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 Georgia

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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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Georgia

Electricity Market

Installed capacities

Electricity generation in Georgia is based 80% on hydropower and the remaining 20% on gas-fired steam turbine power stations. Of the installed power station capacity of approximately 4,800 MW, only at most 2,400 MW was in operable condition in 2003. The output available at any specific time was generally lower, however, depending on precipitation and the availability of flowing water.

The hydroelectric power station capacity of 2,843 MW is shared between 23 large-scale plants and about 80 small generating plants of less than 10 MW each. The largest power plant is the Inguri power station with an installed capacity of 1,300 MW. In 2003, however, operable capacity was only 650 MW. The plant is to be disconnected from the grid completely for three months for repair works in spring 2004. Operable capacities of below 60% are assumed for the other hydroelectric power stations too.

The statistics list two gas-fired steam power stations, Gardabani (1,850 MW) and Tkvarcheli (220 MW), and a combined heat and power plant in Tbilisi (18 MW, of which 10 MW is in operation) with a totalled installed capacity of 2,088 MW. However, the Tkvarcheli power station is irreparably damaged and no longer contributes to electricity generation. Only one of the two largest 300 MW units of the formerly ten-unit Gardabani power station operates regularly. The other has been under repair since a serious incident in December 2001. Three other units are only brought onto load in emergency cases since the electricity generating costs are too high for regular operation.

The Ministry of Energy is pursuing plans for the construction of a new 250 MW coal-fired power station near Tkibuli. A foreign investor is being sought for the project. The coal is to come from the nearby mines whose reserves are quantified at 268 million tons.

Transmission grid

Georgia's electricity grid consists of a transmission grid (500 kV, 220 kV, 110 kV and 35 kV) about 6,200 km long, a distribution network (10 kV and 6 kV) that is 20,500 km long, and a low-voltage network (0.4 kV) with a length of about 53,000 km.

The 576km-long 500kV line forms the backbone of the transmission grid and links Georgia with Russia and Azerbaijan, as well as the generating regions in the west with the electricity consumption centres in the east. It crosses Abkhazia and was frequently the cause of nationwide power cuts, attributable partly to high snow loads in winter and partly to sabotage and insufficient maintenance.

Electricity generation and consumption

In 2002 total electricity consumption was 7,215 GWh, of which 750 GWh was imported from Russia.

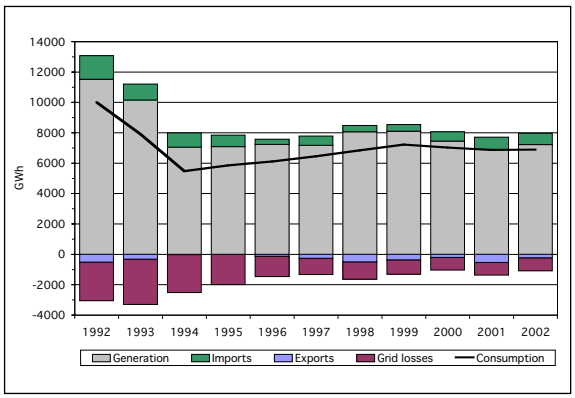

Figure 9: Development of electricity generation and consumption in Georgia; 1992–2002; GWh[220]

Especially in winter there are bottlenecks when supply from hydropower is low and household consumption peaks.

Electricity losses

High technical and non-technical losses cause major problems for Georgia's electricity supply system. Total losses including internal use by the power stations are estimated at 55–60% of gross electricity generation for the year 2003.

220 Source: GNERC 2003.

Technical transmission losses amount to 15%. The main load dispatching centre in Tbilisi is obsolete: for example it does not allow remote control of switching operations or automatic adaptation of electricity generation to load demand. Switching instructions are issued by telephone and are carried out manually.

As much as 40% of losses are accounted for by electricity distribution, including a substantial share of electricity consumption that is not recorded due to defective or lacking measuring equipment and theft.

