Division Environment and Infrastructure
TERNA Wind Energy Programme

Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

21 Country Analyses

Eschborn, June 2004

Part Croatia

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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 hydropower, 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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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 Jepírachi 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

Generating capacities

Croatia's overall power generating capacity is split almost evenly between coal-, gas- and oil-fired steam power plants and hydroelectric power plants. In 2002 the total installed capacity amounted to approximately 4,800 MW.

The large share of hydropower necessitates some means of compensating for seasonal peaks, but Croatia's troubled relationships with neighbouring countries often make that difficult to achieve. For example, unsettled ownership issues concerning Krsko nuclear power station in Slovenia keep giving rise to new disputes.[225]

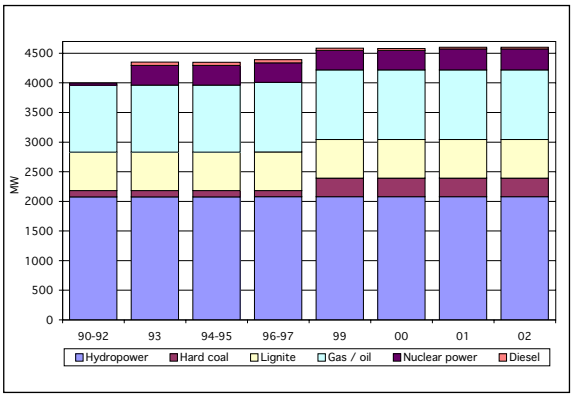

Figure 11: Generating capacities according to energy source; Croatia, 1990–2002; MW [226]

Croatia's single largest addition to its overall power generating capacity since gaining independence was the newly built Plomin 2 power station, a coal-fired thermal power plant with a capacity rating of 210 MW. Jointly owned by Germany's RWE Power and the state-owned power provider Hrvatska Elektroprivreda d.d. (HEP), each of which holds 50%, Plomin 2 was one of the first major projects to be undertaken by a foreign investor in the Croatian energy sector.

Power generation

Gross power generation in 2002 totalled approximately 14.8 TWh, of which roughly a quarter was imported.

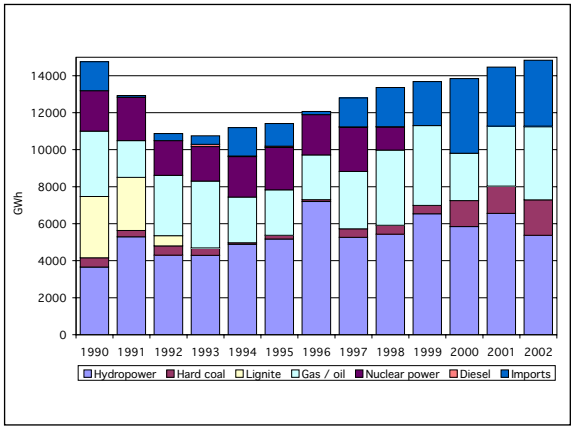

Figure 12: Gross power generation according to energy source; Croatia; 1990–2002; GWh[227]

Due to conflicts with neighbouring states, the supply of electricity from lignite-fired power plants in the erstwhile successor republics ceased after 1991. Disputes over payments and unsettled ownership issues regarding Krsko nuclear power station also caused deliveries to halt in 1998.

Power grid

Croatia has a quite closely-knit, well-developed national power grid.[228] However, the destruction of substations during the war still impairs the transmission of power to neighbouring countries. When the Osijek and Zagreb transformer substations are repaired and returned to service in 2003/2004, though, Croatia's power grid will once again be fully integrated in the European interconnected network.

Trends in power consumption

War in Yugoslavia led to a marked reduction in electricity consumption in 1991 and 1992. After the war, the economy was slow to recover. Then, the change of government coupled with the opening of the economy in early 2000 produced a steep rise in gross domestic product, mostly attributable to increased domestic demand and to the revitalisation of tourism, all of which meant that more electricity was needed. The country's own power generating capacities cannot meet the full demand, so some power has to be imported. Due to a lack of transmission capacity in the grid structure, however, access to inexpensive electricity from Eastern and Central Europe remains limited.

225 Due to disputes over payments, Croatia stopped purchasing electricity from Krsko nuclear power station at the end of 1998.

226 The chart includes thermal power plants located outside Croatia (650 MW lignite-fired plants in Obrenovac, Tuzla, Kakanj and Gacko) and Krsko nuclear power station in Slovenia, in connection with which Croatia has lodged claims of ownership. The respective annual averages are shown for multi-year periods.

