWh. The defective 400 kV connection from the big hydroelectric plant in Visegrad (700 GWh) to Tuzla hinders supply to the western RS area. At the moment, the best technical solution to avoid great losses is to export the power generated there via the 220 kV line to Serbia (Pozega) and to partially repurchase it in Zvornik, for instance. The poor supply situation combined with high non-technical losses (26%) in distribution, produced a loss of EUR 87 m in the 2000 balance.

The export of components for power supply does not presently exist in the EU. The companies we approached all showed great interest. Many purchase pre-products or ready-made products (e.g. electronic control systems/SPS) from the EU and have corresponding contacts with the west.

Huge hurdles still remain, among them the technological/developmental lag due to wartime, the dearth of experience with privatised markets and, last but not least, the inability to do quality checks on products in line with European standards/norms. Before the war, the standards institute was located in Belgrade; since the war, there has been no attempt to set up a replacement. The universities, institutes and technical colleges we visited would all be willing to give technical support, offering their laboratories/measuring equipment and computers.

The export of products such as switch boxes, power pylons and cables is hindered by the passive role taken by the Chambers of Commerce. We particularly noticed this in Banja Luka (Privredna Komora RS), where it was apparent that their information base was lacking and no real service was provided for private companies. Active use of either computers or the Internet was non-existent there. We were unable to hold talks with the chambers in Sarajevo (Privredna Komora FBiH and BiH) as there was not enough time. The German Foreign Trade Development Agency (AHK) in Sarajevo is extremely keen on encouraging cooperation between companies in both countries. This institution publishes a list of all German firms/sites in the country (approximately 35), and offers numerous services such as contacting businesses, exhibition services, interpreters, courses of study and help in finding business locations. Their brochure (Lit. 8) also contains advertising in German and/or in English for domestic companies, e.g. for Messrs Umel-Dalekovod Montaza d.o.o. in Tuzla, who employ 68 staff and offer transformer stations, power pylons, projections and assembly. The use of the Internet and Intranet is a matter of daily routine in the AHK. Round table discussions are held on a regular basis in Sarajevo and are open to anyone who shows interest. These discussions provide a forum for a constant exchange of information between the institution, bankers and business people. A training session for high-tier staff from domestic Chambers of Commerce held at this venue would certainly be an effective measure (c.f. Chapter 5.1.)

Foreign direct investment

The framework of the World Bank Power 3 loan programme has set aside a total of EUR 252.9 m for the revitalisation and modernisation of the power supply. A significant part of this reconstruction work involves the rebuilding of the 400kV and 220 kV overhead power lines and the corresponding reconstruction and modernisation of the 18 power substations. The hydroelectric plants in Jablanica (5th and 6th turbines/generator unit), Rama (water transport tunnel) and Trebinje (1 turbine/generator unit with new controls and safety features) are being overhauled with a budget of EUR 22.2 m. All four thermal power stations are being modernised as far as treatment of fume emissions and ash deposits is concerned. The central SCADA system foresees EUR 22.2 m will be needed to monitor and control the hydroelectric plants, with a further EUR 42.7 m to be invested to rehabilitate the lower voltage sections of the three supply areas of the utilities. These measures should be completed by the middle of 2002. On average, 16% of the financing should raised locally. These loans should be repaid after 2005.

Many countries and organisations are also involved in supporting this programme, including EBRD, the EU, Canada, Japan (JICA, OECF, JBIC), Norway (Norad), Spain, Switzerland, Great Britain and the USA (USAID, USTDA). Of course, the countries mentioned here are also keen to introduce their own firms and products into the projects. Switzerland has been involved and will continue to be involved with the hydroelectric plant in Jablanika, as is clearly apparent from the labels on the new components.

The EP HZHB electricity utility is interested in acquiring a coal-fired power station. There is an as yet unused supply of brown coal in the region of Kongora (about 10 km north of Tomislavgrad) which they would like to utilise to fire a new power plant with two generators each with a capacity of 240 MW. A feasibility study has been completed. Apparently, some US investors have already shown interest. From our point of view, it does not seem to make sense for EP HZHB to invest here themselves because a short-term amortisation does not seem likely. If there is a foreign investor, then it would seem to be sensible from a national economic standpoint to create new jobs and to profit from the sale of the coal. The supply situation in the region would then also be more secure.

Talks with the management at EP HZHB showed that they are interested in wind-generated energy. Some positive results have already been obtained with a small 50 kW wind plant. There is an open, windy high-altitude plateau between Kongora and Doljani (west of Jablanica) that has a inadequate supply of power. There are about 300 holiday homes there without power supply. The area is a ski resort in winter. A nearby lake would provide up to 1 MW hydroelectric power. From our point of view, it would be a good idea to look into the site in more detail, take samples of wind speed and do a feasibility study to see whether the first wind power park in Bosnia and Herzegovina might be opened here. The installation costs per kW could be significantly lower than with a new hydroelectric plant. The volume of power generation would fit well, load-wise, with local requirements as the level of wind and power demand respectively are both, we assume, much higher in winter than in summer. It is somewhat surprising considering the many relatively bare, windy mountain ranges, which often even have high voltage lines crossing them, that there still no larger-scale wind power plants have been installed. There is therefore a great potential for power supply here. (c.f. Chapter 5.2.).

EP RS provided us with a comprehensive bilingual study entitled “Electric Power Potential of Republic of Srpska”. It details the possibility for expansion with more water and coal-driven power stations (Lit. 9). According to this report, the volume of electricity from hydroelectric power (c.f. Table 1) could be increased from the present 3,572 GWh/a to over 10,000 GWh/a in this Republic alone. The increased performance of the two existing power plants and one new plant in the coal basin “Stannari” near Banja Luka would mean roughly a doubling of the thermally generated electricity volume with simultaneous district heating. The old district heating supply network currently used in the town, would have to be extended by 2 km. The study does not go into enough detail as to the economic feasibility of a potential investment. The specific investment costs are estimated at between US$/kWh 0.24 to 0.49. Some important details, such as recurring personnel costs and the operating periods of the power plants, are not included. If these plans are realised, there will be a great business potential for foreign investment and employment opportunities for local personnel.

Ecology

A positive feature is the widespread utilisation of hydroelectric power – a trend which is growing due to new plants being built and old plants being streamlined. Hydroelectric power has been utilised up to now mainly at peak and medium load periods. The main load is carried by the significantly more expensive coal-fired plants which emit, among other things, CO_2. These plants are not easily regulated despite good individual performance grading. Our recommendation would be investigate the feasibility of a different kind of general plant management using central dispatching.

