



Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

21 Country Analyses

Eschborn, June 2004

Part Bosnia-Herzegovina



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Background to the New Edition

Structural changes in the energy sector, accompanied by liberalisation of the relevant markets, have been continuing in many developing and transition countries in recent years. Growing demand for electricity and the ongoing climate debate are increasing the level of interest in technologies for generating electricity from renewable energy sources in these countries.

The rapid expansion of the use of renewable energy in Germany is a subject that is being followed with interest, even outside Europe. Experience here shows that the creation of a conducive political and economic framework and the implementation of appropriate promotion measures can speed up the exploitation of renewable energy.

The German and European market acts as the motor for a wind energy industry and provides an indispensable background of experience. The level of growth in this sector within Germany has slowed down, however. Project developers are therefore increasingly turning their attention to off-shore schemes, other parts of Europe, and the Mediterranean states. The markets for technologies based on other renewable energy sources are also experiencing growing interest. While it is true that the potential for hydro-power, wind power, solar power, biomass and geothermal energy in developing and more advanced countries is often considered to be high, obstacles to entry into this field include insufficient knowledge of the framework conditions prevailing in the energy industry in those countries and a lack of transparency with regard to the prior experience and interests of the national actors.

One of the aims of this third, updated and expanded edition of the study – under a new title – is to facilitate entry into the field of renewable energy. It is based on the previous editions from 1999 and 2002, which were published under the title ‘Producing Electricity from Renewable Energy Sources: Energy Sector Framework in 15 [or 12] Countries in Asia, Africa and Latin America’. These studies have been much in demand, not only by suppliers and project developers but also by financing and operating companies involved in renewable energy technologies.

The analyses of the individual countries comprise sections on the respective electricity markets and the actors in those markets, along with information on the energy-policy framework. The policy for promoting electricity generation from renewable energy sources is examined, and the status of the various forms of renewable energy is analysed in detail. The chapters on each country are rounded off by information about rural electrification.

In comparison with the 2002 edition, eleven new countries have been added. The information about a further ten countries has been updated:

New since 2002		Updated	
Albania	Philippines	Brazil	India
Bosnia - Herzegovina	Senegal	Chile	Mexico
Croatia	Sri Lanka	China	Morocco
Georgia	Vietnam	Colombia	South Africa
Jamaica	Yemen	Dominican Republic	Tunisia
Pakistan			

Information about Argentina, Cuba, Jordan, Kazakhstan and Turkey is given in the 2002 edition. Analyses of Egypt, Indonesia and Thailand were conducted in the 1999 edition. These previous editions are available in electronic form free of charge from www.gtz.de/wind/english/downloads.html.

Our grateful thanks go to a large number of GTZ staff members and other experts for their help with putting this information together.

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Legal Information

1. The data used in this study is based on both publicly accessible sources of information (publications, specialist articles, Internet sites, conference papers etc.) and non-public papers (for example internal expert reports from promoting institutions), as well as personal interviews with experts (for example officials at energy ministries in the investigated countries and project staff at promoting institutions). Although all information has been checked as far as possible, errors cannot be ruled out. Neither the GTZ nor the authors can therefore provide any guarantee of the accuracy of the data included in this study; no liability can be accepted for any loss or damage resulting from use of the data included in the study.

2. The sole authorised user of this study for all forms of use is the GTZ. Duplication or reproduction of all or part of the study (including transfer to data storage media) and distribution for non-commercial purposes is permitted, provided the GTZ and the TERNA Wind Energy Programme are named as the source. Other uses, including duplication, reproduction or distribution of all or part of the study for commercial purposes, require the prior written consent of the GTZ.

The TERNA Wind Energy Programme

Specialised knowledge and experience are needed to determine what wind energy resources a country possesses and to identify suitable locations. Technical and economic analyses of wind power projects are also impossible without hard information about wind conditions. Such analyses, however, form the basis for the financing and ultimately the successful implementation of a wind farm.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) Wind Energy Programme, implemented by the GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and more advanced countries in planning and developing wind power projects. Since 1988 the aim within the TERNA framework has been to lay the foundations for sound investment decisions while at the same time enabling partners to plan and develop further wind power projects in the future.