227 Source: HEP.

228 A map of the Croatian electricity system can be found at www.hep.hr/publikacije/ElectricityData2002.pdf.

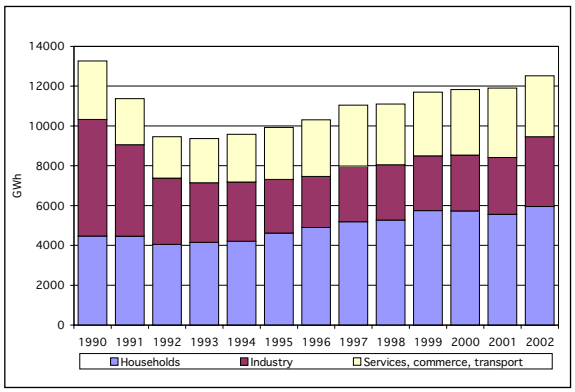

Figure 13: Electricity consumption by sector; Croatia; 1990–2002; GWh[229]

This sectoral power consumption chart clearly shows how household power consumption has been increasing, while the industrial sector still is not consuming anywhere near as much electricity as it was before the war.

Cost of electricity

Electricity prices are graduated according to voltage. Studies produced by the European Bank for Reconstruction and Development (EBRD) place the ratio between the selling price (meter rates) and the mean long-term marginal costs at 0.9.

Voltage level/ consumer	1994	1995	1996	1997	1998	1999	2000	2001
110 kV	3.61	3.94	3.59	3.65	3.73	3.50	3.38	3.21
35 kV	4.88	4.90	4.91	4.74	4.88	4.72	4.51	4.25
10 kV	7.12	6.95	6.84	6.864	6.96	6.79	6.57	6.09
Households	5.32	5.22	5.30	5.30	5.14	5.41	5.74	6.99
Services sector	9.82	9.41	9.42	8.23	9.04	8.84	8.92	7.94
Public lighting	7.17	7.11	7.19	7.02	7.030	7.01	6.87	6.45
Average selling price	6.00	6.24	6.43	6.13	6.11	6.15	6.20	5.82

Table 42: Average electricity supply prices according to voltage; Croatia; 1994–2001; € cents/kWh excluding taxes[230]

Market Actors

State monopolies HEP and INA

The energy market in Croatia is dominated by the state-owned public utilities and erstwhile monopolists Hrvatska Elektroprivreda – HEP (electricity) and Industrija Nafte - INA (gas and oil supplies). Despite measures taken to liberalise and privatise the energy market, no other providers have yet gained much of a foothold.

With a view to introducing market-economy principles while harmonising the electricity market with EU directives, HEP was unbundled in January 2002. Among other things this involved establishing separate divisions: HEP Generation, HEP Transmission and HEP Distribution.

Privatisation of the energy market

HEP has no private shareholders to date. According to information provided by the Ministry of Economy, the infrastructural rehabilitation programme should be completed first, and the actual privatisation process is planned to begin in 2004. A privatisation law was enacted in March 2002, according to which the state is to retain 51% ownership of HEP pending Croatia's ultimate accession to the European Union. In addition, CROISMO (Croatian Independent System and Market Operator) was spun off as a separate enterprise which will remain entirely under public ownership.

The electricity market is still under development, and the market is still practically devoid of alternative providers and competitive structures. Additional independent market participants are envisaged for the future in the areas of power generation, transmission and distribution.

Legal Framework

Institutional and legislative framework

The PROHES programme (Development and Organisation of Croatian Energy Sector) was devised in 1994 to bring about the restructuring and privatisation of the energy market and to work out various measures designed to improve energy efficiency and promote the use of renewable energy sources. That position paper paved the way for the establishment of a legal framework, the design and development of consolidation and promotion programmes, and the drafting of a long-term strategy paper for developing the energy sector. The scientific organisation Energy Institute Hrvoje Pozar (EIHP) was

229 Source: HEP.

230 Source: Energy in Croatia, Annual Energy Report. The turnover tax amounted to 22% in 2003.

set up in that same year to carry out work in this field while serving as a coordination and management centre and providing scientific backstopping for the pertinent activities.

Energy laws

A legal framework for the liberalisation and privatisation of the energy market was drafted; this was ratified in June 2001 and came into force in January 2002. The package comprises five individual laws: the Act on Energy, the Act on Energy Service Regulation, the Act on Electric Power Market, the Act on Gas Market, and the Act on Petroleum Products Market. Both the Act on Energy and the Act on Electric Power Market attach special importance to the use of renewable energy sources for building up the energy sector. It is planned for the future to make the purchase of power generated from renewable energy sources mandatory, with compensation provided for possible differences in price compared to conventionally generated power.

