



# Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

## 23 Country Analyses Chapter Morocco

Eschborn, September 2007

**gtz**

commissioned by:



Federal Ministry  
for Economic Cooperation  
and Development



**Energy-policy Framework Conditions for  
Electricity Markets and Renewable Energies**

**23 Country Analyses  
Chapter Morocco**

**Eschborn, September 2007**

**Published by:**

Deutsche Gesellschaft für  
Technische Zusammenarbeit (GTZ) GmbH  
Division Environment and Infrastructure  
PO Box 5180  
65726 Eschborn  
Germany  
Internet: <http://www.gtz.de>

**Edited by:**

Angelika Wasielke  
Tel. +49 (0)6196 79-1224  
Fax +49 (0)6196 7980-1224  
E-mail: [angelika.wasielke@gtz.de](mailto:angelika.wasielke@gtz.de)

**Authors:**

Projekt-Consult GmbH  
Dipl.-Ing. Detlef Loy

**Design:**

Open Ffm.  
[www.open-agentur.de](http://www.open-agentur.de)  
Verena Siebert

## New Edition of the TERNA Country Survey

Since the first edition of the TERNA country survey appeared in 1999, there has been a distinct heightening of public and political awareness of the consequences of climate change and of energy provision as a key factor in sustainable development. In Germany and other industrialised countries, a political tailwind, effective promotion mechanisms and rising energy prices have created the conditions for a dynamic market in which renewable forms of energy are exhibiting high growth rates within the energy mix. In 2006, global new investment in renewables amounted to US\$ 70.9 billion – an increase of 43 % over 2005.

Strong economic development in many emerging countries has triggered rapidly rising demand for energy and competition on the international oil market. Against the background of the rising cost of fossil fuels, supply risks and damage to the environment, the significance of renewable energy as a means of generating electricity is growing – also in developing and emerging countries: according to analyses conducted by the Renewable Energy Policy Network for the 21<sup>st</sup> Century (REN21), 39 countries have set expansion targets for renewable energy sources and introduced promotion mechanisms, nine of which are developing or emerging countries. Of total new investment in renewable energy around the world, US\$ 15 billion was invested in developing and emerging countries. Nevertheless, the majority of countries still have a long road ahead of them before they overcome existing barriers to the successful introduction of renewable forms of energy.

The German and European market acts as the driving force for the wind energy industry and provides an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries. It is the successes in countries such as India, China and Brazil which encourage commitment beyond the borders of industrialised nations. In those three countries there is a growing proportion of local content in the systems and equipment they produce – and not only for supply to their own domestic markets.

A number of other countries though, too, are erecting their first wind farms, thereby establishing the basis for gaining experience to be utilised in future markets.

To help interested players gain access to the new markets, this survey provides detailed descriptions of the framework conditions for electricity markets and renewable energy in 23 developing and emerging countries.

Latin America	Africa/Middle East	Asia
Argentina	Egypt	Bangladesh
Brazil	Ethiopia	China
Caribbean States	Jordan	India
Chile	Morocco	Indonesia
Colombia	Namibia	Pakistan
Costa Rica	South Africa	Philippines
Dominican Republic	Tunisia	Viet Nam
Mexico		
Nicaragua		

This latest country survey and the previous editions are available on our homepage: [www.gtz.de/wind](http://www.gtz.de/wind). For the first time, the publication is also available on CD-ROM. For information on how to obtain this, again, go to the homepage.

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

Eschborn, September 2007

## 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

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) wind energy programme, implemented by GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and emerging countries in planning and developing wind power projects. Since 1988 the TERNA programme has pursued the twin goals of laying the foundations for sound investment decisions while at the same time enabling partners to assess wind energy potentials, plan wind energy projects and improve energy-policy frameworks for renewable forms of energy.

The TERNA wind energy programme's partners are institutions in developing and emerging 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 expertise 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.

Up until 2007, TERNA has been active in over ten countries around the world.

Further information on GTZ's TERNA wind energy programme, the application procedure etc. is available at [www.gtz.de/wind](http://www.gtz.de/wind) or directly from:

Deutsche Gesellschaft für Technische  
Zusammenarbeit (GTZ) GmbH  
Postfach 5180  
65726 Eschborn  
Germany

Dr. Rolf Posorski  
Tel. +49 (0)6196 79-4205  
Fax +49 (0)6196 7980-4205  
E-Mail: [rolf.posorski@gtz.de](mailto:rolf.posorski@gtz.de)

Angelika Wasielke  
Tel. +49 (0)6196 79-1224  
Fax +49 (0)6196 7980-1224  
E-Mail: [angelika.wasielke@gtz.de](mailto:angelika.wasielke@gtz.de)

Tim-Patrick Meyer  
Tel. +49 (0)6196 79-1374  
Fax +49 (0)6196 7980-1374  
E-Mail: [tim-patrick.meyer@gtz.de](mailto:tim-patrick.meyer@gtz.de)

## 13 Morocco

### 13.1 Electricity Market

#### Installed capacity

At the end of 2005 the power generating capacity installed in Morocco was capable of producing a total output of 5,252 MW. Of this, thermal power stations accounted for 3,469 MW (66%). The installed capacity available from hydropower is 1,729 MW (33%). Wind generation plants provide the remaining 54 MW (1%).

The Jorf Lasfar Power Station is particularly significant for the country's power supply. This is a coal-fired plant owned by a Swiss-American consortium. With a power rating of 1,356 MW, it is the largest privately owned and operated power plant in Africa. 9,936 GWh of electricity was produced there in 2004, which was 60% of all the electricity generated in Morocco, while its share of total installed capacity was about 29%. Most of the coal used in Jorf Lasfar is imported from South Africa. Morocco itself has barely any coal reserves worthy of note. Yields from the country's only coal mine in Jerada are declining.

The installed capacity connected to the grid belonging to the national power utility, Office National de l'Électricité (ONE), has changed as follows in recent years:

	2000	2001	2002	2003	2004	2005
	MW					
Thermal	3,168	3,168	3,168	3,189	3,096	3,469
Hydropower	1,167	1,167	1,167	1,167	1,498	1,729
Wind	54	54	54	54	54	54
<b>Total</b>	<b>4,389</b>	<b>4,389</b>	<b>4,389</b>	<b>4,410</b>	<b>4,648</b>	<b>5,252</b>

Tab. 1: Installed capacity by energy source; ONE and independent power producers; Morocco; 2000-2005; MW<sup>1</sup>

In addition to the capacity installed on its own territory, Morocco can also call upon a further 700 MW via a subsea cable to Spain if the need arises.