Combined heat and power systems within the 4 coal-fired power stations for steam-driven processes and district heating can be generally recommended as this improves the overall efficiency of the plants. The reverse is true in summer, however, when a whole power station section must operate to provide the required steam and a little heating. In this case separate central boilers would be considerably more efficient. The carbon dioxide emissions in 1998 for power and heating came to only 5.2 m. t., according to information from the IEA. The emissions of the 4 power plants alone for production in the year 2000 total 5.4 m. t. according to our calculations. The CO_2 emissions per capita and annum within the EU, by contrast, total approximately 9.5 t. The total emissions of CO_2 in BiH come to approximately 36.5 m. t. The SO_2 emissions are relatively high for brown coal power plants. Plans to install desulphurisation apparatus, which are in the pipeline, should bring about significant improvements.

The country frequently enjoys sunshine and clear weather. We did not sample weather data in this study, but Dubrovnik has an average of 2,550 hours of sunlight annually and in Belgrade the figure is 2,070 h/a according to published statistics. BiH receives an average of 2,250 hours of sunlight annually with global radiation of approx. 1,400 Kwh/m²/a. This figure is approximately 40% higher than in the sunniest regions of Germany. It is accordingly remarkable that solar energy is not at all widespread in BiH. Wood, liquid gas, natural gas and electricity seem to represent cheaper alternatives. There is still much that has to be done to catch up, such as providing technical training for installation engineers, as well as perhaps a state-sponsored incentive programme. Photovoltaic technology is sometimes employed successfully in remote cell phone transmission pylons. It is less commonly seen in private

use, presumably due to the relatively high cost. A input supply law that gives higher compensation for privately-run regenerative power systems does not yet exist.
We have already described possible actions relating to wind power utilisation in connection with EP HZHB. This type of power generation technology is already well-established in Germany, Denmark and the USA and represents a growing global trend. The technological lag in BiH caused by the war and the pre-war monopoly is clearly apparent in the lack of plants on the windy, stony, sparsely wooded mountain crests. Unlike in other parts of Europe, overhead power lines criss-crossing the mountain sides are a common sight here. These allow a relatively good current supply with short supply lines. Unfortunately, data on wind velocities etc. in this country and its neighbours do not appear in the European wind atlas (Lit. 10). Data on wind supplied by universities, meteorologists and airports in the area would thus be most helpful.

The country has large forests (covering 49.2% of the total surface area) with a correspondingly high volume of lumber, some of which is exported. In rural areas there are many wood-fire grills in restaurants, open fireplaces and stoves. These ecologically-sound methods are to be encouraged because as long as the distances are kept short, burning this reliable biomass is $C0_2$ –neutral. However, it is still important to use the energy efficiently by paying more attention to effectively cooling the exhaust fumes.

On the other hand, the disposal of domestic rubbish remains at a comparably low ecological level. The sorting and separating of rubbish and glass, paper and biomass recycling are practically non-existent. Old stone quarries or mountain sides are used for waste disposal without any noticeable attempts to protect the ground water. There do not appear to be any laws relating to environmentally-protected areas that would allow fines as high as one might receive for a traffic offence to be imposed. The first waste-powered thermal station in Sarajevo serves as a good role model for the 4 further such plants that are planned in the rest of the country.

2.2 Sector overview (Power stations, network, customers, consumer behaviour)

In line with the different sections of the country, we have assembled the following tripartite overview of the national power plants, drawing on numerous in-depth interviews and conversations with experts as well as the technical literature. The results are presented in two tables (see Tables 1 and 2). Table 1 shows the 15 existing or planned future large-scale hydroelectric plants and gives sum totals for 11 small, private hydroelectric power generators. Table 2 describes the 4 brown coal-fired power plants and totals the output data of all power stations.

Table 1

Power Generation Plants in all entities of Bosnia and Herzegovina

13 existing and 2 future Hydropower Plants

Location Name	river	entity or EP	since	plant type	type of turbines	units	inst. MW	aver. annual GWh	in 2000 prod. GWh	connect. voltage kV	remarks
Trebinje 1	Trebisnjica	RS	1968	PA	Francis	3	168	571	350	220	Rehabil.of unit 1 planned
Trebinje 2	Trebisnjica	RS	1981	P	Kaplan	1	8	22	15	35/220	
Dubrovnik	Trebisnjica	RS	1965	DA	Francis	2	216	1564	900	220	
Capljina	Trebisnjica	HZHB	1979	RHE	Francis	2	430	451	122	220	400kV connection fails
Rama	Rama	HZHB	1968	DA	Francis	2	160	731	657	220	rehabil.of power tunnel, repair of surge shaft
Jablanica	Neretva	BIH	1955	DA	Francis	6	155	800	627	110	rehabil. running, dam monitoring planned
Grabovica	Neretva	BIH	1982	PA	Kaplan	2	117	372	251	220	
Salakovac	Neretva	BIH	1982	PA	Kaplan	3	210	563	356	220	
Mostar	Neretva	HZHB	1987	PA	Kaplan	3	75	310	191	110	rehabilitation completed
Jajce 1	Pliva	HZHB	1957	DP	Francis	2	60	259	198	35/110	new control equipm.. installed
Jajce 2	Vrbas	HZHB	1954	DP	Francis	3	30	181	149	110	revitalization of generating sets runs
Bocac	Vrbas	RS	1982	PA	Francis	2	110	307	215	110	
Visegrad	Drina	RS	1989	PA	Kaplan	3	315	1108	700	400	part of 400 kV connection destroyed
Most. Blato	Neretva	HZHB					60	170	0		planned
Pec Mlini	Trebizat	HZHB					30	82	0		under construction
4 small HPP		RS					14		56		
7 small HPP		BIH					17	45	41		
overall							**2.175**	**7.536**	**4.828**		

DA = Derivation Storage
DP = Derivation Run-of-river
P = Run-of-river
PA = Storage
RHE = Reversible

