



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

## 23 Country Analyses Chapter Tunisia

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 South Africa**

**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)

## 16 Tunisia

### 16.1 Electricity Market

#### Installed capacity

In 2005 the installed power plant capacity in Tunisia totalled roughly 3,300 MW. Of this, 3,170 MW (97 %) was provided by thermal power stations, 62 MW (2 %) by hydroelectric power and 20 MW (less than 1 %) by wind generating plants.

Type of power plant	2002	2003	2004	2005
	MW			
Thermal (steam) power plant	1,145	1,145	1,145	1,145
Combined-cycle gas turbine	364	364	364	364
Gas turbine	804	804	922	1,163
Hydropower	62	62	62	62
Wind power	10	19	19	19
STEG <sup>1</sup> total	2,385	2,394	2,512	2,753
IPPs <sup>2</sup>	471	498	498	498
<b>Total capacity, national</b>	<b>2,856</b>	<b>2,892</b>	<b>3,010</b>	<b>3,251</b>

Tab. 1: Installed power plant capacity; Tunisia; 2002–2005; MW<sup>3</sup>

For some years now the state-owned power utility Société Tunisienne d'Electricité et du Gaz (STEG) has primarily relied on gas-fired power plants for generating electricity, fuelled by natural gas from the country's own reserves and by imports from Algeria.<sup>4</sup> 11 % of the installed capacity comprises combined-cycle gas turbine (CCGT) power plants. Independent power producers feeding electricity into the public grid account for approximately 500 MW (15%) of the nationally available capacity.

In 2005 the peak load in public supply was 2,172 MW. This has risen by about 100 MW per year since 2001.

By 2011 the total power generating capacity is supposed to be expanded to 4,400 MW in order to meet the growing demand for electricity. As well as adding new thermal power plants, the government envisages promoting renewable energy to play a part in the provision of the requisite production capacity.

#### Power generation

Annual electricity production in Tunisia amounted to approximately 13,300 GWh in 2005. Of this, about 7 % was produced by self-generators for their own purposes. The remainder came from power stations on the public grid, including independent power producers (IPPs). 80 % of Tunisia's electricity was generated from natural gas in 2005, and 20 % from heavy oil.<sup>5</sup> 76 % of the natural gas consumed in Tunisia in 2005 went into the production of electricity, with 24 % being used by industry and households.

	2001	2002	2003	2004	2005
Production (GWh)	10,853	11,281	11,830	12,454	13,006
Consumption (GWh)	8,751	9,085	9,542	9,991	10,353

Tab. 2: Electricity production (incl. IPPs and self-generation) and consumption; Tunisia; 2001–2005; GWh<sup>6</sup>

#### Power transmission and distribution

Tunisia has a well developed electricity grid, to which more than 99 % of households in the country are connected. In 2005 the transmission system operated by STEG consisted of some 5,300 km of high voltage power lines, 46,000 km of medium voltage lines and 84,000 km of low voltage lines. It is connected to the European power grid via the grids in Algeria and Morocco. To the east, the Tunisian power grid is linked with Libya. The aim is to establish a North African interconnected grid that would extend through Egypt and Jordan as far as Syria.

1 Société Tunisienne d'Electricité et du Gaz (STEG).

2 Independent power producers (IPPs).

3 Source: STEG Annual Report 2005.

4 The natural gas occurring in the country is exploited by international companies under contract, and its price is dependent on the exchange rate with the dollar. The price is linked to oil prices on the international market, with a reduction of 15%. Until now the petroleum and natural gas used in the thermal power stations has mostly originated from Tunisian sources. All in all, however, Tunisia has to import 60 % of the crude oil and derivatives that it requires.

5 Source: L'Energie No. 68, October/November 2006.

6 Source: Tunisian Statistical Office 2006.

### Electricity consumption

Almost all of STEG's 2.7 million electricity customers are connected to low voltage lines, with only 14,000 customers using medium voltage and just 18 customers a high voltage connection. Altogether they used 10,353 GWh of electricity in 2005. Almost 57% of this (5,948 GWh) was supplied as high or medium voltage to business customers in various sectors: industry (3,714 GWh), agriculture (350 GWh), infrastructure (420 GWh), transport (237 GWh), tourism (607 GWh) and services (620 GWh). The remaining 43% was low voltage power sold to end consumers primarily in commerce and the domestic sector.