#### Power generation

In 2004 the amount of electricity produced by the public utility ONE and two independent power producers totalled 16,383 GWh. Thermal power generation is based largely (86%) on the burning of imported coal, with the rest (14%) coming from oil (imported from Saudi Arabia, Iran, Iraq and Nigeria). Hydropower accounted for 10% of electricity supplies, and wind power 1%. In addition to the electricity produced within the country, a further 1,555 GWh was imported from Spain.

	2000	2001	2002	2003	2004
	GWh				
Thermal	10,771	12,091	13,068	13,657	14,584
Hydropower	705	856	842	1,441	1,600
Wind	65	207	194	187	199
Imported	2,363	1,564	1,392	1,455	1,555
<b>Total</b>	<b>13,904</b>	<b>14,718</b>	<b>15,496</b>	<b>16,752</b>	<b>17,938</b>

Tab. 2: Gross electricity generation by energy source; Morocco; 2002-2004; GWh<sup>2</sup>

#### Power transmission and distribution

In 2004 the transmission grid belonging to the state power utility ONE consisted of 17,532 km of high voltage power lines. It covers the entire country, and is connected to the Algerian<sup>3</sup> and Spanish power grids via regional links. The capacity of the subsea cable between Morocco and Spain has been 700 MW up to now. A €117 million project to double this capacity to 1,400 MW is nearing completion. This will then contribute to a growing link-up between the European and North African electricity markets beyond just these two countries, Morocco and Spain.

1 Source: ONE.

2 Source: ONE.

3 Two 400 kV power lines; a third is at the planning stage.

The distribution network was made up of 40,560 km of medium voltage lines and 112,017 km of low voltage lines. Depending on the region, the supply of electricity to ultimate consumers is the responsibility of either ONE itself, or one of seven local municipal authorities or one of four private companies (as in the cities of Casablanca, Agadir, Tangier and Rabat). In 2004 the electricity sold through these eleven distribution enterprises to end customers accounted for 49% of the total.

Since 2004 a three-year action plan has been running which is meant to improve the quality of the Moroccan electricity grid. In the first year of the programme alone it proved possible to reduce the down time per customer by 22%. Transmission losses were 5.5% in 2004. Together with distribution losses, the total losses for the national power utility ONE were almost 11%.

### Electricity consumption

The amount of electricity sold by the Moroccan state-owned power utility ONE reached 17,627 GWh in 2005, compared with 16,288 GWh in 2004. Against the background of economic growth and rising living standards in Morocco, demand for electricity rose at an average annual rate of 6.5% from 1995 to 2005. For the period through to 2015 the Government of Morocco is expecting the annual growth rate to be as much as 7.5%. According to estimates by ONE, national demand for electricity in 2015 will be 35-40 TWh.

	2001	2002	2003	2004	2005
	GWh				
Direct sale to households	no data	1,630	1,846	2,041	2,316
Services	410	436	821	881	no data
Industry	3,062	3,213	3,578	3,894	
Agriculture	695	676	817	943	
Administration	167	166	504	546	
Sale through local power providers	6,908	7,228	7,646	7,984	8,474
Total	13,452	14,085	15,214	16,288	17,627

**Tab. 3: Electricity sales from production by ONE and imports, according to end user; Morocco; 2001-2005; GWh<sup>4</sup>**

### Electricity prices

The price of electricity for ultimate consumers, apart from customers obtaining their electricity from private power supply companies, is fixed by decree from the Prime Minister of Morocco. Different tariffs apply in the low voltage sector depending on the type of use<sup>5</sup> and the amount purchased. In 2004 the kilowatt-hour rates for private households started at 0.08 euro/kWh (DH 0.84/kWh) for the first 100 kWh and then rose progressively with increasing electricity use to 0.12 euro/kWh (DH 1.35/kWh) for consumption above 500 kWh. The prices for rural regions are graduated according to maximum connected load, and are somewhat higher. The electricity tariffs for private consumers have remained constant in nominal terms since 1996.

The prices for medium voltage power depend on the time of day at which the electricity is required. For medium voltage customers the kilowatt-hour (unit rate, net) costs between 0.04 euro (DH 0.42) at times of low electricity demand (after 11 p.m.) and 0.08 euro (DH 0.92) at peak load times. There is a separate preferential tariff for farmers, which also varies according to the time of year.

<sup>4</sup> Source: ONE.

<sup>5</sup> Households, commerce, administration, street lighting, motor drives.

In the high voltage sector three tariff options allow customers to choose the lowest-priced combination of demand charge and unit rate. The demand charges per kW range between 18.36 euro (DH 204) and 102.69 euro (DH 1,141) depending on the period of consumption. The unit rates for high voltage customers are also dependent on the time of consumption, with the net price per kWh ranging between 0.03 euro (DH 0.35) and 0.11 euro (DH 1.19) at peak load times.

Between 1997 and 2004, net electricity prices fell by 44% in the medium voltage sector and by 36% for high voltage customers. The Government of Morocco made these price reductions possible by introducing a reform of the tax system, which came into force on 1 January 2004. The lower electricity tariffs reduced the burden on the Moroccan economy by € 80 million (DH 890 million) in 2004 alone.

The degree to which the long-term macroeconomic marginal costs of power supply are covered has shown a declining tendency in recent years, and is currently estimated to be approximately 80%. By regional standards the electricity tariffs are high.

## 13.2 Market Actors

### Office National de l'Electricité (ONE)

Office National de l'Electricité (ONE) is a state-owned power utility and is the dominant enterprise in the Moroccan electricity sector. It operates in the fields of power generation, transmission and distribution and has 9,000 employees. In 2005 ONE achieved sales of € 1.08 billion (DH 12 billion). The number of customers was around 3,000,000, growing at an average annual rate of 10%.

On the list of Moroccan companies with the highest turnover in 2006, ONE occupies fourth place. Other companies from the energy sector occupy places 13 (Lydec), 30 (Redal) and 40 (Amendis) in this ranking. All three are local utility companies, which in addition to supplying drinking water also sell electricity from ONE's grid to their end customers in the cities of Casablanca, Rabat, Tangier and Tétouan.