Location Name	entity or EP	since	Coal	gross inst. MW	in 1990 prod.GWh	in 2000 prod.GWh	specific coal consumption kj/kWh	percentage of total generat. %	remarks
Tuzla A1		1964	LM	32	112	6			
Tuzla A2		1964	LM	32	113	1			
Tuzla A3		1966	LM	100	419	210			rehabilitation finished
Tuzla A4		1971	LM	200	953	0			rehabilitation planned in 2001
Tuzla A5		1974	LM	200	1119	842			rehabil. finished,electrostatic precipitator planned
Tuzla A6		1978	M	215	1119	909			rehabilitation finished
Tuzla	BIH			**779**	**3835**	**1968**	11.457	18,9	
Kakanj A1		1956	M	32	146	0			
Kakanj A2		1956	M	32	146	0			
Kakanj A3		1960	M	32	146	0			
Kakanj A4		1960	M	32	146	8			
Kakanj A5		1969	M	110	418	382			rehabilitation finished
Kakanj A6		1977	M	110	517	331			rehabilitation finished
Kakanj A7		1988	M	230	1282	731			rehabilitation finished,optimization of cooling
Kakanj	BIH			**578**	**2801**	**1452**	13.252	13,9	
Gacko	RS	1983	L	**300**	**1650**	**980**	12.420	9,4	reclamation of the Granica ash disposal site
Ugljevik	RS	1985	M	**300**	**1610**	**1201**	11.403	11,5	new system of ash transport and disposal
all thermal	RS	in 2000		600		**2.181**		20,9	L = lignite coal fired
all thermal	BIH	in 2000		1.357		**3.420**		32,8	LM = lignite and brown coal fired
thermal pow.	total	in 2000		1.957		**5.601**		53,7	M = brown coal fired
hydro power	total	in 2000		2.175		**4.828**		46,3	
generation	total	in 2000		**4.132**		**10.429**		100,0	

Before the war in 1990, BiH generated 12,613 GWh power from the power plants within its area. Consumption was 11,535 GWh during this period. The system included 13 hydroelectric plants with a total output of 2,034 MW and an average annual generation total of 6,922 GWh, as well as 4 thermal coal-fired plants with a total output of 1,957 MW and an average generation total of approximately 9,250 GWh (Lit. 2). The thermal plants are run on brown coal mined in the region. BiH was responsible for operating its own plants and networks and had to cover the demand there. As the network was part of the previous Yugoslavian network, the 400 kV high-voltage network and the power output exchange volumes were supervised by the load dispatch centre (JUGEL) in Belgrade.

At the beginning of 1996 half the power capacity in the country was out of service either because of direct war damage, destruction of power lines or lack of coal. Most plants also suffered from lack of maintenance during the war. About 60% of the transmission lines and the control and monitoring stations in the Federation were damaged, including the sub-stations and power lines to neighbouring countries. There was a similar situation in the Republic of Srpska, especially where the front battle lines were located. The important 400 kV network in BiH was nearly completely out of service except for the Trebinje-Podgorica link in the southernmost section of the country (see Illustration 1). Many distribution networks in both entities were destroyed as a result of heavy fighting or lack of maintenance. Many transformer stations, buildings, telecommunications and maintenance organisations and many specialised tools and a great deal of equipment were either extremely badly damaged or destroyed.

After the rebuilding of the mains supply, an approximate total of 10,429 GWh was generated (c.f. Table 2), made up of 46.3% hydroelectric power and 53.7% power from coal-fired plants. That represents 82.7% of the pre-war level. The registered consumption was 9,543 GW minus the export surplus in the Federation of 1,285 GWh, 67% of which, however, was fed back directly to the aluminium works in Mostar (c.f. Chapter 2.1). Thus, the true figure for direct national consumption including these works is only 9,119 GWh, or 79% of the pre-war level. When one looks into the matter more closely, the figures from the utility companies indicate that while household power consumption is back to pre-war levels, industrial consumption has only reached 30% of pre-war levels. War damage to industrial buildings or whole-scale disassembly, as outlined in Chapter 2.1 with the aeroplane works in Mostar, has certainly played a large role here.

As well as network losses, which we estimate at 8.5% on average from various sources, we also noticed that customers had great problems paying bills (only 87% to 97% of bills are paid, depending on which entity one looks at). This is compounded by other factors such as defective meters (not functioning or reporting false measurements) or the simple theft of electricity, which accounts for another 3% to 15% of income shortfall. Thus non-technical losses are a significant factor in EP RS's high losses in the Serbian area of the country.

Bill collection must be speeded up and the system of sending reminders must also become more reliable and rapid. Routine power disconnection as a result of non-payment, together with a close monitoring of this process must become part of the system. Another obstacle for the utilities is the fact that at the moment a great deal of new building and renovation is taking place, which means many people are on the move, including refugees returning to their country.

This makes reading meters and invoicing correctly extremely difficult. The utility companies, aided by the World Bank, are aiming to drastically cut losses by implementing better controlling within the whole accounting process.

The large number of donations and loans within the framework of the World Bank Power 1 and 2 projects have facilitated the reconstruction of the power plants and networks. Within the framework of the current Power 3 project, as we have already outlined in Chapter 3 and will later describe in more detail, EUR 252.9 m is to be invested in central dispatching and further network repair, especially of the 400 kV power lines. On completion of this phase we can assume that the power supply in the country will technically have reached at least pre-war levels.

The present state of the network and load monitoring within the tripartite system already described can only be viewed as a stepping stone in the process towards the set-up of a more effective central dispatching system. Only through the active integration and consensual acceptance of a central dispatcher for the country as a whole (Independent System Operator or ISO) can the power plants be effectively operated and the export and import of power be made economically feasible. The three separate control centres of the Elektroprivredas are already co-operating in an organisation known as the Joint Power Co-ordinating Centre (ZEKC), which later will only be responsible for data acquisition and execution of measures set out by the ISO regarding switching and controlling. The intercontinental hook-up of the whole network will follow in line with the European-wide regulations set out by UCTE (the European Union for the Co-ordination of Transmission of Electricity). This strategy dates back to pre-war times within the Federation, whereas the Republic of Srpska oriented itself via the rest of Yugoslavia* towards the eastern European networks as far as frequency was concerned. The readjustment of the technical apparatus is to follow within the Power 3 framework. The synchronisation and frequency stability of the whole net is already contained in the hydroelectric plant in Jablanica (EP BiH).

The three existing electricity utilities (Elektroprivredas) have already been described in Chapter 2.

Electricity tariffs for industrial customers using the high and medium voltage lines are roughly 0.06 $/kWh, which is about average within the EU (c.f. Lit 12) and thus competitive. Household tariffs, however, tell a different story: the average of 0.05 $/kWh is far lower than the rest of Europe (0.12 $kWh). The tariff system distinguishes between high and low tariff periods. For larger customers there is also a peak tariff period during which, for example in BiH, electricity costs 24Pf/kWh or roughly 0.11 $/kWh. In addition, there are seasonal adjustments for all customers. In summer electricity costs less than in winter. To highlight the difficulties in billing for these adjustments, it must also be noted that there are 5 different tariff rates within BiH.