Higher living standards have led to a considerable rise in consumption by private households, which grew by 30% in the period from 2000 to 2005. Ninety per cent of households have TV sets. Refrigerators are now to be found in 82% of all households, and account for about 40% of private electricity consumption. The targeted promotion of energy-saving measures through energy audits in industry and the spread of energy-efficient domestic appliances enabled electricity consumption to be reduced by about 370 GWh in 2005. In the course of implementation of the 11th five-year plan, these savings are supposed to rise to 2,300 GWh per year by 2011, equivalent to almost 18% of the forecast power consumption of 13,000 GWh for that year.

### Electricity prices

Electricity prices are set by the Ministry of Industry, Energy and Small and Medium-sized Enterprises on the basis of proposals submitted by STEG. By international standards, the electricity tariffs are low. They are broken down in two ways: firstly according to voltage level and type of use<sup>7</sup>, and secondly according to the time of use. In the low voltage sector the tariff structure has a progressive component.<sup>8</sup>

	Daytime tariff €-ct/kWh	Night-time tariff €-ct/kWh
High voltage sector	3.41	2.66
Medium voltage sector	4.96	4.96
Low voltage sector		
0-50 kWh/month	4.01	4.01
> 50 kWh/month	6.72	6.72

Tab. 3: Standard electricity tariffs, unit rate (not including taxes); Tunisia; 2006; € cents/kWh<sup>9</sup>

The Tunisian Government manages to keep electricity prices low by subsidising the price of natural gas to the tune of twenty per cent. For a number of years now the cost of this state subsidy has risen sharply along with global market prices for crude oil, and is an increasing burden on the Tunisian budget. In 2005 for example, about € 930 million (1.5 billion Tunisian dinars) was spent on compensatory payments to stabilise energy prices, accounting for roughly 15% of state expenditure or 4% of gross domestic product.

<sup>7</sup> For example domestic, agriculture, irrigation, air conditioning.

<sup>8</sup> A detailed overview of the current tariffs is provided on the website of the Tunisian state energy supply company. See: [www.steg.com.tn](http://www.steg.com.tn).

<sup>9</sup> Source: STEG 2006.

## 16.2 Market Actors

### STEG – Société Tunisienne d'Electricité et du Gaz

The electricity supply business in Tunisia is dominated by the state-owned enterprise STEG, which is answerable to the Ministry of Industry and Energy. It is still responsible for supplying electricity and gas to all Tunisian customers, apart from the autonomous electricity suppliers. As well as the power grids, STEG operates most of the Tunisian power stations and extracts the natural gas itself from four of the country's five gas fields.

In view of the high rates of growth in demand for electricity, STEG lost its state monopoly in power generation in 1996, with the market being opened for independent power producers (IPPs). IPP projects have been permitted since Decree 96-1125 was issued, although they must be awarded within the framework of an international tendering process. Since 1999 it has also been permitted for gas extraction companies to operate gas-fired power plants without a preceding bidding procedure and to sell the generated electricity to STEG.<sup>10</sup> Despite the opening of the generating market, even in 2005 it was still the case that 85% of national electricity generating capacity belonged to STEG, while only 15% was operated by independent producers.

### Other Actors

#### Ministry of Industry and Energy; CSPIE and CIPIE

The Ministry of Industry and Energy, or its Directorate General for Energy, draws up plans for expanding the energy infrastructure and implements the energy policy adopted by the government. Most of the state actors in the energy sector are answerable to the ministry. These also include two commissions: the 'Commission Supérieure de la Production Indépendante d'Electricité' (CSPIE) and the 'Commission Interdépartementale de la Production Indépendante d'Electricité' (CIPIE), which were both set up in 1996. The Ministry of Agriculture, Environment and Water Resources is responsible for the exploitation of hydropower.

The CSPIE decides on the procedures and selection criteria for public tender processes and awards contracts to independent power producers. It also passes rulings on the granting of tax incentives for investors. The interministerial CIPIE carries out preliminary work for the CSPIE by selecting projects for tendering, preparing bidding procedures, evaluating offers, flanking the contractual negotiations between the independent producers and the Energy Ministry, and securing the granting of public subsidies on a case-by-case basis.