ONE supplies roughly 50% of the electricity consumed in Morocco directly to final users. The other half is sold by public and private local power providers, although they for their part obtain their electricity from ONE. Distribution is organised in such a way that ONE is more likely to supply electricity directly to customers in rural regions while the municipal and private distributors primarily operate in the cities. Although the liberalisation of the electricity market offers opportunities both on the supply side and in sales, opening the way for independent power producers and the supply of electricity to end users by independent power providers, as yet it is always necessary to deal with ONE in its role as a single buyer and operator of the transmission network.

In respect of renewable energy sources, ONE is mainly active in the areas of hydropower (it owns all 26 hydroelectric power plants) and wind energy. The construction of new hydropower plants and two new wind farms is at the planning stage.

Apart from ONE, there are two private companies in Morocco that operate as independent power producers, each having their own power plant or wind farm. These are described below.

#### **Jorf Lasfar Electricity Company (JLEC)**

A consortium made up of the Swiss group ABB and CMS Energy Corporation from the USA operates the 1.3 GW coal-fired power station in Jorf Lasfar, an industrial port on Morocco's Atlantic coast, 15 km south of Jadida. About 60% of the electricity produced in Morocco originates from this consortium's plant.

#### **Compagnie Eolienne de Détroit (CED)**

Compagnie Eolienne de Détroit (CED) owns and operates the Al Koudia wind farm in Tetouan, which has a rated output of 50 MW. CED is owned by Electricité de France (EDF, 49%), Paribas Merchant Bank (35.5%) and Germa Consulting (the initiator of the project; 15.5%).

#### **Other Actors**

##### **Actors in the renewable energy sector**

#### **La Compagnie Du Vent**

This French wind power service provider was responsible for building the first and so far only sizeable grid-connected wind farm in Morocco (Al Koudia near Tetouan, 50 MW).<sup>6</sup> A second major wind power project, rated at 10.2 MW, for the cement works belonging to Lafarge Ciments in Laayoune is also being implemented by Compagnie Du Vent. The company has been in existence since 1991 and now has 55 employees. Apart from Morocco, most of its wind power projects have been located in France. The services offered include wind measurements and location studies, planning and developing wind farms and also operating and maintaining wind farms.

#### **L'Association Marocaine des Industries Solaires et Eoliennes (AMISOLE)**

The association of solar and wind power enterprises is an umbrella organisation representing the interests of companies and individuals with a professional involvement in the field of renewable energy. Founded in 1987, the association now represents about 40 companies with several hundred employees. AMISOLE is open to all interested parties whose activities are primarily focused on the use of renewable energy sources in Morocco.

#### **Individual companies**

The market survey by the industry association AMISOLE<sup>7</sup> lists 26 Moroccan companies that are active in the field of photovoltaics. There are 14 companies in the solar thermal sector. The list also includes two wind power companies and a planning office. According to information from AMISOLE, about twenty companies assemble simple PV systems from imported components. There are also several companies that import complete solar systems and sell them on the Moroccan market.

One established local company in the solar business is Afrisol SA (a member of the BP Solar group). Established in 1987, Afrisol sells solar energy systems under the Solarex brand (USA). Since 1998 Afrisol has been operating in the Maghreb/West Africa region and other African countries as Solarex's master distributor. Since 2003 Afrisol has supplied Sun Box solar home systems to future solar power customers of ONE within the framework of the rural electrification programme (PERG). Other major solar enterprises in Morocco include SunLight Power Maroc (SPM), Noor Web and Total Energie Maroc.

<sup>6</sup> On completion the wind farm was transferred to Compagnie Eolienne de Détroit (CED) for operation.

<sup>7</sup> Guide du marché, December 2006, <http://www.amisole.com/>.

### **Centre d'Information sur l'Energie Durable et l'Environnement (CIEDE)**

CIEDE is a project run by the Environment Ministry. Its work complements the activities of the administration in the fields of energy and climate change. Its primary tasks are to acquire, collect and disseminate information about the sustainable use of energy and about the impacts of energy generation on the environment. The Centre provides information about developments relating to climate change mitigation and sustainable development. It is also meant to advise on new opportunities for cooperation and funding available to actors in the fields of environment, energy and development and promote technology transfer.

### **Centre de Développement des Energies Renouvelables (CDER)**

Established in 1982, the Centre for the Development of Renewable Energy Sources (Centre de Développement des Energies Renouvelables, CDER) is directly subordinate to the Ministry of Energy and Mining. CDER's activities include conducting studies, disseminating knowledge, performing quality-control checks on equipment (PV systems in particular), and training specialists in the renewable energy sector.

### **Maisons de l'Energie et de l'Environnement**

The Government of Morocco is promoting the establishment of what it calls Maisons de l'Energie et de l'Environnement, in cooperation with ONE. These 'maisons' (French for 'house') are small rural enterprises that help local residents plan their own energy supplies. CDER and the United Nations Development Programme (UNDP) provide technical and financial assistance in the setting up of these advisory centres. So far almost 100 such enterprises have been established.

## **13.3 Legal Framework**

### **Opening of the electricity market**

ONE is a public law company answering to the Ministry of Energy and Mining and has been responsible for the generation and transmission of electricity in Morocco since 1963. It operates as a single buyer. Since 1994, however, power plants with ratings above 10 MW can also be built and operated by private enterprises, on condition that the project was subject to open tendering and all power produced is sold to ONE. This opening of the electricity market is governed by law no. 2-94-503 dated 23 September 1994.

### **Planned liberalisation**

Morocco intends to offer electricity to consumers in the country at internationally competitive prices as soon as possible. The prices charged by European power providers, and in particular those on the Spanish market, are taken as the benchmark. In a policy decision in 2001, the management of ONE determined that this objective was to be achieved by further opening of the Moroccan electricity market in several stages.

It is aimed to divide the Moroccan electricity market into two parts, an open market segment and a regulated one. On the open market independent power producers will be able to produce electricity and sell it directly to 'eligible end customers'. Initially, customers shall be considered eligible if electricity is of particular economic importance to them and they can benefit from more flexible, competition-oriented electricity prices. The terms can then be negotiated directly between the producer and the customer. Such 'eligible end customers' would therefore be free to choose their electricity suppliers on the open market. It is planned to set up an energy exchange for this open market, where electricity is to be traded according to the laws of supply and demand.