Small business pay a relatively high rate of between 5.4(0.025) and 26.8 Pf/kWh (0.125 $/kWh) according to the tariff zone, and feel at a disadvantage in regard to the rest of the country as far as costs and income are concerned.

The average electricity yield per customer is around 12 Pf/kWh net.

The low electricity price for households is a political measure in keeping with the relatively low incomes of families. It is also not surprising, when one considers the official 40% unemployment rate and lack of social or unemployment benefits or the 3 month delays in paying official wages, that electricity customers exploit holes in the system and do not pay their bills. In addition to this, as we learnt in Banja Luka, the right to low electricity prices is represented in political campaigns as a basic social right that anyone can lay claim to even if unable to pay their bills (c.f. Chapter 2.1). Although the time-zone tariff system is, in principle, an effective way of regulating demand, the ensuing administrative work of meter reading and billing is considerable. The fact that socially-disadvantaged customers are deliberately registered under tariffs which are too low in order to give them some support reflects unfairly on the company's balance sheet.

The situation that industrial customers find themselves in is very difficult. With the exception of the construction, cement and aluminium branches, industry is still in a critical state with consumption only at approximately 30% of pre-war levels. Missing exports and the slow recovery of the domestic market still pose a great problem. Parts of many facilities have been destroyed and there is widespread overstaffing, which also poses additional challenges.

2.3 Products/Inputs required

The country is not greatly different to other European ones in regard to the materials, apparatus and components needed for modern electricity provision. A typical feature here is the high percentage of hydroelectric plants together with the brown coal-fired plants. The high percentage of overhead power lines at all voltage levels is due to the large expanse of hard, rocky ground which is sparsely populated. From a professional point of view, the layout of the three rather ragged networks (see Illustration 1) is extremely unfavourable for an economical, tripartite network operation and requires a large number of transfer meters with the monitoring features necessary for remote sampling.

Large power plant components used to be acquired from the south-eastern parts of Europe (Litostroj turbines, Maribor, Slovenia; Rade Koncar generators, Zagreb, Croatia, Energoinvest switch gear) or from the former Soviet Union. The rehabilitation of expensive large apparatuses such as turbines, generators and boilers with state-of-the-art coal transport and ash disposal systems, as well as equipment featuring modern regulatory technology, has seen a rise in imports from western Europe and the USA. The financial support through donations from the suppliers' countries and the favourable loans awarded by the World Bank have also had a bearing on this. Donor countries indirectly promote their own manufacturers who, in turn, occasionally offer especially favourable conditions. In addition to the large suppliers such as ABB or Siemens, there are numerous smaller western firms present in BiH with sales networks and service centres in place. It has to be noted that the country did not produce any large turbines or generators itself before the war. The new components for the hydroelectric plants come mainly from Switzerland or Austria, i.e. from countries in western Europe that themselves have many hydroelectric plants. If a manager wants to show that he or she is capable of running a modern, privatised company, it seems that the purchase of equipment from prestigious western companies enhances his or her reputation. Dismantling and assembling is also contracted out to local companies. In the low-

voltage supply of the plants, a certain switch-gear producer based in Sarajevo, Messrs* TEO, made a good impression on us when we visited their premises.

Suppliers from BiH and the rest of Yugoslavia (Navasta and Alexinetz) are also active in the reconstruction and extension of the network, at least in the areas of civil engineering, dismantling and assembly, cement-encased overhead pylons, and high-voltage steel-girder pylons. Overhead lines and cables are purchased mainly from Siemens, Raychem or Alcatel or from the rest of Yugoslavia* (Jagodina) although there is an old, not yet privatised cable works in Tomislavgrad (see appendix: Tvornica Kablova Tomislavagrad) . Isolators and small parts for overhead lines are also produced within BiH. The large high and medium-voltage switches in the sub-stations, switching stations and transformer stations are also obtained from the west (e.g. Siemens SF6 switches, or switches from a Norwegian manufacturer). Transformer buildings made of concrete are assembled using finished parts and bought from the rest of Yugoslavia* together with the large concrete-encased pylons. There is another old works producing concrete pylons on the river Neretva in Caplijina which, according to our information, has not yet been privatised and probably is running into difficulties trying to supply the local market (c.f. list in the appendix). The transformers themselves are supplied by Rade-Koncar, Zagreb; Minel, Belgrade, Etra (formerly Energoinvest), Slovenia; Elino, Poland or M-Ochrid, Macedonia. In BiH we only noted the company already mentioned, Umel in Tuzla which produces transformers. Low voltage-fuses are supplied by Messrs* Alko in Predolje near Stolac; Elektroinvest, Doboj produces switches.

ISKRA, Slovenia, is the biggest supplier of electricity meters and switch timers. In Banja Luka and Sarajevo (Iskrameco Sarajevo) there is a privatised, new meter manufacturer in which EP BiH also holds shares. Switch timers and similar regulatory equipment are produced by ETI, Sarajevo which is a new subsidiary of EP BiH.

Computers and PCs have only now in recent years been purchased from well-known manufacturers in Japan and the USA. It is planned to gradually introduce SAP software into the Elektroprivredas.

2.4 Intermediate Level

The intermediate level contains training institutions and their syllabuses, laboratory equipment and practically-based orientation. We visited the Technical University in Sarajevo, a technical college in Mostar and a privatised gas institute in Sarajevo.

At the university, student enrolment has steadily increased since the war. The Electro-technical Faculty has 4 areas of study (including telecommunications and information technology) and 900 students are enrolled. in 1995 there were only 23 students enrolled for the new semester, but now there are about 70 enrolments per semester. The facilities, which are located in a former school, are rather cramped after part of the main building, which had been slightly damaged during the war, was demolished. A move is planned which will transfer the facilities to the site of some former barracks which have been converted for this purpose. There will be more room there for laboratories, offices, storerooms and small workshops. However, there is no large auditorium for assemblies, and new furniture and

equipment for the facilities has not yet been made available. There is not enough money to equip the laboratories and classrooms according to European standards.