The TERNA Wind Energy Programme's partners are institutions in developing and more advanced countries that are interested in commercial exploitation of wind power: these include, for example, ministries or government institutions which have the mandate to develop BOT/BOO projects, state-owned or private energy supply companies (utilities) and private enterprises (independent power producers).

TERNA offers its partners know-how and experience. In order to initiate wind power projects, favourable sites must be identified and their wind energy potential ascertained. To do this, wind measurements are normally taken over a period of at least twelve months and wind reports are drawn up. If promising wind speeds are found, the next step is to conduct project studies investigating the technical design and economic feasibility. TERNA also provides advice to partners on matters of finance, thus closing the gap between potential investors and offers of funding from national and international donors. If required, CDM baseline studies can be prepared and advice can be offered to potential operators on setting up an efficient operator structure. In order to ensure as much transfer of know-how as possible, efforts are made to ensure cooperation between international and local experts, for example when preparing the studies.

In successful cases, TERNA initiates investment-ready wind farm projects by this method. TERNA itself is not involved in financing. In addition to the activities that are tied to specific locations, TERNA advises its partners on how to establish suitable framework conditions for the promotion of renewable energy sources.

The prerequisite for promotion by the TERNA wind energy programme is that project development has a realistic prospect of implementation: if the underlying conditions in the electricity sector are sufficiently favourable, and if the proposed wind farm project has a minimum capacity of roughly 20 MW and is situated in a windy area (expected annual average wind speeds of over 6 m/s at a height of 10 m above ground level). Small individual installations or decentralised wind/diesel systems are not normally eligible for promotion, nor are research projects.

Up until 2004, TERNA has been active in over ten countries around the world. In Colombia the first wind farm started operation at the end of 2003 with the help of the TERNA programme. The municipal utility of Medellín built the 19.5MW Jepirachi wind farm on the Guajira peninsula with a total investment volume of some 27 million euros. The 800,000 tons of carbon dioxide saved by the wind farm by 2012 will be documented and sold to the Prototype Carbon Fund (PCF), which will mean additional revenues of around 3.2 million euros for the investor.

The TERNA projects are not financed from the country quotas which the Federal Germany Government agrees with individual partner countries. From the viewpoint of the partner country, therefore, TERNA offers additional funds for wind energy.

Further information on the GTZ's TERNA Wind Energy Programme, the application procedure etc. is available at www.gtz.de/wind or directly from:

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Electricity Market

Energy sources

Electricity supplies in Bosnia and Herzegovina are essentially based on coal-fired steam-turbine power stations and the exploitation of hydropower. The reserves of brown coal in Bosnia and Herzegovina are estimated at almost 3.9 billion tons. In 2001, 78% of the extracted brown coal was used for power generation. Imports of oil and natural gas largely meet the needs of industry, transport and heat generation for space heating. Natural gas is imported exclusively from the Russian Federation (via a pipeline through the Ukraine, Hungary, Yugoslavia and Montenegro). At present, annual demand is at roughly one third of pre-war consumption levels, at 150 to 200 million m³.

Generating capacity and electricity generation

In 1990 the installed power station capacity amounted to approximately 4 GW. As a consequence of the war in the 1990s, about 56% of the generating capacity and 60% of the transmission and distribution grid were heavily damaged. The previous power-station capacity levels were attained once more in 2002. Some of the coal-fired power-station units in Tuzla and Kakanj also supply local district heating networks.

		1990	1997	2002
Total installed capacity	MW	3,994	n.D.	3,842
Coal-fired power stations	MW	1,957 (49%)	n.D.	1,790 (47%)
Hydroelectric plants	MW	2,037 (51%)	n.D.	2,052 (53%)
Electricity generation	GWh	13,090	9,300	10,795
Electricity consumption	GWh	11,822	6,974	9,257

Table 36: Installed capacity, electricity generation and consumption; Bosnia and Herzegovina; 1990, 1997, 2002; MW, GWh²¹²

At 10,795 GWh, electricity production in 2002 was about 82% of pre-war production in 1990.

Electricity grid

Since 1996 the electricity grid has been rebuilt and renewed with international support. A central role has been played in this by the World Bank, which is currently accompanying the third stage of an aid pro-

gramme for reconstruction of the energy infrastructure in Bosnia and Herzegovina. The objective of the Power III Programme, which is scheduled to continue until March 2005, is to recommission the high-voltage network (especially the 400kV lines) and to establish the institutional capacity of an independent national system operator.