Eligible companies are also supposed to be able to obtain their electricity from intermediaries acting solely as wholesalers or from international suppliers from other countries, provided this is possible within the framework of the coupling to neighbouring grids. The quota of 'eligible end customers' with access to the open market segment is to be raised in stages.

Those not belonging to the category of eligible customers shall continue to purchase their electricity from the regulated market at officially determined prices. Over the long term this is meant to secure the supply of power to private households with a low voltage connection at prices set by the state. Ensuring that if possible everyone in Morocco has access to affordable electricity is a common social concern for which the Moroccan state intends to continue to bear responsibility.

The liberalisation of the Moroccan electricity market does not constitute a radical upheaval of existing structures but rather a movement towards long-term strategic objectives,<sup>8</sup> and in the opinion of those responsible it contributes to achieving these more quickly.

In April 2006 the Government of Morocco applied for a loan<sup>9</sup> of US\$ 100 million from the World Bank/International Bank for Reconstruction and Development (IBRD) to assist it with the reform of the entire energy sector, including liberalisation of the electricity sector.

## 13.4 Policy Promoting Renewable Energy Sources

### Action plan for renewable energies

The Ministry of Energy and Mines (Ministère de l'Énergie et des Mines) has aggregated its efforts in the field of renewable energies in an action plan for the period up to 2015. The four primary goals of the plan are: security of supply, improved access to energy by the population, greater competitiveness within the production sector, and protection of the environment.

One aim of the action plan is that by 2015 wind farms with a total capacity of 600 MW are supposed to be on stream. 400,000 m<sup>2</sup> of solar collectors are to be installed for producing hot water, and 150,000 households in rural areas are to be provided with decentralised energy from renewable sources. All in all the action plan is meant to save the energy equivalent of about 500,000 t of oil (5.8 TWh).

The rural electrification programme is just as much part of the action plan as the efforts to use more energy-efficient technology in households, public buildings and industry. A further component is the creation of establishments dubbed 'energy houses', local advice centres which provide citizens with information and offers relating to energy saving.

### Wheeling of electricity from renewable energy sources

Since September 2006, companies which generate their own electricity from renewable energy sources can transmit the electricity via ONE's national high voltage grid from the location of the power plant to their production facilities. Up to 2011 the grid operator will impose a wheeling charge of 0.5 euro cents/kWh (6 cDH/kWh). After 2011 the charge will rise to 0.7 euro cents/kWh (8 cDH/kWh). Surplus electricity which the self-generators do not need can be sold to the public grid; the price paid is 20 % higher than the usual purchase prices.

<sup>8</sup> Reduction of electricity costs for end customers, electrification of the entire country by 2008, opening of the market for international investors, diversification of energy sources.

<sup>9</sup> Project ID P099618.

The first Moroccan company to enter into an agreement with ONE on the basis of this provision was the Ciments du Maroc group in November 2006. Ciments du Maroc will generate power from its own planned wind farm (10 MW) in Tetouan for use in the neighbouring cement works; in future it intends to transmit any electricity not consumed there to its other production sites elsewhere in the country, via the ONE grid.

### Other fiscal incentives

Foreign investment in the environment sector in Morocco is basically not subject to any restrictions. Morocco has substantially reduced (from 10% to 2.5%) its import duties on certain components for use in harnessing renewable energy sources. However, this only applies if the imported goods are not also manufactured in Morocco itself.

### International promotion measures

Morocco is a priority partner country of German Development Cooperation. Since 1961 a total of €1.2 billion of German promotion funds has flowed to Morocco. In the 1970s and 1980s, financial cooperation by Kreditanstalt für Wiederaufbau (KfW) in the energy sector was initially focused on developing hydropower potential. Today, promotion is additionally directed towards the wind power and photovoltaic sectors. KfW's Tangier wind farm project was the first donor-financed wind energy scheme in Morocco. It paved the way for further wind power projects. Preparatory wind measurements for it were carried out in 1992-1994 in northern Morocco as part of GTZ's Special Energy Programme. KfW also promoted PV projects to bring about rural electrification, in which private companies were involved at an early stage in order to maintain the systems.

During a visit to Morocco by the German Minister for Development, an agreement was reached in Rabat in September 2006 to promote a 33 MW hydropower plant in Tilougguit (High Atlas) through the provision of €35 million.

Other international assistance organisations are also active in Morocco. The World Bank, for example, is promoting modernisation of the energy sector with a loan of US\$ 100 million. Since January 2007 the Deutsche Gesellschaft für technische Zusammenarbeit (GTZ) has been advising CDER and the Ministry of Energy in Morocco on developing a law on renewable energy. The consultancy work by GTZ should also be seen as the result of donor coordination and as part of the Development Policy loan from the World Bank. The consultancy work starts out from the draft of a law that was presented by the World Bank in October 2006, dealing in particular with the wind sector; the other fields such as solar thermal energy, biogas etc. will be covered by the GTZ consultancy services. The results of the study were due to be available in May 2007. From 2008 onwards GTZ is also scheduled to advise the new organisation that is to be set up to promote the use of renewable energy in Morocco and will provide backup as it becomes established; it will do this in the course of a three-year capacity-development project. The World Bank together with the African Development Bank are also involved in the financing of a solar thermal combined-cycle power plant.

### Clean Development Mechanism

After Morocco ratified the Kyoto Protocol in 2002, the country quickly succeeded in creating smoothly functioning administrative frameworks for implementing CDM projects. A national CDM strategy was developed in the course of an internationally promoted project<sup>10</sup> that was completed in 2005. The Moroccan Designated National Authority (DNA) was established as soon as September 2002, and is accommodated within the Ministry for Territorial Planning, Water and Environment (Ministère de l'Aménagement du Territoire, de l'Eau et de l'Environnement – MATEE). According to the DNA there are also a further eleven consulting companies or independent consultants specialising in providing support to CDM projects and preparing the documentation. In April 2006 the Moroccan DNA had 40 projects in its portfolio, which taken together would enable total savings of five million tonnes of CO<sub>2</sub> to be made each year.

10 UNDP Project ID number: MOR/02/M08.

This, though, by no means exhausts the country's CDM potential. On the supply side Morocco still has considerable reserves of unutilised renewable energy sources.<sup>11</sup>

By December 2006, three Moroccan CDM projects had been registered with the CDM Executive Board (EB): two wind farms and a rural electrification project.