The university has a strong international exchange programme. During the war the University of Graz, Austria accepted many students. Mobilcom Austria supports the faculty in Sarajevo by commissioning research projects. A professor from Erlangen, Germany was there recently, while Heidelberg has donated a complete technical library to the faculty. There are good contacts with Australia and Istanbul as well. The aim is to gain official recognition for the degree courses in Sarajevo within other European countries. Regrettably, many graduates emigrate thanks to the high standard of their training and tend not to return as it is easier to find work abroad than within BiH. This is especially true for telecommunications and information technology experts. The university houses the active mainframe computer belonging to the first Internet provider of the Federation. A good climactic chamber to test electronic components at different humidity levels and temperatures is available but not yet fully utilised. The laboratory for electrical motors with different testing platforms is being improved upon with great drive and initiative and there is a large networked PC classroom with the latest technology available. One possibility would be to integrate the testing of new components for industry such as meters, switches etc. according to European standards into the training course.

The technical college at Mostar is very cramped and is provisionally located in 5 classrooms on one floor of a primary school. The teaching therefore continues until 9 pm so that all 8 parallel classes for technicians and master technicians, with 50 students to a class (nearly all Muslims, of which approximately 5% are women) can be held. In a new retraining course also held on Saturdays and Sundays, 20 Croats and 12 Muslims are being taught together for the first time. For the teaching staff this is often just a second job. Some of them have a main job at the PTT (Post/Telecommunications). The salary for 20 hours a week is DM 530 net and payment is often delayed: the salary for March, for example, was paid three months later in June after the staff went on strike for two weeks demanding better working conditions. Apparently the Ministry has no budget for chalk, photocopying paper or measuring apparatuses. Two workshops where practical exercises can be performed have been set up on the initiative of teachers in their spare time on the grounds of the former barracks in Mostar. They are now trying to procure measuring apparatuses, tools and supplies with foreign aid. Old electric machines and household devices which would otherwise have been scrapped serve as teaching tools. Computers have been donated and there is access to the Internet. Material has been supplied from Norway and an exchange with Sweden has been set up, although there are not enough funds for the trip. Contacts to Italy (Turin) are to be improved. The college has no immediate plans for new facilities as yet and it is astonishing how it is possible to train good electronic technicians, energy technicians, computer experts and telecommunications experts under such unfavourable conditions.

The IGT-Gas Institute in Sarajevo is privately owned and employs approximately 8 staff under Dr Peljto. The focus of this study is electricity, but the GTZ encouraged this visit as the positive experience gained in the gas industry by this institute can easily be transferred to the electricity industry. The institute runs training courses which are important for gas suppliers and installation technicians. It inspects gas equipment and boilers according to different norms and issues inspection certificates. It is commissioned by industrial clients to undertake

research and development and organizes national and international conferences to exchange inputs. It aims to fulfil a regulatory role similar to the gas umbrella organisation in Germany.

The institute is highly flexible, offering a variety of topics and good foreign contacts and orientation. The laboratory equipment is not up to western standards, but can be supplemented depending on the project commissioned. There is enough room as far as the facilities are concerned.

To sum up, while the technical colleges and universities are very cramped, and state funds in some areas paltry, the professors and teachers are nevertheless highly motivated and make the best of a bad situation. The practical orientation of the courses seems to be good as technical solutions often have to be demonstrated with simple materials. Access to the Internet, media and international exchanges enable these institutions to break out of their isolation and offer a modern education. There are certainly still deficits regarding business topics; however, the universities have shown great interest in research commissions, co-operation on projects and in EU conformity.

3 Opportunities for Local Procurement

3.1 The local procurement market

It was interesting to note in our talks with the CEOs and purchasing managers that very little attention was paid to the national balance of payments of Bosnia and Herzegovina. Their focus was only on the situation of their own company and the good business relations dating back to pre-war times. There is tradition of purchasing from a domestic market: Croats like to purchase in Croatia, Serbs like to buy in the rest of Yugoslavia* and Bosnians prefer perhaps Slovenia. Unfortunately, this is a reflection of the various ethnic antipathies that exist in the former Yugoslavia, and many prefer to purchase from abroad rather than from a neighbouring entity, even though this is detrimental to the national balance of payments.

Another damaging factor is that information about changes to old firms and new start-ups can only be gleaned from simple sources such as the yellow pages or the Internet. Even the Chambers of Commerce have scant information in this regard.

We have compiled a list of addresses of over 500 suppliers in this branch from both entities with the help of a local expert (Mr Sacir Sosevic, RIC d.o.o., Sarajevo) which can be found in the Appendix. The list shows which products or services are available, how large the range is, whether they have experience in exporting and whether they have an Internet site. Unfortunately, only about 3% of companies have a web page, only 10% have fax facilities, and few have experience with exporting. The details given have to be treated with some scepticism as the information was often provided over the telephone and there was a certain reluctance to impart details in some cases.

Moreover, some components such as turbines, generators and transformers and services cannot be procured within the country and have to be imported.

3.2 The regional market

The regional market, if we define this as states sharing a border, has already been outlined in Chapter 3.3 in relation to the electricity supply products required there. As mentioned in the previous chapter, there is a certain tendency among purchasers and managers to use the traditional structures. Sometimes it is certainly logical to procure spare parts from manufacturers of whole components. The regional market is still active but is now competing with the new western market. Young people are more likely to buy western products as they are made to look more attractive and are heavily advertised.

3.3 Competitors

Western competitors are using familiar strategies (c.f. East Germany after unification) to approach the BiH market. The first step is to sell products and then offer local service followed by the purchase of cheap production facilities, the take-over of a local company, or the start-up of a subsidiary.

Many larger companies would greet western investors with open arms if they were willing to take on the staff and the debts. But few investors are willing to do that. Investment conditions at present do not offer an adequate framework for private investment to take on such uncertain risks.

The tendency to buy western products is more marked in people who deliberately want to appear modern. Everyone wants to profit from the newly-found freedoms. This makes it easy for new suppliers to find customers. In addition to this, we have the new situation of reconstruction with foreign aid and donations as already outlined.

Competition in the international electricity market is already functioning quite well. The Federation has a balanced export surplus of over 1,300 GWh which can be evaluated at a rate of approximately 4.5 Pf/kWh, or around DM 58.5 m. A large proportion of this was returned in 2000 to the aluminium works in Mostar via Debis (see Chapter 2). The planned extension of hydroelectric power plants and the reconstruction of the 400 kV network will mean increases here in the future.