Bosnia and Herzegovina's electricity infrastructure was built up after the Second World War and in 1955 was integrated into what was then the Yugoslavian electricity grid. Whereas the high-voltage network was controlled from Belgrade from that time on, generation and distribution remained under regional management.

Supply areas

Following independence in 1992, the entire energy infrastructure was divided up into three separate supply areas according to the ethnic majorities of the population, the area of the Bosnian utility Elektroprivreda Bosne i Hercegovine (EPBiH), the area of the Croatian utility Elektroprivreda Hrvatske Zajednice Herceg-Bosne (EPHZHB) and the area of the Serbian utility Elektroprivreda Republike Srpske (EPRS).

The EPBiH transmission grid is mostly back up to the pre-war level, extending to 2,166 km in the 110kV and 220kV range; it is only in the 400kV range that certain important links to neighbouring countries are still missing. The distribution network has a total length of some 30,000 km. EPHZHB operates 1,060 km of high-voltage lines and a distribution network of about 12,000 km. EPRS maintains 2,395 km of transmission lines and a distribution network of roughly 78,000 km.

The major consumption centres are Sarajevo, Mostar, Tuzla and Trebinje. The location of the coal-fired power stations and hydropower plants and the unfavourable subdivision of the supply areas mean that complex and costly electricity transit settlements are needed between the three electricity suppliers.

Electricity consumption

Electricity consumption in 2002 was 9,257 GWh, roughly 78% of the figure from 1990. Bosnia and Herzegovina along with Slovenia are the only net electricity exporters among the former Yugoslav republics.

Tariff structure for end customers

The three power utilities submit proposals for the tariff structure to the responsible energy ministries, or in the case of EPHPHZ to the administrative authority of the relevant canton. The prices are set by the political institutions. In 2001 and 2002 there were standardised tariffs for both of the power utilities in the Federation of Bosnia and Herzegovina, which is why in the table below the only differentiation is between the Federation and the Republika Srpska.

Electricity prices

In 2002 the net electricity prices for industrial customers worked out at an average of 2.6 € cents/kWh in the Federation and 4.9 € cents/kWh in the Republika Srpska. The net prices for smaller commercial customers were in the region of 10 € cents/kWh in the Republika Srpska and between 6.9 and 13.7 € cents/kWh in the Federation of Bosnia and Herzegovina, thus making them comparable to German prices. The net electricity price for private households was significantly below the equivalent prices in Germany, at 5.9 € cents/kWh in the Federation and 5.2 € cents/kWh in the Republika Srpska.

The precise graduation of prices applied by the utility company EPBiH in 2001 is shown in Table 37. A distinction is drawn between high-voltage tariffs (110 kV, 35 kV and 10 kV) and low-voltage tariffs, and the low-voltage range is further broken down into households, commercial users and public lighting. In addition, the price groups are divided into low, high and peak tariffs according to the time of year and time of day.

Market Actors

In 1992/93 the supply of electricity was divided up into three separate companies along the dividing lines between the ethnic population groups: EPBiH and EPHZHB in today's Federation of Bosnia and Herzegovina, and EPRS in Republika Srpska (RS).

Elektroprivreda Bosne i Hercegovine (EPBiH)

EPBiH, which has its head office in Sarajevo, is the largest of the three power utilities, with about 600,000 customers and an installed power station capacity of 1,790 MW. Almost 79% of the 5,474 GWh generated in 2002 was produced in the two coal-fired power stations in Tuzla and Kakanj, with the remaining 21%

Tariff rate		High and medium voltage			Low voltage							
		Households					Other consumers		Public lighting			
Season	Day	110 kV	35 kV	10 kV	Group I	Group II	Group III	Group IV	Group V	Group I	Group II	
Capacity (€/kW)												
High		8,70	9,66	11,60	2,30	2,30	2,30	0,28	0,28	10,35	10,35	*
Low		5,80	6,44	7,73	1,53	1,53	1,53	0,18	0,18	6,90	6,90	*
Energy (€-ct/kWh)												
High	High	3,32	3,99	4,95	6,14	7,67	7,67	6,14	7,67	8,28	13,68	9,20
High	Low	1,66	1,99	2,47	*	3,83	2,56	*	3,83	4,14	6,84	*
High	Peak	*	*	*	*	*	*	12,27	12,27	*	*	*
Low	High	2,22	2,66	3,30	4,09	5,11	5,11	4,09	5,11	5,52	9,12	6,14
Low	Low	1,11	1,33	1,65	*	2,56	2,56	*	2,56	2,76	4,56	*
Low	Peak	*	*	*	*	*	*	8,18	8,18	*	*	*