#### National Energy Agency (ANME)

The former Tunisian agency for renewable energies, the Agence Nationale des Energies Renouvelables (ANER), was founded in 1985. Under Law No. 2004-72 of 2 August 2004, the national Tunisian energy agency, the Agence Nationale pour la Maîtrise de l'Energie (ANME), succeeded the ANER and took over all its functions. The ANME is answerable to the Ministry of Industry and Energy and is tasked with translating its policy directives into practice. These include securing Tunisian energy supplies in the long term. The agency is meant to approach this in two ways: on the one hand by working towards a wide-ranging increase in energy efficiency, and on the other by helping to develop new energy sources. Its activities extend from scientific research and the preparation of studies to training experts and raising awareness among the population, and also embrace engagement in international cooperation. Renewable forms of energy are a focal area of its work. The agency employs roughly 100 people, and is funded partly from the Tunisian national budget and partly from donations and external lenders. Since 2003 the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) has worked with the ANME within the framework of a project on the promotion of renewable energies and rational energy use, providing support in the fields of planning, project management and quality assurance and on matters relating to innovative energy-saving technologies and the harnessing of renewable energy sources.

10 Law No. 99-93 of 17.8.1999: Portant promulgation du code des hydrocarbures.

### Tunis International Centre for Environmental Technologies (CITET)

1996 saw the founding of the Centre International de Technologies de l'Environnement de Tunis (CITET), which has the task of disseminating and promoting environmental technologies. It is answerable to the Tunisian Ministry of the Environment. In addition to providing a range of advisory and training services, it also has laboratory and development capacity at its disposal. A library and an extensive online presence serve the purpose of documenting and disseminating information relating to environmental matters. The CITET is involved in numerous cooperation projects, including international projects. Together with the CITET and two other German partners, the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) is running the IHK/GTZ Company Pool on Environmental Technology in Tunis, which has set itself the goal of supporting small and medium-sized European companies from the environmental technology sector in gaining access to the market in Tunisia and other Maghreb countries. The target group comprises companies with at least a medium-term interest in the promotion of further-reaching cooperation with Tunisian partners (for example in the form of licensing, technology cooperation or joint ventures).<sup>11</sup>

### 16.3 Legal Framework

Since the early 1980s the Tunisian Government has contributed to the promotion of rapid economic and social development in the country by adopting legislation implementing appropriate energy policy. In the year 2000, for the first time the country's own oil and gas deposits were no longer sufficient to meet the higher demand for energy that was rising along with economic growth. Instead of potential additional funding of economic growth in Tunisia from income generated by energy exports, the country found itself dependent on the international crude oil price. As a consequence, from 2001 onwards the government increasingly developed strategies aimed at the rational use of energy and diversification of energy supplies. In addition to adopting new legislation and Presidential decrees, the government also made considerable improvements to the institutional, financial and organisational framework for sustainable energy use. The two most important components are described in the following.

#### Law No. 2004-72

Law No. 2004-72 on the rational use of energy defines the sensible use of energy as a national priority and as the most important element of a sustainable development policy. It states three principal goals: energy saving, the promotion of renewable energy and the substitution of forms of energy previously used, wherever this offers technical, economic and ecological benefits.

Article 14 lists four areas in the field of renewable energy which are to be treated as priority areas of a national promotion programme:

1. Expansion of wind power for electricity generation
2. Introduction of incentives for the use of solar thermal energy
3. Use of solar energy for further electrification of rural areas, irrigation and seawater desalination
4. Encouragement of the greater use of production residues for energy generation and of geothermal springs and small-scale hydropower plants.

**Law No. 96-27**

The door to private-sector involvement in the electricity sector was opened with the adoption of the law on demonopolisation of the state-owned power utility STEG of 1996 (No. 96-27). Fundamentally this allows private companies to generate electricity if they are successful in a bidding process, and to sell that electricity to STEG as a single buyer. The detailed terms and procedures for the granting of concessions to private generating companies were laid down in ordinance no. 9661125 of 20 June 1996.