Two other renewables energy projects have so far been approved by the responsible Moroccan authority (DNA) on the basis of the Project Design Document (PDD). By the end of 2006, however, they had not been submitted to the UNFCCC for registration. The projects concerned are a wind power station (10 MW) in Tan Tan for powering a seawater desalination plant belonging to the Office National d'Eau Potable (ONEP) and a land-fill gas plant for the city of Rabat.

Registered	Project	Commissioned	Construction costs	DOE <sup>12</sup>	Annual saving
23.09.2005	10.2-MW wind farm in Tétouan for supplying energy to a cement works belonging to the French company Lafarge	2005	approx. US\$ 10 million	DNV	28,600 t CO <sub>2</sub> e
29.10.2005	60-MW wind power plant in Essaouira belonging to the state utility company ONE	2008 (planned)	approx. US\$ 90 million	DNV	150,000 t CO <sub>2</sub> e
28.04.2006	Rural electrification programme run by ONE with off-grid photovoltaic systems (approx. 105,000 solar home systems)	2004 (first of four parts)	approx. € 208 million	TÜV Süd	39,000 t CO <sub>2</sub> e

Tab. 4: Registered Moroccan CDM projects; 2004-2006<sup>13</sup>

The website of the Moroccan DNA<sup>14</sup> lists a further 16 projects which have successfully presented a Project Idea Note (PIN) and are being further expedited by the investors. These include several wind farms, two hydro-electric power plants, a biodiesel project, several biogas facilities in the waste management sector and a project to improve efficiency in public lighting.

11 Cf. section headed: Status of Renewable Energy Sources

12 The Designated Operational Entity (DOE) is the independent test and certification organisation responsible for the project.

13 Source: UNFCCC, as at: 12/2006.

14 See: [www.mdpmaroc.com](http://www.mdpmaroc.com), as at: 12/2006.

### 13.5 Status of Renewable Energy Sources

The greatest potential for harnessing renewable energy sources in Morocco is to be found in wind power, hydropower and solar energy. Whereas hydropower already accounts for a share of 10% of national power generation and the first wind farms have been built, the use of solar energy is still in its infancy.

#### Hydropower

Morocco's technically exploitable hydroelectric power potential is estimated at 2,500 MW, giving annual electricity production of 4,600 GWh; only some 40% of this has been developed to date. The degree of exploitation is supposed to be increased to 68% by 2015. Due to severe fluctuations in precipitation rates, hydropower's overall contribution to annual national power production varies between 5% and 10%.

At the end of 2005 the state-owned power utility ONE operated a total of 26 hydroelectric plants, which together have an installed capacity of 1,265 MW. As well as those there is the pumped-storage power plant at Afourer, which can supply an additional 470 MW to the grid at peak load times. With the aid of a low-interest KfW loan of €27 million, the obsolete control technology for at least ten elderly hydropower plants is set to be renewed. This is meant to allow centralised remote control of the plants.

ONE is constantly expanding the number of power plants at hydroelectric schemes. Two new power plants are planned to be commissioned in the Khénifra region in 2007. The plant in Tanafnit on the Oum-Er-Rbia river will be equipped with a generator capacity of 2 x 9 MW. The El Borj power plant lies directly below this on the same river and will have an installed capacity of 2 x 13 MW. The power generation complex as a whole, with its total capacity of 44 MW, is supposed to produce 212 GWh of electricity per year. The cost, €8.5 million (DH 95 million), is being financed jointly by ONE and the German organisation KfW.

Another scheme at the planning stage is a run-of-river plant in Tilougguit on the upper reaches of the Assif Ahancal river, with a final installed capacity of 33 MW with diurnal storage. KfW is providing assistance for the project amounting to €35 million. The plans ready for public tendering and the tender documents themselves were prepared by the French consulting engineers Coyne et Bellier. There is also a feasibility study containing the results of the initial investigations into the anticipated environmental impacts of the project. As about three years will be needed for construction, the plant will not be able to be commissioned until 2009 at the earliest.

#### Small-scale hydropower

Morocco also has considerable potential in the category of micro hydropower (up to 300 kW). As part of the programme to employ small hydropower schemes for rural electrification, ONE commissioned the 220 kW Oum Er Rbia generating plant in 2004. It is supposed to produce 2,000 MWh of electricity per year and thus supply an isolated grid serving 18 villages (556 households). Previously a small hydropower plant with a capacity of 200 kW had been commissioned in Askaw in 2002. In this programme the investment costs are borne jointly by the newly electrified households, the local municipal authorities and ONE. Further such systems are planned, and ONE and CDER are in the process of evaluating the economic efficiency of various locations.

#### Pumped-storage power plant

A 470-MW pumped-storage power plant for peak load coverage has been in operation near Beni Mellal/Afourer since the end of 2004. The project received financial assistance from the European Investment Bank (EIB) and the Arab Fund for Economic and Social Development (FADES). The plant was built by Alstom (France/Morocco) and SGTm (Morocco).

### Wind energy

Morocco has good to very good wind conditions, with mean wind speeds exceeding 11 m/s in some places, so the country's exploitable wind potential is substantial. CDER estimates Morocco's total wind power potential at 6,000 MW. The Government of Morocco is planning to increase the share of electricity generated with wind power to 4% by the year 2010.

### Wind power potential

Between 1991 and 1994, in the course of a wind energy evaluation programme, CDER conducted measurements to determine the wind potential along the Atlantic coast and in the northeast of the country, with financial assistance from GTZ.<sup>15</sup> Then, in a second phase from 1997 to 2000, the wind potential of selected sites along the Atlantic coast was investigated. The third phase – from 2001 to 2010 – is geared to evaluation of the mountainous Atlas and Rif regions.

The data gathered to date confirms that Morocco has several areas with excellent potential for exploiting wind energy, particularly in the greater Tangier, Ksar Sghir and Tétouan areas (where average annual wind speeds at a height of 10 m range from 8 m/s to 11 m/s) and in the Dakhla, Laâyoune, Tarfaya and Essaouira areas (with average annual wind speeds at a height of 10 m ranging from 7 m/s to 8.5 m/s). The Sahara Wind Project, which is looking at developing wind potential in Northwest Africa in order to supply energy to Europe, has conducted wind surveys and investigated the possibility of laying a high voltage power transmission line between Morocco and Western Europe.<sup>16</sup>

The InWEnt study<sup>17</sup> 'Wind Regimes of Africa' published in May 2004 includes an extensive chapter on the wind conditions in Morocco.