Table 37: Net electricity tariffs of EPBiH, as at 1.4.2001, € cents/kWh²¹³

coming from the three hydropower plants in Grabovica, Jablanica and Salakovac. As consumption in 2002 was only 3,070 GWh, it was possible to export approximately 2,030 GWh. The bulk of the exported electricity was routed to the EPHZHB supply area. Smaller quantities were also exported to Croatia and Slovenia and to Serbia and Montenegro.

Elektroprivreda Hrvatske Zajednice Herzeg-Bosne (EPHZHB)

EPHZHB, which is based in Mostar, is the second power utility in the Federation of Bosnia and Herzegovina and has 130,000 customers. It operates five hydropower plants (Rama, Capljina, Jajce I, Jajce II and Mostar) with a total output of 1,086 MW. In 2002 EPHZHB generated 1,175 GWh, and was therefore unable to meet the demand in its own supply area itself, which amounted to 2,987 GWh.

Elektroprivreda Republike Srpske (EPRS)

EPRS is the power utility for Republika Srpska, and has 370,000 customers. EPRS operates two large lignite-fired power stations in Gacko and Ugljevik, and three hydropower plants in Bocac, Trebinje and Visegrad. It also has smaller hydropower plants and owns holdings in hydropower plants outside the country. Altogether this brings EPRS to an installed capacity of 1,361 MW. In 2002 production amounted to 4,080 GWh, while consumption in its own supply area totalled 3,200 GWh.

Central coordination

In 1998 the Joint Power Coordination Centre (ZEKC) was founded with assistance from the World Bank; this is a body in which the three power utilities coordinate the reconstruction and operation of the 400kV grid. At the same time it constitutes the first step towards setting up an independent system operator (ISO) within the framework of the privatisation process.

Legal Framework

State Energy Regulatory Commission SERC

Legal jurisdiction over energy policy in Bosnia and Herzegovina lies largely with the two entities, the Federation of Bosnia and Herzegovina and Republika Srpska. According to the law on liberalisation of the electricity market adopted in April 2002 (Law on Electricity Transmission, System Regulator and Operator in BiH), which was supplemented in both entities by a corresponding law on electricity generation and distribution (Law on Electricity of the FBiH and RS), in future a state commission (SERC) is to take over regulatory tasks for the transmission grid, whereas generation, distribution and trading are to be the responsibility of the regulatory commissions of the individual areas (ERCFBiH and ERCRS) separately.

Unbundling the electricity supply companies

In order to bring this about, it is planned to unbundle the three previous electricity suppliers into separate parts for transmission, distribution and generation. On the basis of the study produced by the PA Consulting Group in December 2001, 'Bosnia and Herzegovina: Power Sector Restructuring and Privatization Analysis and Action Plan', the entities have envisaged that this unbundling should take place in four stages.

The redistribution of resources and personnel to the areas of generation, distribution, transmission and system management is scheduled to take place in the first stage. During the second stage it is intended that the future generating and distribution companies should begin to operate as separate units, and new invoicing systems will be introduced. In the third stage the newly formed generating and distribution companies will operate as a consortium and produce performance reports for potential investors. The fourth and last stage will comprise the privatisation of the individual companies. In the generation sector it is recommended that four separate companies should be formed for the coal-fired power stations and three companies for the hydropower plants.

Privatisation of energy supply

Whereas at the legislative level the liberalisation process has already progressed a relatively long way, the utility companies are still at the initial stages of unbundling. Action plans for the privatisation of energy supply were adopted in both constituent republics in July 2003. Full privatisation is planned for the period from 2004 to 2006.

Independent system operator

At the higher state level an independent system operator (ISO) is to have the task of guaranteeing trouble-free operation of the system. In order to achieve this, a national transmission grid operator is to be created. The laws to bring this about²¹⁴ were passed in October 2003 by the Council of Ministers of Bosnia and Herzegovina and still have to be confirmed by parliament.