The distribution companies only receive payment for about 30% of the electricity supplied to final customers, and in turn only pass on about 10% of revenues to the Georgian Wholesale Electricity Market (GWEM) for electricity supplies. 12% of all electricity is consumed in the provinces of Abkhazia and South Ossetia, but is not paid for. So far the Georgian Government has only covered about 10% of losses due to unsettled billings for these supplies.

According to a study by the U.S. firm PA Consulting, total electricity supplies delivered in 2001 were worth US$ 404 million. Of this amount only US$ 91 million was recovered from consumers settling bills, with most of this remaining with the electricity distributors.

As a consequence, most of the market participants are highly indebted, which is why there is no capital available for infrastructure investments in the fields of transmission and distribution. In the field of electricity generation this leads to the Georgian power station operators not paying their gas bills to Russian importers, for example, which, in turn, results in supply interruptions, and thus to shutdowns of the steam power plants. Furthermore, investment funds are lacking for maintenance and repair of the power stations.

Electricity tariffs

Electricity tariffs have risen rapidly since the electricity market was liberalised in 1997. Whereas households had to pay 1.54 €-cents for one kilowatt-hour of electricity in 1996, since January 2004 (tariff decision of 14 August 2003) the electricity price in the capital city has risen to as much as 5.44 €-cents/kWh in accordance with the progressively staggered tariff schedule.

Tbilisi		Other regions	
	€-cents/kWh		€-cents/kWh
up to 100 kWh	3.93	up to 75 kWh	2.61
101 - 200 kWh	4.43	76 –150 kWh	2.74
201 - 400 kWh	4.93	over 150 kWh	2.90
over 400 kWh	5.44		

Table 40: Net electricity tariffs for low-voltage consumers; Georgia; January 2004; €-cents/kWh[221]

Market Actors

Market structure

Up to 1995, electricity supply in Georgia was provided by the government-owned and vertically integrated utility company Sakenergo. Within the framework of the liberalisation and privatisation process, work started on unbundling Sakenergo in 1996. For this the government enterprise was divided into divisions for generation, transmission and distribution, and privatisation was started step by step in the fields of generation and distribution.

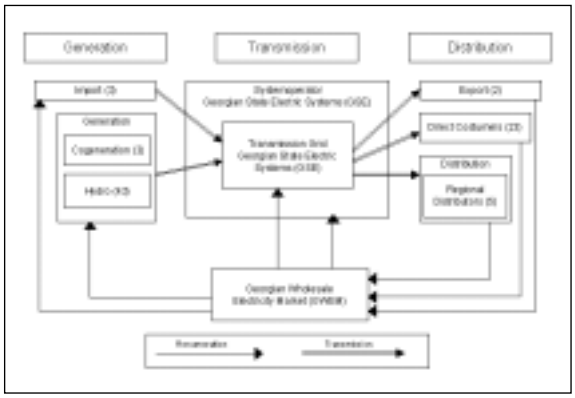

Figure 10: Structure of the electricity market; Georgia[222]

Wholesale market

The Georgian Wholesale Electricity Market (GWEM) was set up as a legal entity for electricity trading and commenced its work in July 1999. It constitutes a pooling of all licensed market participants and bulk customers. In 2000 about 60–65% of electricity consumption was traded via GWEM, while the remaining 35–40% was sold through bilateral contracts. In January 2002 a consortium consisting of the Spanish energy supplier Iberdrola, the Spanish electricity trading market OMEL, and the British consulting firm

221 Source: GNERC.

222 Figures in brackets show the number of licensed participants in the market.

IPA took over management of GWEM for a period of five years.

Electricity generation

In January 2001 there were 46 licensed electricity generators in Georgia. These have either been privatised already or are being managed by the government-run Sakenergogeneratsia until they are privatised. Since September 2003 the most important private electricity generator has been the Russian energy holding company Unified Energy System of Russia (RAO UESR). It owns two 300MW units of the Gardabani power station and holds leasing contracts for 25 years for the hydroelectric power stations Khrami I and II (223 MW), giving it total generating capacities of 823 MW.