### Wind farms

Wind-farm	Capacity [MW]	Com-missioned	Average annual-production [GWh]	Financing	Operator
Al Koudia	3.5	03/2001	no data	KfW	ONE
Al Koudia	50	08/2000	226	European Investment Bank	CED
Tétouan	10.2	09/2005	38	Lafarge Ciments	Lafarge Ciments <sup>18</sup>
Tanger	140	End of 2008	510	European Investment Bank und KfW	ONE
Essaouira	60	2008	210	KfW	ONE

Tab. 5: Installed and planned wind farms; Morocco

A 3.5 MW wind farm was erected at the Al Koudia Al Baïda site (Tlat Taghramt in Tétouan Province, 40 km east of Tangier) in late 2000 at a cost of approximately €6 million. KfW provided a low-interest loan of €4.35 million for this scheme, which uses German turbine technology (Enercon). The wind farm is being operated by ONE.

Another wind farm at the same location, this one with a rating of 50 MW, entered service in August 2000 with the help of a €24.4 million loan from the European Investment Bank. The cost of generating the electricity was calculated at 3.7 to 5.5 euro cents/kWh (0.4-0.6 DH/kWh). Eighty-four wind turbines from Vestas, each rated at 600 kW, were erected on behalf of Compagnie Eolienne de Détroit (CED) for approximately €45.7 million. This scheme is a purely private project based on a BOT contract with ONE; ownership of the wind farm will be transferred entirely to ONE after 20 years.

15 CDER published the initial findings in a report entitled 'Le Gisement Eolien du Maroc' in March 1995.

16 For further information see: [www.saharawind.com](http://www.saharawind.com).

17 Benjamin Jargstorf, Wind Regimes of Africa – Comparative Evaluation of Wind Data from Selected Countries, 05/2004, Factor 4 Energy Projects GmbH.

18 Only generating to meet the company's own needs.

### Expansion plans

Other wind farms with capacity totalling 200 MW are planned, and are intended to exploit wind potentials in the greater Tangier area in the north of Morocco and in an Atlantic coast region near the town of Essaouira.

The planned Tangier wind farm will comprise two sites: Sendouk, with 65 MW, and Dhar Saadane, with 75 MW. In the wake of a fruitless international tendering process, ONE decided in February 2003 to erect the Tangier wind farm on its own account. The project is being financed by loans from the European Investment Bank (€80 million) and KfW (€50 million).

A second 60 MW wind farm is to be installed some 15 km south of Essaouira on the Atlantic coast. The €83 million project will be receiving assistance from several sources, including a €50 million loan from KfW. The wind farm is expected to produce 210 GWh of electricity per year, and likewise is intended to be operated by ONE.

ONE has already conducted wind measurements for a 60-MW wind farm near Taza, which is about 100 km east of Fez, and has completed a study into the potential environmental impacts. Plans to build an additional 60-MW wind farm in the south of Morocco, near the town of Tarfaya, have been temporarily shelved by ONE.

### Decentralised exploitation of wind energy

To a lesser extent wind energy is also being exploited for the purposes of distributed rural electrification. For example, a pair of 25 kW wind generating systems and a 15 kW unit were installed in the province of Essaouira. Together, these systems supply electricity to 123 households. According to CDER, Morocco presently has towards 300 off-grid wind power plants and roughly 5,000 wind-driven pumps.

Industrial companies are also beginning to make use of wind energy on a decentralised basis. A shrimp-processing factory in Tangier, for example, is using two second-hand 80 kW turbines to cover part of its own electricity needs. The reconditioned turbines were supplied and installed by a Dutch company in June 2005. Thanks to average wind speeds of 6.5 m/s at the site, the two systems are likely to provide 386,000 kWh of electricity per year. Any surplus energy produced there will be fed into the public grid.

### Biomass

Nearly one-third of Morocco's total energy requirement is met by biomass, mostly in traditional form, i.e. through the use of biomass in the form of fuel wood or charcoal for heating and cooking purposes. Morocco has approximately 5 million hectares of forested area. The country's rapid consumption of wood as a source of energy (approx. 11 million tonnes annually) is not indefinitely sustainable, however, and is contributing to the loss of more than 30,000 hectares of forest each year. The Government of Morocco is therefore promoting the introduction of technologies for the efficient use of fuel wood and for its substitution by other energy sources.

### Biogas

Every day, Morocco produces approximately 8,000 tonnes of domestic waste and 1.1 million cubic metres of wastewater that could be put to use for generating landfill gas/sewage gas. Animal and vegetable wastes from the agricultural sector could also be utilised. Appropriate biogas plants have been developed with GTZ assistance in the past, and the potential of the planned large-scale sewage treatment plant for the city of Agadir is being examined by RAMSA with help from GTZ (measurement programme). The EIB has put forward the prospect of financing the feasibility study for a biogas plant. The industry association AMISOLE estimates the number of biogas plants presently installed in Morocco to be about 20 small units. There are also plans to produce biogas from domestic waste in Rabat and Fez.

### Solar energy

Despite excellent solar irradiation conditions – average daily irradiation is 5 kWh/m<sup>2</sup> and there are over 300 days of sunshine per year – the use of solar energy for grid-coupled electricity generation is still at an early stage of development in Morocco. The only installation connected to the grid is a 1 kW<sub>p</sub> photovoltaic system serving as a pilot plant and model project.

### PERG Solaire

The electrification campaign with solar home systems (SHS), which is part of the Moroccan rural electrification programme (PERG), is making good progress. The first phase of the programme, during which 16,000 households were fitted with SHSs, was completed in 2005. A further 37,000 households are to be equipped with their own PV systems in the second phase, which will run until 2008. The contract for the second phase of the programme was again awarded to Temasol, an enterprise jointly owned by Total Energie and Electricité de France (EDF).