Electricity wholesaling

As far as electricity wholesaling is concerned, a distinction is drawn between three categories of customers: qualified consumers (QCs) such as energy-intensive industries, regional electricity traders (RETs) and independent retail traders (IRTs). Whereas the RETs represent the independent trading departments of the electricity distribution companies, the IRTs are supposed to be new, autonomous market participants. As the electricity market is opened step by step, initially only qualified consumers are to be able to purchase their electricity freely.

Clean Development Mechanism

Bosnia and Herzegovina ratified the UN climate change agreements in September 2000; it has not yet signed or ratified the Kyoto Protocol. The latter step is a prerequisite for participation in the Clean Development Mechanism (CDM), by means of which industrialised countries could transfer parts of their obligation to reduce greenhouse gases to Bosnia and Herzegovina. Austria has already expressed its interest in this connection to undertake projects in the country.

Policy for Promoting Electricity Generation from Renewable Energy Sources

The serious damage caused by the war meant that until now efforts have concentrated on rebuilding the energy infrastructure. The traditional use of hydropower and the fact that there is still considerable unused potential is leading at present to work being focussed on an expansion of hydropower.

Remuneration for infeed of renewable energy

In 2002 the government adopted a resolution to promote the generation of electricity from renewable energy sources. In this, the electricity suppliers or grid operators are obliged to accept electricity from renewable energy sources in their grids and to pay a fixed rate for it. The level of remuneration for the infeed of electricity from renewable energy sources with a maximum installed capacity of 5 MW is coupled to the amount of the medium-voltage tariff (10 kV; 4.95 € cents/kWh). This tariff is multiplied by a correction coefficient depending on the type of renewable energy involved in order to obtain the applicable infeed tariff.

Energy source	Correction coefficient	Feed-in-tariff (€ cents/kWh)
Small-scale hydropower plants	0.80	3.96
Landfill-gas and biogas plants	0.77	3.81
Wind and geothermal power plants	1.00	4.95
Photovoltaic installations	1.10	5.45

Table 38: Infeed remuneration and correction coefficients, Federation BiH²¹⁵

The definition of the term "renewable energies" in the Bosnian regulation governing electricity infeed differs from the EU directive on the promotion of electricity from renewable energy sources in the internal electricity market. Furthermore, the sections on 'national indicative targets' and 'guarantee of origin of electricity produced from renewable energy sources' stated in the EU directive are not taken into account in the regulation adopted by the Federation of Bosnia and Herzegovina. Discussions are therefore currently in progress to produce an infeed directive that would be standard for the whole of Bosnia and Herzegovina and in conformance with EU policy.

214 Law on the BiH Company for the Transmission of Electrical Energy; Law on Independent Service Operator for Electrical Energy.

215 Compiled on the basis of the resolution on the method of determining the level of remuneration for electricity from renewable energy sources with an installed capacity of up to 5 MW by the Government of the Federation of Bosnia and Herzegovina of 2002.

Status of Renewable Energy Sources

Hydropower

The theoretical potential of hydropower in Bosnia and Herzegovina is stated as being 8,000 MW, the technical potential 6,800 MW and the economic potential 5,600 MW. With an installed capacity of 2,052 MW (53% of electricity generation), hydropower is highly significant in Bosnia and Herzegovina, although its potential is far from being fully exploited yet (37% of the economic potential). The majority of the installations are more than 30 years old. Various projects there therefore currently in progress to modernise and expand existing plants.²¹⁶

Small-scale hydropower plants

The potential for small-scale hydropower plants is put at 2,500 GWh/a.²¹⁷ At present there are about ten plants with a total capacity of 31 MW; two other plants are under construction, and 20 plants with a total capacity of 28 MW are planned. In addition, a study by the Federation of Bosnia and Herzegovina lists a further 42 locations for small-scale hydropower plants with a total capacity of 51 MW which could be built at existing weirs.