The Tbilisi combined heat and power station has also been privatised and belongs to Sakgazi AG, which is owned by the Russian gas trader Itera. Among the small and medium-sized hydroelectric power plants, facilities with a capacity of 270 MW have already been privatised or leased under long-term contracts. In 2002 the Greek firm Terna entered into a three-and-a-half-year management contract for the Vartsikh hydroelectric power station. The plant is to be overhauled with the aid of a KfW loan and the capacity expanded to 184 MW.

Electricity transmission

The LLC Georgian State Electric System (GSE) is Georgia's state-owned transmission grid operator and comprises two business divisions, transmission and system operation. The Irish company ESB International took over management of GSE for five years in March 2003. The Georgian transmission grid itself is owned by three companies: GSE, JSC Sakrusenergo (50% RAO UESR) and Telasi (75% RAO UESR).

Electricity distribution

Electricity distribution for the 1.1 million electricity customers in Georgia is divided between five licensed distribution companies: the Georgian United Distribution Company (GUDC, 100% state-owned) with 630,000 customers, Telasi (Tbilisi Distribution Company; 75% RAO UESR) with 340,000 customers, Relasi (Rustavi Distribution Company; 75% Telasi), the Kakheti Distribution Company (owned 75% by the Georgian Takla GmbH) and the Ajara Distribution Company (100% state-owned) in the region of Adzhariya.

Telasi, as the electricity supplier to the capital city, is the most important distribution company in Georgia, meeting 44% of total national electricity demand in 2000 (a further 35% was distributed by the other companies and 21% was supplied directly to industrial firms). On 23 May 2003, PA Government Services Inc. entered into a management contract for GUDC with the task of preparing the distribution company for privatisation. The Ajara Distribution Company is still state-owned. In view of the special situation of Adzhariya, privatisation is not likely to be imminent.

Electricity imports and exports are controlled by GSE, JSC Sakrusenergo (50% RAO UESR) and Transenergy (50% RAO UESR).

Legal Framework

In Georgia the Ministry of Fuel and Energy is the authority responsible for the energy sector and for developing and implementing a national energy policy, as well as for ensuring secure supplies.

The Georgian National Energy Regulatory Commission (GNERC) is an independent, public-law body and is responsible for setting electricity and gas tariffs for generation and feeding power into the grid, as well as for consumer tariffs. In addition the GNERC issues licences for the generation, transmission, distribution, importing and exporting of electricity, and is the dispute-settling body for the various market participants. Finally, it is also responsible for supervising electricity trading (GWEM).

Electricity market law of 1996

Liberalisation and privatisation of Georgia's electricity market began in 1996 with Presidential Decree #437 of 4 July 1996 'On Restructuring of the Electricity Sector', which governs the unbundling of the state electricity supplier Sakenergo into the segments of generation, transmission and grid operation, and distribution.

Law on Electricity and Gas of 1997

The Georgian electricity sector is governed above all by the Georgian Law on Electricity and Gas of 1997 and amendments of 1999. This law defines liberalisation of the electricity and gas market and thus above all the tasks and objectives of GNERC and GWEM, and lays down the conditions for issuing licenses and pricing.

Clean Development Mechanism

Georgia ratified the UN climate change agreements in 1994, established a National Climate Protection Programme in 1996, and acceded to the Kyoto Protocol in 1999. Consequently the conditions for participating in measures within the framework of the Clean Development Mechanism are in place. Initial proposals for CDM projects in the wind sector are already on hand.

Policy for Promoting Electricity Generation from Renewable Energy Sources

Renewable energy sources are not considered explicitly in the existing law on electricity and gas. However, there are two presidential resolutions on renewable or 'non-traditional energy sources', dating from 1997 and 1998 in which the goal of promoting renewable energy is formulated in general terms. At present, though, there are no special regulations or tariffs relating to feeding electricity from renewable energy sources into the grid.

Tax legislation

In the field of tax legislation, imported equipment designed to exploit renewable energy sources is exempted from value-added tax. In addition, revenues from the production and installation of equipment designed to exploit renewable energy sources are also exempted from value-added tax. Furthermore land for systems exploiting renewable energy sources is exempted from land tax.