### Photovoltaic Market Transformation Initiative (PVMTI)

The Photovoltaic Market Transformation Initiative (PVMTI), an important solar energy programme devoted to developing national markets for PV systems in India, Kenya and Morocco, was launched by the GEF and the International Finance Corporation (IFC) in 1998.<sup>19</sup> The programme envisages an investment volume of US\$ 5 million for Morocco. Some of these funds have already been allocated to two companies. One is the Moroccan financing company Salafin SA, which in June 2002 received US\$ 1 million for a lending programme designed to promote solar energy systems. The systems are supplied, installed and maintained by Afrisol SA. The second scheme is a microfinance project by Association Al Amana, for which the IFC is making US\$ 720,000 available in the form of guarantees and loans. The project intends to offer microloans for the purchase of solar energy systems in the Taroudant region. In this case the Moroccan PV enterprise Noor Web is supplying the solar energy equipment.

### Solar thermal energy

The Promasol programme for promoting thermosolar systems for water heating has helped to boost the number of installed units from 21,700 in 1997 to 111,300 in 2004. An initiative by the Italian Environment Ministry (MEDREP) is promoting the development of a market for solar water heaters in Morocco.

### Solar thermal power plant

Assisted by a GEF subsidy of €43 million and a loan of €136 million from the African Development Bank, a power plant is to be built in the eastern part of Morocco near Ain Beni Mathar, some 90 km south of Oujda, which combines a conventional combined-cycle gas turbine with a thermal parabolic trough solar generating system. Over 200,000m<sup>2</sup> of reflector area shall capture the sunlight and use it to generate thermal energy. The total design capacity is 240 MW, of which approximately 30 MW is to be produced from solar energy. In the course of a year the power plant will generate 1,590 GWh of electricity. According to calculations, 55 GWh will be attributable to the solar generating system, which will therefore account for almost 3.5% of total production.

The fuel for the gas turbine is to be taken from the pipeline between Algeria and Europe. According to a feasibility study that was completed in 1998 and financed by the European Investment Bank (EIB), the project is expected to cost €213 million. The difference between the promised loan and the total costs will be borne by ONE, which will then also run the power plant. According to ONE, tendering for the project began in 2004, and the plant is scheduled to be completed in 2009.

### Geothermal energy

Morocco's geothermal potential is still largely unexplored. The country's geothermal resources are confined to the north-eastern region and parts of the Sahara. The resources are relatively minor in magnitude but, according to the International Geothermal Association (IGA), could be used for heating purposes.

### **Desalination of seawater with renewable energy**

The Moroccan water authority, Office National d'Eau Potable (ONEP), is planning to build a seawater desalination plant to supply Tan Tan, a town on the Atlantic coast in the south of the country; the plant is to be powered by electricity from a 10 MW wind farm. The project is due to be completed in 2007, when initially it is supposed to supply 6,000 m<sup>3</sup> of desalinated water per day, rising in stages to a capacity of 11.000 m<sup>3</sup> by 2015. The bidding procedure for the plant was in preparation in April 2006. Operation and maintenance will be the responsibility of a separate company, which will be given purchase guarantees for the water it produces by ONEP. The project is to be registered under the Clean Development Mechanism (CDM). The Moroccan DNA has already given its approval for this, but so far no application has been made to the UNFCCC for registration.

## **13.6 Rural Electrification**

### **Degree of electrification**

In recent years Morocco has made great progress in providing grid power to its population. ONE presented a national electrification programme – Programme pour l'Electrification Rurale Global (PERG) – to the Moroccan governing council in 1995, and launched it in 1996. The degree of rural electrification was only 18% in 1995 before the programme started, but this rose steadily to 82% by the end of 2005. Even villages situated long distances from the power grid now have at least a basic decentralised electricity supply, with the aid of renewable energy sources.

According to data provided by ONE, 21,689 villages, or 1,392,954 households, had been provided with an electricity supply by the end of 2005 within the scope of the PERG programme. The Government of Morocco aims to achieve full electrification of the country by 2007.

### **Programme for rural electrification**

ONE is responsible for rural electrification in cooperation with the relevant local authorities. International donors, ONE and the users jointly finance the electrification measures.

The role of the private sector in decentralised rural electrification has continued to grow in recent years. Private companies are responsible for the procurement, installation and maintenance of the solar energy systems. In return, after the systems have entered service the companies collect charges from the users at regular intervals. The only help provided by ONE to the future electricity customers is with the financing of their systems. Within the framework of its new fee-for-service model, ONE has now completely surrendered the technical side of rural electrification to privately owned enterprises.

### Solar home systems and fee-for-service contracts

ONE provides a financial subsidy for each installed solar home system, with contributions ranging from € 389 to € 1,598 (DH 4,320 to 17,760). The precondition is that the implementing solar energy company must enter into a contract with ONE. Solar home systems rated at 50, 75, 100 and 200 watts are being promoted. The household in which the SHS is installed then repays the remainder to the implementing contractor in instalments over a period of 10 years. The SHS itself remains the property of ONE for that 10-year period, after which its ownership passes to the household in question. The solar contractor is responsible for installing and servicing the solar home system.

One subsidiary project within the rural electrification campaign that operates according to this principle is the TEMASOL programme, which is supposed to supply electricity from PV systems to 370,000 people in 53,000 households in 24 Moroccan provinces. It is based on cooperation between ONE and two companies (Electricité de France and Total Energie), and is co-financed by German Financial Cooperation (KfW), the French development agency AFD and the French Global Environment Facility (FFEM).

The costs to be borne by the households under this programme are made up of a once-only connection cost of € 63-360 (DH 700-4,000) and a monthly fee of € 5.85-13.50 (DH 65-150), depending on the output of the installed system.

### Decentralised rural electrification with renewable energy sources

In contrast with its predecessor programme (PNER), which came to an end in 1996, PERG also includes the off-grid electrification of communities and villages situated away from the existing distribution networks. The part of the programme targeting decentralised electrification began in 2000 and primarily promotes the use of SHSs, but also micro hydropower plants and small wind energy conversion systems.

Hybrid isolated grids have been installed at two locations in the province of Essaouira. These involve the use of wind generating systems in combination with diesel generators. In Sidi Kaouiki, two wind turbines each produce 25 kW and a diesel generator 30 kW. In Moulay Bouzerktoun there is 15 kW of wind power and 15 kW from diesel. According to estimates from the Centre de Développement des Energies Renouvelables (CDER), there are about 300 off-grid wind turbine systems in Morocco.