Table 39: Hydropower plants; Bosnia and Herzegovina, status 2001²¹⁸

Power plant	River	Committed	Type of plant	Type of turbine	Head (m)	Design mass flow (m ³ /s)	Mean mass flow (m ³ /s)	Installed capacity (MW)	
Trebinje 1	RS	Trebinjica	1968	Storage	Francis	86,5	3 x 70	81	2 x 54+1 x 60
Dubrovnik 1	RS	Trebinjica	1965	Storage	Francis	270	2 x 45	94	2 x 108
Trebinje 2	RS	Trebinjica	1981	Run-of-river	Kaplan	20	1 x 45	94	1 x 8
Capljina	F	Trebinjica	1979	Pumped storage	Francis	220	2 x 112,5	29	2 x 215
Rama	F	Rama	1968	Storage	Francis	285	2 x 32	33	2 x 80
Jablanica	F	Neretva	1955	Storage	Francis	93,7	6 x 30	112	3 x 25+3 x 30
Grabovica	F	Neretva	1982	Storage	Kaplan	34	2 x 190	136	2 x 58,5
Salakovac	F	Neretva	1982	Storage	Kaplan	42	3 x 180	183	3 x 70
Mostar	F	Neretva	1987	Storage	Kaplan	21,5	3 x 120	194	3 x 25
Jajce 1	F	Pliva	1957	Run-of-river	Francis	88,4	2 x 30	40	2 x 30
Jajce 2	F	Vrbas	1954	Run-of-river	Francis	42,5	3 x 27	72	3 x 10
Bocac	RS	Vrbas	1982	Storage	Francis	52	2 x 120	78	2 x 55
Visegrad	RS	Drina	1989	Storage	Kaplan	43	3 x 267	342	3 x 105
Total BiH									2064

EPBiH is currently building a 126MW hydropower plant at Konic; the work should be completed by the end of 2003. EPRS is planning to build five new hydropower plants. By 2008 there are supposed to be two plants with a capacity of 450 MW built at Buk Bijela and Srbinje, by 2010 a further two plants at Krupa and Banja Luka and in the longer term a 160MW plant at Dabar. EPHZHB planned to complete two relatively small hydropower plants at Pec Mlini (30 MW) and Mostarsko Blato (60 MW) by the end of 2003.

Foreign investors in the hydropower sector

Currently there are two projects funded by foreign investors (the Swiss company Geva and the Austrian company Small Hydropower Tirol) which envisage the construction of one and four small hydropower plants respectively in Central Bosnia, with a total capacity of 5.4 MW. Both investors have concluded contracts with EPBiH to feed electricity into the grid for a period of 20 years. Small Hydropower Tirol has also entered into a DBOT (Design–Build–Operate–Transfer) agreement with the Central Bosnian canton of Srednjbosanski according to which the plant is to pass into the ownership of the canton after 20 years.

216 Source: Energy Country Renewable Profiles, EBRD, http://projects.bv.com/ebd/renew_profile.htm.

217 Source: Energy Country Renewable Profiles, EBRD, http://projects.bv.com/ebd/renew_profile.htm.

218 Data source: EPBiH. Plants with a capacity of less than 8 MW are not included.

There is presently an ongoing initiative launched by Austria to invest € 350 million in up to five hydro-power plants in Bosnia and Herzegovina with the intention of using these to achieve part of the CO₂ reduction targets for the Kyoto Protocol. To that end, however, Bosnia and Herzegovina would first have to ratify the Protocol.

Wind Energy

Up to now there have been insufficient measurements available to produce an estimate of the potential for wind energy across the whole of Bosnia and Herzegovina; for the time being, therefore, only a qualitative assessment can be made. In a similar pattern to that in Germany, the wind blows more strongly in autumn and winter and less strongly in the summer. The infrastructure offers adequate conditions for connecting possible locations to the grid, as the high- and medium-voltage network is well developed and the damage has been largely repaired.

In a preliminary study carried out on behalf of the GTZ it was established that there is an economic potential of approximately 600 MW that could be developed by 2010, on the assumption that an appropriate incentive system to build wind power installations is set up. Sufficiently suitable geographical locations appear to be available. For example, there are promising wind values shown by measurements taken before the war for the region of Trebinje through Mostar to Bogojno, and more up-to-date measurements from meteorological stations and airports which reveal large areas of the country with wind velocities of over 10 m/s at a height of 10 m on 150 days in the year.

The first systematic wind measurement project in the region of Mostar was planned for 2002, but a lack of funding meant that it was not possible to implement it. The supply company EPHZHB does remain interested, however, in making progress with such schemes.