Despite these initial steps in the direction of opening of the market, the electricity sector in Tunisia is still largely subject to state control and only geared to competition to a limited extent. To date, as is the case with conventional power stations, electricity from renewable energy sources can only be fed into the STEG grid on the basis of tendering processes and individual contracts between the private producers and STEG.

As yet there are no standardised arrangements governing the terms and tariffs according to which independent power producers are able to feed their electricity into the STEG grid. Private operators have to arrange these matters on a case-by-case basis through a contract with STEG. As a general rule, STEG is prepared to purchase surplus electricity from companies for which power generation is merely an ancillary activity, not their primary business. If electricity generation is a company's main activity, STEG is not obliged to purchase the electricity, although it can do in the context of an individual contractual arrangement.

**16.4 Policy Promoting Renewable Energy Sources**

The Tunisian energy agency ANME states that its work on promoting renewable energy focuses on two areas: solar thermal energy for water heating, and wind power for electricity generation. In the solar thermal sector the government target is an installed collector area of 500,000 m<sup>2</sup> by 2009. Towards this aim, the PROSOL promotion programme has been running since 2005. In the case of wind power, the existing capacity (20 MW) is supposed to be increased to 155 MW by 2009. The government is relying on private investors and international promotion, for which it also intends to create favourable conditions within the context of the CDM.

**Fiscal and other incentives**

As yet there is no specific legislation in place in Tunisia to promote electricity production from renewable energy sources. Investors can, however, generally benefit from tax and customs duty relief. Customs duties can be reduced from a general rate of 18% to the minimum rate of 10%. Value-added tax can be reclaimed entirely for imported goods if they cannot be manufactured in Tunisia, and for locally produced capital goods. As well as this, in specific cases income taxes can be remitted for up to five years and investment subsidies can be granted.

The Tunisian state can also contribute to the costs of expanding the infrastructure. If a project is considered to be particularly important on account of the magnitude of the amount invested or the number of jobs created in Tunisia, the state can also make the required land available at a symbolic price. Decisions on concessions of this nature are taken by CSPIE.

### Clean Development Mechanism

Although Tunisia can be considered a model for other African countries in terms of its environmental and energy policy, the CDM sector is still in its infancy. To date there are only two landfill gas projects that have been successfully registered with the CDM Executive Board; these are being implemented with Italy as the partner country.<sup>12</sup>

The Tunisian authorities have recognised the opportunities presented by the CDM, however, and are planning a huge expansion of such activities. In the period up to 2011 the plans envisage projects that, taken together, are supposed to achieve savings of 12.7 million tonnes of CO<sub>2</sub> equivalents. The planned reductions in greenhouse gases are supposed to be shared roughly equally between the energy and waste sectors. According to the government's CDM strategy, it is intended to develop about 360 projects by 2011, equivalent to an average of 60 new projects per year. Efforts are to be focused on the following areas: waste management, wind power, combined heat and power, energy efficiency for bulk consumers, fuel switch, industrial process technology, and optimisation of oil and gas extraction.<sup>13</sup>

The Tunisian Designated National Authority (DNA) for the CDM has been set up within the Ministry of the Environment, and has had official statutes and rules of procedure in place since mid-2006. So far there is no information available on approval procedures for project developers or certificate buyers.

The Tunisian energy agency ANME is a competent point of contact for CDM projects, and is also able to provide financial support for the development of CDM projects.

GTZ has advised Tunisia on building up capacity for implementing CDM activities since early 2006. Important project executing agencies such as the national energy supply company STEG, the state-owned Groupe Chimique Tunisien and the oil company Entreprise Tunisienne d'Activités Pétrolières (ETAP), likewise state-owned, are also to be brought in as part of this initiative.

Most of the future CDM projects in Tunisia are likely to be implemented in cooperation with one of these three principal actors in Tunisia's industrial and energy sector.

### 16.5 Status of Renewable Energy Sources

Apart from centralised electricity generation from hydropower, the use of renewable energy to produce electricity is still at an early stage of development in Tunisia. One focus of attention is currently wind energy, although the utilisation of solar energy for thermal purposes is also gaining in importance.