Internationally promoted projects

In 1997 a GEF-financed study project was implemented on how to achieve the CO_2-saving goals set on the basis of the UN climate change agreements. The greenhouse gas emissions from 1980 to 1997 were registered and pilot projects in the fields of wind power, geothermal energy, hydropower, biomass and solar energy were suggested.

A UNDP project on 'Promotion of the use of renewable energy sources for local energy production' funded by GEF and KfW is set to start. The objective is to dismantle administrative obstacles and promote free competition, as well as to set up a promotion fund for hydropower and geothermal energy.

Status of Renewable Energy Sources

Hydropower

The hypothetical hydropower potential is estimated at 194 TWh a year (about 40% of this from power plants rated at less than 30 MW) and the annual economic potential at 32 TWh. This corresponds to more than four times Georgia's current total electricity consumption. So far there are some 100 hydroelectric power stations with a total installed nominal output of 2,843 MW. Due to the poor condition of the plants only about 5.6 TWh was generated in 2001 instead of the expected 10 TWh. The six largest hydroelectric power stations are undergoing repairs.

Small hydropower plants

The installed capacity of the 80 or so smaller hydroelectric power plants (output below 10 MW) totals 110 MW. In addition about 80 possible new locations for such plants have been defined, with a total capacity of some 350 MW. As in the case of large-scale hydroelectric power stations, many projects and plans have been drawn up for expanding and building smaller hydroelectric power plants, but these have not yet become reality due to a lack of funds.

Promotion fund for small hydropower

The project on 'Promotion of the use of renewable energy sources for local energy production' supported by the UNDP and funded by GEF and KfW is to contain a promotion fund for refinancing loans for rehabilitating small hydropower plants as of 2004, which is intended to benefit private power station operators, helping them to repair and expand non-operative small hydroelectric power plants rated at below 10 MW.

Wind Power

In the Russian study 'Masterplan of Wind Power Development of the USSR till 2010' of 1989 the technical potential of wind power in Georgia is estimated at 83 TWh a year. With mean annual full-load hours totalling 2,500 h, this would result in a technical potential of 33,200 MW.

Extensive wind measurements

Extensive wind speed measurements at a height of 30 m were conducted for this study and a rough map of windy areas in Georgia was drawn up. According to this the most promising areas lie in the South Caucasus north of Mleta, the Kura River Valley near Tbilisi and Khashuri, the south Georgian Uplands around Lake Paravani (in the area bordering on Turkey and Armenia), and the southern coast of the Black Sea. The categorisation of wind speeds can be described as very rough. At locations mapped with over 6 m/s at a height of 30 m, wind speeds of 8 to 10 m/s were measured at a height of 10 m in some cases.

The Karenergo Wind Energy Scientific Center is currently engaged in producing a wind atlas with the help of international participation. For this purpose wind measurements at 10 to 12 locations are being correlated with the data from about 40 meteorological stations and then evaluated. The measurements for the wind atlas are due to be completed in spring 2004.

Plans for two wind farm projects

Two wind projects with CDM financing were proposed for Georgia within the framework of the Eastern Climate Change Network (ECCN) project (1998 to 2002) that was implemented with support from the EU Commission's Synergy Programme. Under these projects a 40MW wind farm could be constructed in the Batumi region and a 20MW wind farm in the Potii region. Both locations are on the southern coast of the Black Sea. The project partner in both cases is the Karenergo Wind Energy Scientific Center.

Biomass

No comprehensive studies estimating Georgia's biomass potential have been presented so far. In 2000 the Georgian non-governmental organisation Bioenergy devised a national programme for developing biomass use in rural areas and quantified the biomass potential at over 600 MW_{th}.

41% of Georgia's territory is wooded. Firewood is very widely used, especially in rural regions. As a result of the collapse of the gas and district heating networks in the cities, the demand for firewood has soared there too. The Georgian State Office for Statistics quotes the demand for firewood in 2001 as 8.6 million m^3.

Project proposal for biogas plants

A biogas project was proposed for Georgia within the framework of the Eastern Climate Change Network (ECCN). The proposal includes the condition that a promotion fund for small loans € 1,000 to € 1,200) be set up for constructing 100 biogas plants in 46 villages in the district of Akhaltsikhe. The project is to be implemented by the Energy Efficiency Center Georgia in cooperation with Bioenergy.