Exchange rate (December 2006):

1 Moroccan dirham (DH) = 0.09 euro (EUR)

## 13.7 Information Sources

- Afriwea:  
Press Release, Two WES18 – 80 kW wind turbines for a shrimp processing farm in Tangiers, Morocco, 06/2005
- Arabic News:  
Morocco's renewable energy sector boosted by three international agreements, Morocco, 12/2004
- Breuer, Siegfried  
(Bundesagentur für Außenwirtschaft-bfai):  
CDM-Markt kompakt – Marokko, 05/2006
- BMZ – Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung:  
Kleine Solaranlage, große Wirkung:  
Strom für entlegene Dörfer, 2004
- Eichhammer, Wolfgang et al.:  
Assessment of the Worldbank – GEF Strategy for the market development of concentrating solar thermal power, 05/2005
- Jalil Bennani in Aujourd'hui – Le Maroc dated 09.09.2005:  
Reflexion sur une nouvelle politique,  
Morocco, 09/2005

- Jargstorf, Benjamin: Factor 4 Energy Projects GmbH:  
Wind Regimes of Africa – Comparative Evaluation of Wind Data from Selected Countries, 05/2004
- Manuel Antonio Leandro Reguillo:  
Les énergies renouvelables au maroc – Le rôle du CDER dans leur développement, Maroc, 11/2004
- Marsiske, Hans-Arthur in Financial Times Deutschland dated 16.11.2005:  
Wechselstrom aus der Wüste, 11/2005
- Neidlein, Hans-Christoph: Grüne Energie: Marokko setzt auf Zusammenarbeit mit Europa, Europa digital, 02/2005
- Office national de l'électricité (ONE):  
Annual Report 2003, Morocco, 2005
- Office national de l'électricité (ONE):  
Annual Report 2004, Morocco, 2006
- Pfeiffer, Tom: in Reuters/PlanetArc dated 20.7.2006:  
Morocco Pushes Renewable Energy as Oil Prices Soar, 07/2006
- Rimi, Abdelkrim:  
First assessment of geothermal resources in Morocco, 2000
- Senhagi, Faouzi (GERER, Maroc):  
Financing the development of the renewable energy in the mediterranean region – Baseline study for Morocco; United Nations Environment Programme (UNEP), 05/2003
- Zejli, D. et al.:  
Quel avenir pour l'énergie éolienne au Maroc?, 2005

### 13.8 Contact Addresses

#### Office National de l'Electricité (ONE)

Head Office

65, rue Othman Ben Affane

20000 Casablanca Maroc

Tel. +212 (22) 66 80 80

Fax +212 (22) 22 00 38

www.one.org.ma

#### Ministère de l'Energie et des Mines (MEM)

La Direction de l'Energie

Rue Abou Marouane Essaadi – Haut Agdal

Rabat

Tel. +212 (37) 68 88 30

Fax +212 (37) 68 88 31

E-mail: admin@mem.gov.ma

www.mem.gov.ma

#### Centre de Developpement des Energies

Renouvelables (CDER)

Rue Machaar El Haram

Quartier Issil, B.P. 509

Marrakech

Tel. +212 (24) 30 98 14/22

Fax +212 (24) 30 97 95

E-mail: cder@menara.ma

www.cder.org.ma/

#### Association Marocaine de Gestion et d'Economie d'Energie (AMGEE)

Route Cotière SAMIR

Mohammedia

Tel. +212 (23) 31 22 40/41/42

Fax +212 (23) 31 22 66

#### Association Marocaine de l'Industrie Solaire (AMISOL)

5, rue de Midelt

Rabat

Morocco

Tel. +212 (37) 76 89 61/62/63

Fax +212 (37) 76 89 64

**German Chamber of Industry and Commerce  
in Morocco**  
Chambre Allemande de Commerce et d'Industrie  
au Maroc  
140, Bd. Zerktouni  
6<sup>ème</sup> étage  
20000 Casablanca  
Tel. +212 (22) 42 94 00/01  
Fax +212 (22) 47 53 99  
E-mail: [info@dihkcasa.org](mailto:info@dihkcasa.org)  
[www.dihkcasa.org](http://www.dihkcasa.org)

**Photovoltaic Market Transformation Initiative  
(PVMTI) – Morocco**  
Mohamed Aboufirass  
c/o Resing  
9, lot. Mejjat, Rue Gharnata  
B.P.: 1569 Marrakech  
Hay Mohammadi – 40007 Maroc  
Tel. +212 (44) 32 98 20  
Fax +212 (44) 32 98 19  
E-mail: [m.aboufirass@resing.ma](mailto:m.aboufirass@resing.ma)  
[www.pvmti.com](http://www.pvmti.com)

**Embassy of the Kingdom of Morocco**  
Niederwallstr. 39  
D-10117 Berlin  
Tel. +49 (30) 20 61 24 0  
Fax +49 (30) 20 61 24 20  
E-mail: [marokko-botschaft@t-online.de](mailto:marokko-botschaft@t-online.de)  
[www.maec.gov.ma/berlin/](http://www.maec.gov.ma/berlin/)

**Deutsche Gesellschaft für Technische  
Zusammenarbeit GmbH (GTZ)**  
Morocco Office  
Country Director: Dr. Brigitte Heuel-Rolf  
2, Avenue Tour Hassan  
Rabat Hassan  
Tel. +212 (37) 20 45 17  
Fax +212 (37) 20 45 19  
E-mail: [gtz-marokko@gtz.de](mailto:gtz-marokko@gtz.de)  
[www.gtz.de/marokko](http://www.gtz.de/marokko)

**GTZ Environmental Programme Morocco**  
Programme Manager: Mohamed El-Khawad  
Tel. +212 (37) 68 07 10  
Fax +212 (37) 68 07 11  
E-mail: [Mohamed.El-Khawad@gtz.de](mailto:Mohamed.El-Khawad@gtz.de)

**Embassy of the Federal Republic of Germany  
in Morocco**  
7, Zankat Madnine  
B.P. 235  
10000 Rabat  
Tel. +212 (37) 70 96 62



There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources and to the involvement of foreign investors include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors. This fourth, updated and expanded edition is aimed at overcoming barriers such as these.

The electricity markets and their respective actors are investigated for 23 countries in various regions: Latin America, Africa - Middle East and Asia. The country studies 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.

Deutsche Gesellschaft für  
Technische Zusammenarbeit (GTZ) GmbH

Dag-Hammarskjöld-Weg 1-5  
Postfach 5180  
65726 Eschborn  
T +49 (0)61 96 79-1303  
F +49 (0)61 96 79-80 1303  
I <http://www.gtz.de>