#### Hydropower

145 GWh of electricity was generated from hydropower in 2005, or 1.6% of the total produced by the state-owned energy supplier STEG. At 62 MW, hydropower accounts for about 2% of the country's installed capacity.

The Sidi Salem dam is the most important hydroelectric power installation in Tunisia, and has been in operation since 1982. With an installed capacity of 36 MW, it produces 40 GWh of electricity per year.

In future, with the planned expansion of renewable energy, particular emphasis is to be placed on the use of small-scale hydropower schemes. Nine sites for such plants have been identified in the course of a development programme: Barbara (3 MW), Sidi Saad (1.750 kW), Siliana (850 kW), Bejaoua (750 kW), Medjez el Bab (250 kW), Nebhana (500 kW), Sejnane (1 MW), Bouhertma (1,2 MW) and Khanguet Zezia (650 kW). The total capacity of the programme is supposed to be 10 MW (60 GWh/a). According to a study from 1993, the total potential for hydropower in Tunisia is some 1,000 GWh per year, although realistically only about a quarter of this is technically utilisable.<sup>14</sup>

<sup>12</sup> As at: December 2006, <http://cdm.unfccc.int/Projects>.

<sup>13</sup> Amous, Samir, *Stratégie nationale pour la mise en oeuvre du mecanisme pour le developpement propre en tunisie*, Rapport final, Ministère de l'environnement et du developpement durable, Tunisia 2005.

<sup>14</sup> Source: International Small-Hydro Atlas.

### Wind energy

Greater use of wind energy has been a declared primary goal of Tunisia's energy development programme since 2001. There is still no nationwide wind atlas for the country, however, although one is currently being drawn up, and measuring stations have already been installed for that purpose. The national energy agency ANME has conducted a series of pilot measurements with international support. These attest that the conditions for harnessing wind energy in Tunisia are good. The total on-shore potential is estimated at approximately 1,000 MW.<sup>15</sup>

Site analyses in the north and northeast of the country revealed potentials of 300 MW in regions with wind speeds between 7 and 10 m/s.<sup>16</sup>

Although initial experience with small turbines was gathered in Tunisia as long ago as the early 1980s, the commercial use of wind power for electricity generation has only just begun. In the past, wind energy has mainly been used on a decentralised basis, for example for pumping water as part of field irrigation schemes in remote regions.

### Sidi Daoud wind farm

Until now only one wind farm has been built, in Sidi Daoud (Gouvernement Nabeul) near Cap Bon. It has been in operation since 2000. Average annual wind velocity at this location is 8.4 m/s at a height of 30 m. The systems were partly (20 %) financed from STEG's own funds, with 80 % coming from a Spanish loan. The contract for the turnkey erection of the turbines, valued at US\$ 9.7 million, was awarded to the Spanish manufacturer MADE. The wind farm is operated by STEG, and with 32 turbines each rated at 330 kW it initially had a generating capacity totalling 10.6 MW. In 2002 this was used to generate 30 GWh of electricity. In 2003 the wind farm was expanded by the addition of twelve turbines with a capacity of 8.7 MW for US\$ 8.2 million. It now has a total generating capacity of almost 20 MW, thus representing about 0.6% of the country's installed capacity.

In 2005 the wind farm generated 42.4 GWh of electricity, which was almost 0.5 % of Tunisia's total production. STEG is planning a second expansion, by 34 MW, for 2007. At the end of this third project stage the total installed capacity at the wind farm will be 55 MW. Since it first entered service, the wind farm has enjoyed a proven technical availability of over 95 %.

### Site analyses

Various organisations (STEG, GTZ, private companies) have conducted, financed or promoted measurements to investigate further possible locations for wind farms in Tunisia, and are continuing to do so.<sup>17</sup> GTZ together with ANER has examined three locations in more detail to determine their suitability for siting wind farms. The locations in question are Enfida on the east coast, Zargis south of the island of Djerba, and Cap Negro on the north coast. With support from UNDP, locations were evaluated on the Cap Bon peninsula, a plateau south of Thala in the centre of the country, and a site near to Kebeli in southern Tunisia. Preparations are also being made by large-scale industrial consumers to use wind generators to produce their own electricity. The first step involves eight cement works, where the necessary measurements are being taken so that the companies' own needs of 60 to 80 MW can be met by wind generators on or near the premises.