Solar Energy

Georgia has considerable potential for exploiting solar energy. Direct and global radiation reaches daily values of 4.5 to 7 kWh/m^2 at the most promising locations, corresponding to annual values of 830 kWh/m^2 to 1,670 kWh/m^2.

Zone	Global radiation	Direct radiation		Number of clear days per year
	kWh/m^2	May–Nov. kWh/m^2	kWh/m^2/a	
A	1,400–1,670	530–560	830	65–85
B	1,360–1,450	500–530	780–800	55–65
C	1,330–1,400	470–500	750–780	50–55
D	1,250–1,330	440–470	720–750	40–50
E	1,250–1,400	390–440	690	30–40

Table 41: Global and direct radiation in various zones; Georgia; kWh/m^2;[223]

The solar energy sector was already researched in Georgia during Soviet Union times and there are comprehensive scientific studies on photovoltaics available, especially in the field of gallium-arsenide solar photovoltaic cells.

223 Source: Kekelidze 1999, where a cartographic presentation is also available.

Solar-thermal energy

Experience in the practical use of solar energy is available in Georgia in the solar-thermal sector in particular. The total capacity of the installed facilities for hot-water preparation amounts to about 4–5 MW.

PV isolated systems for remote consumers

In the photovoltaic sector installations have so far been restricted to small systems serving to supply small-scale off-grid consumers. In November 2003, in the mountain region of Dusheti the seven-family village of Ukanapshavi (which has no access to the grid) was completely equipped with PV systems for lighting and operating a radio and television set. The project was organised by the non-governmental organisation Sun & Earth.

Geothermal Energy

Georgia's geothermal energy resources have been well researched and already developed to a considerable extent for thermal use. There are some 250 natural and man-made hot-water springs in Georgia.[224] The geothermal water has a very low salt content (1–3 g/l), which is why there are hardly any deposits in pipes and pumps. So far thermal water has only been pumped out; there are no injection boreholes for feeding it back.

Geothermal energy for heat production

The data on the capacities used in 1998 varies between 250 and 400 MW_{th}. The main fields of application are greenhouse and swimming pool heating, fish and livestock breeding, drying of agricultural produce, and to a lesser extent industrial process heat and domestic heating. The geothermal water temperatures lie between 30 and 108°C.

Activities in the field of geothermal energy have declined steeply since 1990 due to shortage of capital. Between 1995 and 1999 only one single borehole was drilled for development.

Geothermal water sources have been used to provide hot water in Tbilisi since 1975. So far water has not been fed back, which leads to a reduction of the flow rate. As a pilot project within the scope of the UNDP project on 'Promoting the use of renewable energy sources for local energy production', plans have been developed to expand the central hot-water supply to 20,000 residents in the urban district of Saburtalo in Tbilisi and to drill an injection borehole to feed the water back. In the preliminary study the total annual potential of locally available geothermal resources in Tbilisi is estimated at 1.4 TWh_{th}, corresponding to 40% of the capital city's heating energy demand.

Plans for geothermal electricity production

At temperatures above 90°C it is possible to install an additional electricity generating facility upstream of the thermal use. For example the spring at Kindghi-Okhurei with a water temperature of 105°C and a flow rate of 350 kg/s could be used to achieve an output of 4 MW_{el}. All in all, sites of a similar structure with a total output of 10 to 15 MW_{el} have been explored. It is planned to build a geothermal power station with a rating of 500 kW_{el} by 2005.

One of the purposes of the promotion fund for hydro power and geothermal energy resources proposed within the framework of the said UNDP-GEF-KfW project is to pave the way for the use of geothermal energy for providing hot water and space heating for private or local government undertakings.

Rural Electrification

Some of the many mountainous regions in Georgia have insufficient access to electricity. Furthermore there are problems regarding secure electricity supply in many parts of the country.

224 A map of the main geothermal resources in Georgia can be found in: EBRD 2002.

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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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