3.4 Market Opportunities and Perspectives

3.4.1 Overview, Specific Strengths and Weaknesses, Potentials and Perspectives

From a technical point of view, the present state of the power plants and networks within BiH after completion of the Power 3 phase represents an improvement on the pre-war situation. The many new electricity pylons and power lines are apparent even to the layman when travelling through the country. It is good to see that the high number of hydroelectric plants in the country continues to grow, as these represent an economical and environmentally-friendly resource for the country as well as revenue from electricity exports. The mountainous

regions also offer exciting potential for the exploitation of wind energy on a large scale. We can assume there is potential here to test the production of wind converter parts or new logistic devices such as transport by Zeppelin, for instance.

The tripartite regional division of the whole area into independent networks with numerous border indentations is disadvantageous. The accounting system within internal borders is understandable from a historical perspective but now presents a great obstacle, as the whole country is compact and has a straightforward layout. It is hoped that the efforts to install central dispatching and load monitoring will be speedily adopted by all electricity utilities and not undermined by efforts to make life difficult for one another by, for instance, failing to delivering brown coal from RS to the region of Mostar at critical times. It is therefore extremely important to consign regulatory authority to the hands of an independent system operator.

It is regrettable that there are no more major manufacturers of large building parts and components within the country. This means that money will drain abroad in the future even if the former parts of Yugoslavia are not directly perceived as being abroad. Some factory facilities in good locations are lying obsolete, such as the former aeroplane manufacturer's in Mostar.

3.4.2 Sub-sectors

Nearly all areas of daily life profit from good reliable electricity provision. The people affected by the war certainly remember how vital this service is and how difficult it was to live without power.

Modern, strategically important communications technology (the Internet, cell phone technology, directional radio) need good energy provision. The new construction of high-voltage lines has led to the parallel installation of fibre-optic cables for data exchange. This means that telecommunications also possess excellent connections.

The new system of privatised supply coupled with modern data capture and control requires new investment to replace old meters, or switch apparatus and programmed controls/displays. Imminent developments supported by universities and colleges such as economical, pre-paid card meters might be an incentive for graduates to stay in the country.

The great need for new construction naturally has a great impact on structural and civil engineering branches, the transport industry, and various urban planning and development agencies in the country. It is important for foreign investment schemes to involve domestic experts and to publish complete documentation jointly to facilitate later extension and repair work to proprietary companies.

4 Developmental Strategies for the Sector

4.1 Target Structure

The State of BiH has very nearly completed the reconstruction of the electricity supply with the material help of the USA and European countries, at least to the degree that electricity is required. The planned reconstruction of the highest voltage network (400 kV) is underway, while the central recording of electricity demand and the corresponding regulation of power plants within the country is planned and in some cases has been partially completed. The liberalisation of the electricity market is progressing in line with efforts in the EU. The present three electricity utilities assess their business according to the familiar three core divisions: generation, transmission and distribution. This therefore creates the essential transparency needed in this market. Liberalisation has not yet been completed, but the right foundations have been built.

There has been a visible increase in the significance of environmental protection in energy provision with the introduction of more extensive exhaust fume treatment in the thermal plants and an increase in the number of hydroelectric plants. The remaining regenerative energy resources (wind, geothermal, and solar power) have not yet achieved the recognition they deserve. An energy input law allowing regenerative energy use to be compensated does not yet exist.

The individual local interest of the three electricity utilities is understandable considering recent history, but is at odds with the development of the country as a whole, especially with the wish for economic growth to pick up. The difficulty of unifying three ethnic groups and four religions certainly poses a major challenge to national politics. There is a clear lack of trust in other ethnic groups and some suspicion (possibly justifiable) that each group wants to make life difficult for the other.

In Germany, the process of overcoming the horrors of the Second World War, accepting blame and offering apologies and reparations, has taken about 50 years. However, 6 or 7 years after the war things had visibly improved thanks to American help, and the 1950s and 1960s are remembered as the years of the economic miracle. This is an encouraging model for BiH and offers an incentive to focus on chances and opportunities rather than to wallow in a state of paralysis and retrospection.

At present, the new privatisation schemes and desire to be closer linked to the EU are additional burdens, but they point the only possible way ahead, as can be seen, for instance, by the decline in the Russian economy. There are more than 500 companies in the electricity branch, most of which have already been privatised, which are generally playing a waiting game, on the lookout for external help or interest from an investor. Only a few of them perceive this period as an opportunity for change. The amount of public relations work undertaken is correspondingly low. It is important to introduce new ways of thinking in business and communication as soon as possible.

It is essential in these times of tension to co-operate with the Office of High Representative (OHR) in Sarajevo. The recommendations worked out there and their open attitude to

publishing statistics and figures about present achievements (also available online) make this a very valuable and easily accessible resource. Their openness to the press and constant supply of information to the population via the media is an important support line as long as democracy is still not on a firm footing.

4.2 Strategic Approach

The measures suggested are based on the following points:

1. The exploitation of wind energy and the extension of regenerative energy resources
2. The liberalisation of the electricity market (trainee programme)
3. Measures to prevent electricity theft
4. The establishment of inspection and certification bodies
5. Improvement in the services offered by the Chambers of Commerce
6. Branch information, marketing and advertising
7. Training institutions
8. The use of the empty aeroplane manufacturer's grounds in Mostar

Talks with the electricity suppliers confirmed that they have regained confidence in technical and operational areas. They welcome the new power plants but seem to be less aware of the financial burdens of the loans, especially in the light of the fact that some donor countries are still giving free aid. In Mostar, there is keen interest in **(1)** wind energy. This form of generation has been successfully and reliably employed in various European countries. If we assume favourable sites on the rocky mountain crests, installation costs can be estimated at approximately 1,000 EUR/kW nominal output. With at least 2,000 fully operational hours a year, the generating costs would be lower than those of new hydroelectric plants.

Overstaffing and the targeted reduction of personnel pose a major problem. There are no magic recipes either here or in western Europe. Early retirement alone is not the solution. The high losses incurred by EP RS makes an action plan in this regard a special priority. The Fichtner/Stuttgart consultancy is helping fix new electricity tariffs and giving advice on how to facilitate bill collection. Both these steps would help reduce financial losses if we assume that the present electricity tariffs will rise based on these measures.

In connection with the liberalisation of the electricity market, the CEOs expressed a preference for a concrete **(2)** trainee programme, possibly in Germany or in other European countries with suitable know-how, in which sales staff, marketing personnel, electricity traders, transmission and computer experts can be trained for specific future tasks.