15 Source: Global Environment Facility: Development of On-grid Wind Electricity in Tunisia for the 10th Plan.

16 Source: African Wind Energy Association – AfriWEA.

17 For example at the Jebel Sidi Abderrahmane location in the region of Cap Bon, where STEG measured average wind velocities of over 10 m/s at a height of 45 m, and at Métline in the region of Bizerte, with an average of 9 m/s at a height of 30 m.

### International projects

A project with international partners aimed at strengthening technical capacities in the wind power sector was launched in Tunisia in 2001. The purpose of the project was to develop grid-coupled and off-grid wind power installations (including a partial investigation of wind potentials) and to throw light on the regulatory framework conditions. In this connection, the Canadian consulting company Hélimax together with a local partner completed a strategic study into the expansion of wind power in 2003. Before that, too, Hélimax also compiled an economic study into the possible establishment of a wind industry in Tunisia, a training manual on wind energy and a baseline study for a CDM project in the wind sector. Subsequent to this initiative an official GEF promotion project<sup>18</sup> was agreed upon in 2003.

### UNDP/GEF project in cooperation with GTZ

In November 2003, UNDP decided to implement a project with GEF assistance under the title 'Development of On-Grid Wind Electricity in Tunisia for the 10th Plan', which was designed to run for eight years. The project began in 2004 and is being executed in cooperation with GTZ. Within the framework of this project, which targets the large-scale exploitation of wind energy, it is planned that private investment of more than US\$ 100 million should be funnelled into the wind sector. The funds provided by the GEF amount to US\$ 10.25 million.

The institutional, regulatory and operational capacities of the key institutions are to be strengthened through technical assistance. The 100 MW of additional capacity that is to be built in the coming years is to be supported by production-dependent financial assistance in the first five years of operation. Based on avoided costs of 0.037 TD/kWh and 35 % availability of the wind farm, at present the additional costs are expected to be 2 to 3 US cents/kWh, about a quarter of which are to be covered by GEF funds.

The Tunisian Government anticipates that private investors will be in a position to finance the remaining additional costs through subsidised export credits or emissions certificates. The government intends to provide only tax concessions as its own contribution to meet the funding shortfall.

The share of assistance contributed by GTZ within the project as a whole consists of site analysis, consultancy services to the Tunisian Government on matters relating to grid integration, tariff structuring and preparation of and backup support for the bidding procedure. In addition, GTZ aims to help ensure that a high quota of local value added is achieved by providing technical assistance to domestic manufacturers.

### Future wind power plans

As part of its 10th development plan (2003-2007) the Tunisian Government is planning the construction of wind farms with a capacity of about 120 MW. The construction of a further 200 MW by private investors on a purely competitive basis is envisaged for the period from 2008 to 2011 under the 11th development plan.

A strategic study into the development of renewable energy in Tunisia conducted on behalf of ANER in 2004 provides an assessment of the potential seen in wind energy.<sup>19</sup>

<sup>18</sup> GEF Project ID 967, UNDP PMIS ID 2129.

<sup>19</sup> ANER Groupement ALCOR-Axenne: Etude Stratégique sur le Développement des Energies Renouvelables en Tunisie Aux Horizons 2010-2020-2030, Tunis 2004.

Wind power	2010	2020	2030
Installed capacity [MW]	310	1130	1840
Production [TWh/a]		2.8	4.6
Primary energy saved [TWh/a]		8.1	14.0
Resultant saving of CO <sub>2</sub> [mill. t CO <sub>2</sub> e]		1.5	2.8
Primary energy saved (aggregated) [TWh]	10.5	64.0	186.0
Resultant saving of CO <sub>2</sub> (aggregated) [mill. t CO <sub>2</sub> e]	2	13	37

Tab. 4: Estimation of wind energy potential; Tunisia<sup>20</sup>

### Tendering for three new wind farms

The deadline for an international call for tenders (N° 2006 E 4025) from STEG for three new wind farms in Métline, Kochbate and Ben Aouf expired in December 2006. Altogether the capacity of these wind farms is supposed to be 120 MW. The object of the tendering process is firstly the turnkey construction of the installations and secondly a five-year operator contract.