Biomass

Apart from the traditional use of firewood and the recycling of wood waste in the wood-processing industry, there is no reliable data on the exploitation of biomass in Bosnia and Herzegovina. If studies have been carried out in the Federation of Bosnia and Herzegovina at the

canton level at all, the results are not accessible. It can be assumed, however, that there is considerable potential for the use of biomass for energy generation in the forestry sector (roughly 50% of the land area of Bosnia and Herzegovina is wooded) and in agriculture.

Utilisation of residual wood

According to a study conducted by Innotech HT GmbH, Berlin, in 2003 on behalf of the GTZ, there is an unexploited potential of approximately 1 million m³/a of residual wood, wood waste etc. which could be used to provide heat to 130,000 residences or 300,000 inhabitants.

One field where wood is already used in Bosnia and Herzegovina is where wood waste is converted into electrical energy in steam power plants, such as in the state-owned Krivaja factory in Zavidovici, manufacturing furniture and timber houses. With a maximum thermal output of 15 MW, peak electricity outputs of 4.5 MW are generated for the factory's on-site power needs. There are also plans with the local authority for a group heating scheme in the locality, but because of a lack of funding it has so far not been possible to put these into practice.

Use of landfill gas

Near Sarajevo a landfill gas plant with a 350kW generator has been built with Austrian support; its capacity is due to be doubled in the near future. The electricity is fed into the urban grid. The remuneration for electricity generated from biomass, as set by the government decree of 2002, is low in the Federation of Bosnia and Herzegovina at 3.81 € cents/kWh.

1.5.4 Solar Energy

With regard to solar irradiation, Bosnia and Herzegovina can be counted among the more favourable locations in Europe with solar irradiation figures of 1,240 kWh/m²/a in the north of the country and up to 1.600 kWh/m²/a in the south. Despite this, the use of solar energy can only be described as insignificant.

The thermal exploitation of solar energy with flat-plate collectors is also practised to only a limited extent.

Photovoltaics

One of the first PV installations is being fitted on the roof of an orphanage in Trebinje with assistance from the GTZ. The installation is also intended to be used for training purposes for the local electrical trade. In view of the relatively high cost involved, the introduction of photovoltaics on the market beyond very small-scale consumers far from the utility grid is dependent on promotion programmes and international projects.

Geothermal Energy

According to the available studies, Bosnia and Herzegovina has a geothermal potential of 33 MW_{th}. It must be said, though, that the temperature at the three known locations in Bosanski Samac (85°C), Kakanj (54°C) and Sarajevo (58°C) is too low for electricity generation, which is why the reserves are currently only under consideration for thermal exploitation. Before the civil war there was an initial pilot project for a 1-MW plant near Sarajevo, which was designed with a volume flow of 240 l/s with water at a temperature of 58°C. The project was not completed, however.²¹⁹

Geothermal use near Sarajevo

Current activities relating to geothermal energy continue to be limited to exploitation for thermal use. For example, a group of buildings in Llidza (a suburb of Sarajevo) is to be heated with geothermal energy. If higher temperatures are discovered in the course of the exploratory drilling, there are also plans for partial conversion to electrical energy. The project is being handled by a German-Bosnian company with the participation of EAN-Nord GmbH from New Brandenburg, Germany. At present the company is attempting to obtain promotional funds for further exploratory drilling.

Rural Electrification

With a distribution network extending to a total length of about 120,000 km, Bosnia and Herzegovina has a well developed electricity grid. It can be assumed that the rural areas of Bosnia and Herzegovina are also for the most part connected to the electricity grid.

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The potential of renewable sources of energy in developing and emerging countries is often considered high. Obstacles to their exploitation and foreign investors' engagement often include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of the national actors. These are barriers which this third, updated and expanded new edition intends to overcome.

The **electricity markets** and their respective **actors** are investigated for **21 countries** in various regions: **Latin America – Caribbean, Africa, Europe – Caucasus** and **Asia – Pacific**. The country reports analyse the **energy-policy framework conditions** and closely examine the **status** of and **promotion policy** for electricity generation on the basis of **hydropower, wind power, solar power, biomass** and **geothermal energy**. The chapters on each country are rounded off by information about **rural electrification**.



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