From our point of view, further extension of the power plants after the rehabilitation of the effective old machinery and equipment should proceed at a measured and careful pace. The electricity market has the advantage of favourable purchasing opportunities and procurement from reserve pools of electricity. Brown coal reserves should be exploited as little as possible as the mining and burning of this material cause major ecological hazards which are easily visible in BiH. Despite dust-reducing and desulphurisation technology, recultivating the mined areas and dealing with ash deposits and air pollution is problematic. The **(1)** extension of regenerative energy technology (after hydroelectric power, wind, geothermal and solar

power) should be accompanied by an increase in know-how and the production of important components within the country itself. This would result in a considerably more positive development for the country in the medium term.

We recommend using the considerable number of existing staff to help accelerate meter reading and billing. A possible measure might be to introduce monthly flat rate accounting among problem customers, investigating the tricks employed in meter tampering and electricity theft, and working out ways to prevent them. In the end it is important that **(3)** electricity theft is not perceived as trivial but instead treated as a punishable offence: in addition to cutting off the electricity supply, other legal steps should be available to stamp it out. As we pointed out in Chapter 2.1, the Government has sent out the wrong signals to socially weak customers who, in turn, back up their actions by referring to these policy statements.

In regard to the export of products to the EU, there is a lack of **(4)** inspection and certification bodies in the country. The available institutes must be used, several laboratories and institutes must be involved in partnerships, and new capacities must evolve initially with external aid. Perhaps co-operation partnerships with Croatia and Slovenia might be possible here.

4.3 Action Plan to Open Up the Market

As we hinted at in Chapter 2.1, the chambers in the country (specific experience in Banja Luka) have not yet completely understood their role in the branch or in the free market economy. They have an important function as an intermediary and information channel, following the interests of the state while also keeping an eye on national economic developments. We recommend a measure to **(5)** improve the work of the chambers as we described in greater detail in Chapter 5.1. The chambers should also have a list of companies in this branch (as per the Appendix) which they can keep updated, and offer competent aid as a result.

Rapid access to reliable information **(6)** is always advantageous, particularly in BiH. The Internet represents an ideal resource in this regard, as up-to-date information on all topics can be rapidly accessed with the aid of search engines, if and when data has been put online in English.

This is where the problem lies. Older companies in the branch have not recognised this opportunity yet, with a few noteworthy exceptions. If, for example, you look up www.city.ba, where registered companies in the Federation are listed, you will not find a single supplier of important electricity components. In the yellow pages of the telephone directory in Sarajevo, you can at least find assembly and transport companies, installation technicians and western suppliers, but hardly any domestic addresses. The list of companies already mentioned can serve as a basis here, too.

Further measures will be described in Chapter 5.

4.4 Action Plan to Better Integrate the Sector

Due to its importance for the rest of the economy, the sector of electricity supply and provision is far from isolated. There are many links to many other areas of the economy which can easily be made out. Despite this, significant problems lie on the horizon as already suggested.

The Ministries responsible should improve learning conditions in **(7)** the electro-technical training institutes. This is the only way to encourage the development of academic excellence among young people keen to learn and to ensure they are willing to remain in their homeland. The salaries of teachers and lecturers should be paid on time.

Computer and Intranet facilities have not yet been made widely available, as previously mentioned. The process of rationalisation should make these resources readily available.

4.5 Qualification Measures, R&D

(re 1): New studies should be commissioned throughout the country to investigate the potential of wind, solar and geothermal power generation. Hard facts lie outside the framework of this study, however, and more detailed investigations into this topic should be undertaken. Perhaps the Meteorological office and the universities and colleges can help build up a good information network. .

(re 2): The Elektroprivredas' wish to have better qualified personnel as outlined in Chapter 4.2 is something that we strongly support. An approach with a practical orientation would be welcome. It would be sensible to put together a small group from the three Elektoprivredas who could later multiply the learning effect by acting as team leaders in their respective utilities.

(re 5): Regarding the domestic chambers, the possibility of training staff to support the electricity branch in the ways already outlined could be investigated and later courses could be offered in a targeted fashion. Chapter 5.1 lists approaches that could be used as an initial orientation.

(re 6): In regard to advertising, exhibition presentations and marketing, there is little experience to draw on within the electricity sector. It would be useful to offer favourably priced training courses locally. Internet and PC-related topics could be linked to this.

4.6 Financing

Generally speaking, the parties benefiting from specific measures should also pay for them. Only in cases where the state has a clear interest or where the relevant party is unable to pay the costs because of the high risk or lack of funds, should support be given by third

parties or the state. From the point of view of the entity governments' present debt situation, it would be preferable if financial aid were to come from foreign donors such as EBRD, EU, JBIC, USAID, USTDA, KfW, CDG, DEG, and the GTZ.
(re 1): The potential of regenerative energy could be worked out within the framework of courses of study or as a topic for a thesis. In this case, it would only be necessary to receive nominal state aid for the university and maybe set up contacts with western experts. The investigation into a site for a wind power park should be supported by the experience and knowledge-base of EP HZHB, and they should also give assistance with the measurement-taking and guarantee a reasonable input compensation for an initial period. In order to make the risk calculable for the private investor, yield prognoses, possible transport and construction costs, electrical connection costs etc. must be estimated beforehand. A special goal here would be to reach agreements with manufacturers to try to move parts of the production and service facilities into the country.

(re 2). This process means that the suggested training of personnel would be financed by the above-mentioned funding bodies. Perhaps matters would be facilitated if a partner country offered to take on trainee candidates.

(re 5): The recommended training courses for the national chambers should be instigated by the relevant entity as this represents a clear state interest.

(re 6): Measures to provide branch-related information, advertising and marketing should be cost-effective* and financed by the companies with a stake in the matter, maybe with support from the chambers or the umbrella organisations.

(re 7): A completely different picture applies as far as the classroom facilities and equipping of the colleges and universities are concerned. There is a great deal of work to be done here by the Ministries for Education and Building in order to considerably improve the currently inadequate situation. However, judging the degree of the shortcomings of these facilities is beyond the scope of this study. Perhaps some institutes that have received foreign aid and are now well-equipped can act as role models.

4.7 Ideas on How to Market the Former Aeroplane Works in Mostar

As regards **(8)** the former aeroplane works in Mostar, the Ministry for Industry of the Federation BiH could commission an exposé offering the production hangars and offices to foreign manufacturers of large components who might be looking for a site in BiH. Possible interested domestic companies could also be looked for at the same time. It might also be viable to start up an innovation centre in which the state could offer favourable conditions for start-up companies for a limited period. This task should be undertaken by the municipal administration in Mostar together with an external expert.