### Biomass

There are hardly any plants in Tunisia for the direct conversion of biomass into electricity. In Hammam Sousse a plant has been run since July 2000 under Tunisian-Chinese cooperation which produces biogas from waste from poultry breeding on an industrial scale, and converts the gas into electricity. The plant can process three tonnes of poultry manure per day, and from this it produces approximately 200 m<sup>3</sup> of biogas, which it converts into 300 kWh of electricity. A small biogas plant was set up at a cattle breeding farm in Sidi Thabet for training purposes. The national energy agency's biogas programme also mentions 50 small plants producing biogas in the northwest of the country.

### Solar energy

Solar irradiation in Tunisia ranges between 1,500 and 1,900 kWh/m<sup>2</sup> annually. The length of sunshine is 2,800 to 3,200 hours/year or 255 days/year. The conditions for utilising solar energy are therefore good.

### Photovoltaics

There has been a national programme aimed at rural electrification with photovoltaic systems since the 8<sup>th</sup> development plan (1992-1996). Since then, 11,000 remote farms have been electrified and 200 rural schools supplied with solar electricity. Solar-powered surface wells and public lighting systems have also been installed.<sup>21</sup> A further 2,000 settlements are to be equipped with PV systems in the future. Other applications for solar-generated electricity are also supposed to be developed in the fields of water supply and desalination.

### Solar thermal energy

Solar thermal systems for heating water have been installed in Tunisia since 1982. By the mid-1990s the total collector area had reached 30,000 m<sup>2</sup>. Problems with quality and a lack of competition led to a tailing-off of demand. Of the existing capacity, 80% is installed in private households, with the remainder in public buildings such as hotels, hospitals and barracks.

20 Quelle ANER, 2004.

21 More details about these PV projects are given in the section on rural electrification. Future prospects: in the 10th development plan, state expenditure of roughly € 19.3 million has been set aside for the promotion and utilisation of renewable forms of energy and the development of an energy-efficiency programme.

According to Law No. 2004-72<sup>22</sup> expanding the use of solar thermal energy is one of the two principal development goals of the national energy programme. Since 2005 there has been a national promotional loan programme in place under the name of PROSOL, which is meant to help Tunisia achieve an installed collector area of 700,000 m<sup>2</sup> by 2011. The state provides a direct subsidy for solar thermal installations at a rate of 59 euro/m<sup>2</sup> (TD 100/m<sup>2</sup>), up to a maximum of 236 euro/m<sup>2</sup> (TD 400). The remaining amount can be covered by credit finance at preferential rates, to be paid back over five years. Collection is taken care of by the state-owned utility company STEG in conjunction with the electricity bill. As an accompanying measure provided by the state, no value-added tax is payable on installation of the systems. In 2005, thanks to this programme, 23,000 m<sup>2</sup> of new collector area was installed in the residential sector. The target for 2006 was 45,000 m<sup>2</sup>. The PROSOL lending programme is part of the Mediterranean Renewable Energy Programme (MEDREP), which has received US\$ 7 million from the Italian Government. The United Nations Environment Programme (UNEP) is contributing US\$ 2 million, thanks to which the interest rate for borrowing can be reduced from the usual 14% to 7% for financing solar thermal systems. Thanks to repayment guarantees provided by STEG, local banks were able to grant the equivalent of US\$ 5.7 million in small loans for solar thermal installations in 2005.

### Geothermal energy

The geothermal springs in the south of the country in the Kebili region have a relatively low temperature of between 30°C and 80°C. Up to 45°C the water is used directly for irrigating about 16,000 ha of oases. Warmer water is first cooled in trickle towers. The thermal springs are also used for heating greenhouses, covering a total area of over 100 ha. According to estimates by the International Geothermal Association (IGA), this involves utilisation of a thermal output of 25.4 MW<sub>t</sub>, equivalent to an annual energy input of some 60.9 GWh/a. To date, geothermal energy has played no part in generating electricity because the available water temperatures are too low.<sup>23</sup>

## 16.6 Rural Electrification

### Degree of electrification

According to estimates by the state-owned utility company STEG, the degree of electrification for Tunisia as a whole was 99.1% in 2005. In rural areas the figure was 98.1%. Grid coverage is poorest in the southeast of the country, where it reaches around 96.5%. The high connection rate is the result of constant efforts on the part of the government over the past 30 years. In the 1970s only 6% of the rural population was connected to the power grid, while around 1990 the figure was still only about half. As a complementary measure along with the expansion of the grid, the installation of more than 11,000 decentralised PV systems has also played a part in the high rate of electrification.