The Croatian Energy Regulatory Council (CERC) was established in 2002 for the purpose of monitoring and supervising the energy market. Since commencing its work in January 2003, CERC has been responsible for issuing licences to access the power grid, setting the rates to be paid by general customers, and monitoring the electricity, gas and oil market.

All power producers wishing to participate on the Croatian market must acquire a licence to supply electricity via the transmission grid. Special regulations apply to the operators of power-generating facilities fuelled with renewable sources of energy.

Partial opening of the electricity market

An initial step toward opening up the market was taken in the form of an ordinance that allows customers with an annual consumption above 40 GWh/a (approximately 10% of the market) to freely choose their electricity supplier and to negotiate their own conditions of supply (Article 23 of the Act on Electric Power Market). That consumption threshold is supposed to be lowered sometime in the future to let 'smaller' consumers also freely choose their suppliers and to gradually open up the electricity market entirely.

Emission taxes

No CO_2 or emission tax exists yet, but the introduction of such a tax is planned for January 1, 2004. The tax rate will be based on CO_2, SO_2 and NO_2 emission volumes and is to be paid on a calendar-year basis.

Clean Development Mechanism

Croatia ratified the UN Climate Change Agreements and signed the Kyoto Protocol in 1996. Ratification of the latter was still pending at the end of 2003. As an Annex I country under the United Nations Framework Convention on Climate Change, Croatia is undertaking to reduce its greenhouse gas emissions to five per cent less than their 1990 levels in the period between 2008 and 2012. Due to the country's rapid economic recovery and projected growth, that limit is expected to be surpassed as soon as 2004, and a subsequent trend reversal will be very difficult to achieve.

Policy for Promoting Electricity Generation from Renewable Energy Sources

Payment for electricity from renewable energy sources

The only fully elaborated payment models for electricity produced from renewable energy sources relate to small wind farms and mini hydropower plants. According to law, CROISMO is supposed to purchase electricity from operators of renewable energy conversion systems. For that, however, the electricity has to be provided at a transmission voltage of 110 kV. According to the envisaged financing model, pollution taxes paid by the industry together with a 'renewable energy levy' paid by regular rate customers would even out differences in the prices of renewably and conventionally generated electricity.

Following a series of studies conducted by the Energy Institute Hrvoje Pozar (EIHP) into various areas of the economy, an array of programmes was initiated by the government in 1997 under the heading of the National Energy Programmes (NEPs). The NEPs deal with a total of ten key sectors for which targeted promotion is planned.

Promotion programmes for renewable energy sources

The NEP promotion programmes of direct relevance to renewable sources of energy are listed below:

- MAHE for the promotion of small hydropower plants
- SUNEN for the promotion of solar energy exploitation
- BIOEN for the use of biomass
- ENWIND for developing the use of wind energy
- GEOEN for the exploitation of geothermal energy
- KOGEN for the promotion of cogeneration
- CROTOK, which focuses on the provision and expansion of electricity supplies on the islands off Croatia's Adriatic coast

In early 2000, international organisations such as the World Bank and UNDP (United Nations Development Programme) were contacted with a view to the co-financing of projects in the fields of renewable energy sources and energy efficiency. In May 2002, this led for example to a pledge of assistance for the GEF-sponsored Renewable Energy Resource Project. The Croatian Bank for Reconstruction and Development (HBOR) also provided financial resources for the project. The purpose of the project is to perform economic analyses of renewable energy sources and to devise framework programmes for the promotion and financing of renewables, the overall goal being to establish a well functioning market for the use of such energy sources in Croatia. The Croatian Ministry of Economy, HBOR and HEP have been charged with implementing and monitoring the project. Proposals for typical implementations were accepted until May of 2003.

Status of Renewable Energy Sources

Hydropower

Croatia derives roughly one-half of its electricity from hydropower. The country has four major storage power plants, several small run-of-river power plants and three pumped-storage power plants, all owned by HEP.

The use of hydropower is recognised as traditionally well developed. Additional potentials could be developed by upgrading old (large-scale) power plants and/or by installing new mini hydropower plants. The power-producing potential of the latter has been estimated at 100 MW installed capacity. The Small Hydropower Plants Construction Programme (MAHE) is promoting the development of this potential.

Payment for electricity from hydropower

Operators of mini hydropower plants (with installed capacities < 5 MW) are offered access to the power grid and a fixed supply remuneration rate based on the 'average selling price' of electricity on the market.

Wind Energy

Despite some good wind velocities, particularly along the Dalmatian coast, the installed electrical output of wind generators remains negligible.