5 Action Plan

5.1 Immediate Measures

Most of the measures described should be implemented immediately or be supported by the funding bodies.

(re 2): The trainee programme targets higher-tier staff at electricity utilities and aims to teach them new tasks that are essential in the wake of privatisation and liberalisation. It should be closely linked to a utility in the west. The managers should be given the chance to further prepare for competition and be offered the chance of practical exchange with foreign colleagues as well as receiving training abroad. Funding for this could be given by the CDG, for instance. The length of the programme should be one month maximum. The expense cannot be gauged until we have details about the topics to be taught.

(re 3): The three electricity utilities have already been required by the World Bank to take immediate measures to stop non-technical electricity losses (see Chapter 4.2) This measure must also be immediately implemented in all areas. Because of the present overstaffing within the EPs, extra personnel who could be trained for this action plan and deployed cost-effectively are available. It is also important for the 3 utilities to keep each other informed about problem customers if they move into a different utility's regional network. In this way, the utility affected would be forewarned and could even collect the outstanding bills of the former utility. The necessary support for this should come from the policy-makers. The duration of this action plan would be several years, after which it could be scaled down, although not entirely disbanded, as there will always be a bad debtors to be chased up.

(re 4): As noted in Chapter 2.2, the electricity industry in BiH lacks inspection and certification bodies which can check components produced for export according to EU norms etc. The inspection bodies could be those that existed during the war (Energoinvest), but the missing ones must be replaced. To support this, measuring equipment exists in universities, institutes or private laboratories. What is missing, however, is an independent centre, like the one formerly located in Belgrade, that can monitor and regulate this task. In addition, some types of testing equipment compatible with the new norms are also likely to be unavailable. This measure should be immediately implemented and result in an institute with numerous calibration and inspection points pursuing a policy of continuous upgrading of facilities in line with changing product norms. The framework of this study does not allow total costs and personnel requirements to be estimated. We can, however, assume that the relevant fees paid by the customers for the services provided will refinance the organisation in the long term. In special cases, co-operation with European standardisation bodies is preferable.

(re 5): The employees of the chambers in the country should be offered a training course teaching them how to provide better service for a privatised, liberalised market place, perhaps oriented toward the standards of successful chambers in other western countries

(for example, AHK in Sarajevo, see Chapter 2.1). The process of transferring the organisational measures into practice should also be monitored by external experts.
The duration of the night school training should be 1 month per entity.
The implementation of the measures should be monitored by an expert for at least a year in all chambers in the country.

The funding should be jointly carried by the offices responsible in the Ministry for Industry. The chamber concerned could provide the classrooms. The acquisition of computers and networks should be financed by the chambers themselves, if this is not already the case.

(re 6): Training courses for specialist staff in the electricity industry in marketing and advertising using PCs and the Internet: night school courses should be offered throughout the country in various municipalities to ensure that the travelling time of participants is kept to a minimum. After about 10 evenings each lasting 2-3 hours, the course participants should have adequate basic knowledge of the topics. A training folder containing all important items learned can be issued to each participant as a reminder of the course and a guideline. Computer training rooms that are already available can be temporarily rented for this purpose.

Duration: the programme should run for about one year, with various groups depending on demand.

Financing: participation fees of about DM100, for 25 hours of instruction which will partly finance the teaching staff and experts. The minimum number of participants should be 8 per course. The additional costs of travel to the course, rent for the rooms and training folders should be the chambers, which will be responsible for the running of the courses.

(re 7): The last urgent measure mentioned here is the upgrading of the facilities in the colleges and universities. The costs that will be incurred are certainly considerable, although we have not been able to estimate them within this study. One idea would be to equip one extremely ill-equipped school (the one visited in Mostar, for example), and use it as a role model. An investment of approximately DM 500 per student would come to DM 200,000, which would help cover some gaps in the equipping of workshops and classrooms.

5.2 Medium-term Measures

(re 1): The medium-term measures should include the exploitation of wind energy, described in detail in the project outlined previously (see Chapters 2.1 and 4.6). The cost of investigating a good site with transport links, possible network connection and estimation of yield can be estimated at about DM 80,000, including wind measurements taken at the site for a period of several months.

This measure would take roughly 6 months. The work should be undertaken with the close co-operation of the network operator in that region and the EP HZHB electricity utility. Wind power experts from the EU should also be involved in the project in order to profit from their extensive experience.

(re 7): Further buildings for universities and schools are necessary, as already suggested. Old, well-preserved buildings which have been renovated and specifically equipped for this purpose could be used. For the survey of data, a needs analysis should be conducted, e.g. by the Ministry for Education. The enormous costs of this could only be covered at present with the help of foreign aid/materials. These new construction and reconstruction measures would last a few years. The work could be done by local planning offices and construction companies.

(re 8): Putting the grounds of the former aeroplane manufacturer in Mostar to good use should also be seen as a medium-term undertaking. The ideas sketched out briefly in Chapter 4.7 depend quite considerably on the interest of possible investors. The municipal administration in Mostar should lead the way in testing the possibilities at home and abroad of finding suitable potential investors. The publication of a multilingual exposé would be a suitable step forward.

External experts should be commissioned to do this. Initial contact with foreign investors and contract negotiation and signing should be done in the presence of these experts, as they are familiar with the perspectives and evaluations of western investors. The duration of the marketing of this project, with the target of creating jobs in Mostar and stimulating the national economy as a whole, is estimated at about a year. The process of viewing and conducting interviews will take about 90 days with travel time on top. The sale of the property could finance these costs in a similar way to a real estate dealer's commission. Should it prove impossible to sell the property, the costs would have to be guaranteed by the funding body.

5.3 Long-term measures

(re 1): The calculation of the energy potential of regenerative resources and country-wide analyses are typical tasks in the curricula of universities and colleges or typical projects for student theses. The results gathered by the measuring points in the country should be inputted and updated in lexicons and databases conforming to EU standards (e.g. Lit 10, European Wind atlas and Solar Figures on the Internet, generated from satellite data, e.g. at www.satel-light.com). The raw data from the weather stations, research stations, airports and energy observation points should be tested and processed. This work could take several years. The material costs of the universities for measurements, data transfer and evaluation software, not including personnel costs, is estimated at about DM 50,000 .

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Appendix

Address List of the Electricity industry