Potential and beginnings of development

Estimates of Croatia's technically exploitable wind energy potential place the achievable power generating capacity at 1,300 MW. Consequently wind energy, along with biomass, will play an important role in the GEF programme for developing Croatia's renewable energy sources.

No wind atlas exists for estimating potentials and determining sites. Measurements conducted by EIHP at a height of 25 m at several locations indicate an average wind velocity of 7 m/s. The most promising locations for wind energy conversion systems are the numerous inhabited islands along the Dalmatian coast, most of which have very good wind conditions. In addition to supplying local-grid electricity, it is primarily the potential for desalinating sea water in reverse-osmosis processes that holds the most promise, since the current cost of supplying drinking water is as much as € 5/m^2.

Promotion of wind energy conversion systems

After the electricity market was opened up and the wind energy promotion programme ENWIND initiated, however, several projects entered the planning stage. The goal of the ENWIND programme is to increase the installed capacity to 400 MW by 2030. Projects with capacities totalling 156 MW are presently in planning,

and a roughly 6MW wind farm on Pag Island is in its initial phase of construction.[231]

ENWIND promotes wind power installations with a maximum capacity of 5 MW per wind farm by offering a fixed supply remuneration of 5.7 € cents/kWh. Also, local authorities do not charge licensing fees for the construction of new wind power plants, as is the practice for thermal power stations.
The uncertainty surrounding remuneration rates for large-scale wind farms acts as an impediment to the operation of wind power plants. Individual negotiations with HEP are required for such projects.

Obtaining the requisite power-infeed licenses and permits is often a difficult, time-consuming process, because the competences are still unclear in many areas. Particularly on the islands, the land-tenure situation is frequently unclear and many of the electricity grids are inadequately developed.

Biomass

The recovery of energy from biomass, primarily in the form of wood and waste wood, plays a significant role, accounting for more than 5% of overall primary energy consumption. Most wood is used as fuel for heating purposes (particularly in rural areas). Very little biomass is used for generating electricity, but this field is targeted for development to a total output of 51 GWh by 2020.

Potentials

Due to differences between vegetation zones and in land usage, the potentially useful biomass volumes vary widely from region to region.[232] While the coastal regions (Dalmatia in particular) have only meagre biomass potentials due to sparse vegetation, the interior regions have ample biomass resources. The BIOEN programme was launched with the aim of expanding the use of biomass, including the utilisation of wastes. The defined objective is to meet 15% of total energy consumption with biomass by 2030. The main thrust will be to expand the thermal exploitation of solid waste (pelletisation).

Solar Energy

The meteorological conditions for solar energy exploitation are very good, particularly on the islands along the Adriatic coast. On average between 2,500 and 3,000 hours of sunshine can be expected, yielding irradiated energy on the horizontal plane of 1,450 to 1,600 kWh/m^{2}a.

Applications for solar energy

Solar energy is primarily used for generating heat in the coastal regions. Especially in tourism (hotels, restaurants, etc.) there is considerable demand for hot water. Another problem is that the islands are not connected to the gas grid, so fuel prices are accordingly high. Further rapid growth in tourism is anticipated for years to come. According to some estimates, this will result in a doubling of the demand for energy in that sector by the year 2020.

Although the use of solar energy on the islands makes economic sense in view of their lack of access to the supply network, it is neglected by the GEF project because most of the implementation schemes (energy supplies for individual buildings or hotels) are too small (below the minimum limit), and the projects are not being combined in an organised manner (for example in the tourism sector).

Geothermal Energy

On the south-western fringes of the Pannonic plain in northern Croatia, the ground temperature gradient of 0.049°C/m is well above the European average.[233] Here, low-temperature geothermal springs are traditionally used to feed thermal baths, but no other form of technical exploitation has taken place to date. Only two of ten geothermal reservoirs discovered in connection with oil exploration are actually in use.

The total installed thermal output at present adds up to approximately 114 MW, some 75% of which is used for heating swimming pools and thermal baths, while the remaining 25% is used for space heating purposes.

The GEOEN promotion programme aims to help greatly expand the use of geothermal energy for such purposes as heating residential buildings and, in the agricultural sector, greenhouses. As well as this, the construction of a geothermal power plant is planned for 2005.

The use of high-temperature reservoirs (above 120°C) offers an estimated installed power potential of some 48 MW.

231 Adria Wind Power, the planner and future operator, is a joint venture between German and Croatian enterprises.
232 A general overview of biomass utilisation potentials can be found at: www.eihp.hr/english/bioen/Program/1.htm.
233 A map of Croatia's geothermal resources is provided in Jelic, Kresimir, et al. at http://iga.igg.cnr.it/pdf/0824.PDF.

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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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