### Electrification programmes and projects

A programme promoting decentralised rural electrification that was launched in 1995 on the basis of national and international assistance provides solar home systems (SHSs) rated at 100 W<sub>p</sub> to households in rural areas. In order to maintain the functionality of the systems and the supply infrastructure in the long term, training measures were implemented at the same time, covering the fields of service, maintenance and system monitoring.

As a demonstration project, the community of Ksar Ghilène in a desert area in southern Tunisia was electrified with a central photovoltaic system. In this case solar energy is used for water treatment, operating telephones and for lighting.

Exchange rate (Sept. 2006):

1 Tunisian dinar (TD) = 0.59 euro (EUR);

1 US dollar (USD) = TD 1.34

<sup>22</sup> See Law No. 2004-72 under Legal Framework.

<sup>23</sup> Mouldi Ben Mohamed, The utilization of geothermal energy in agriculture in Kebili region, Southern Tunisia.

## 16.7 Information Sources

- Amous, Samir:  
Strategie nationale pour la mise en oeuvre du mecanisme pour le developpement propre en tunisie, Rapport final, Ministere de l'environnement et du developpement durable, Tunisia 2005
- Agence Nationale pour la Maîtrise de l'Energie (ANME):  
Evolution of the Solar Water Heater's market in Tunisia, 2003
- Agence Nationale pour la Maîtrise de l'Energie (ANME):  
Naceur Hammami – Directeur des Énergies renouvelables, Marché des CES en Tunisie le programme PROSOL TUNISIE, 2005
- Ben Abdallah, Moncef, Maîtrise de l'énergie: l'approche tunisienne, in: Liaison Énergie-Francophonie 2006
- Ben Mohamed, Mouldi:  
The utilization of geothermal energy in agriculture in Kebili region, Southern Tunisia, 2003
- Bundesagentur für Außenwirtschaft (bfai):  
Hoher Ölpreis bewegt Tunesien zur Diversifizierung der Energiebasis, May 2004
- Global Environment Facility (GEF):  
United Nations Environment Programme (UNEP) and Sustainable Energy Finance, June 2006
- Haarpaintner, Dr. Guido:  
Solarenergie in Tunesien – Markt und Perspektiven, May 2005
- Khalfallah, Ezzeddine  
(Directeur Général ANME, Tunisie):  
Les énergies renouvelables en Tunisie: enjeux et perspectives, in Liaison Énergie-Francophonie 2005
- Kraut, Sandra:  
Windenergie in Tunesien/Energie éolienne en Tunisie, Partenaire & Développement Hiver 2006
- Ounalli, Ahmed (STEG):  
Aspects Institutionnels et Financiers de l'Expérience d'Electrification Rurale: Cas de la Tunisie, 2006
- Breuer, Siegfried, Bundesagentur für Außenwirtschaft (bfai), DEG – Deutsche Investitions- und Entwicklungsgesellschaft mbH:  
CDM-Markt kompakt – Tunesien, August 2006
- Republique Tunisienne:  
La loi no2004-72 du 02 aout 2004 relativ a la maitrise de l Breuerenergie, 2004
- Société Tunisienne d'Electricité et du Gaz (STEG):  
Annual Report 2005
- Société Tunisienne d'Electricité et du Gaz (STEG):  
Appel d'offres international (N° 2006 E 4025), 2006
- United Nations Development Programme (UNEP), Global Environment Facility (GEF):  
Project Brief, Development of On-grid Wind Electricity in Tunisia for the 10th Plan, 2004
- Wenzel, Klaus, GTZ/CITET:  
Firmenpool Umwelttechnik Tunesien/Maghreb, May 2005

## 16.8 Contact Addresses

**Société Tunisienne d'Electricité et du Gaz (STEG)**  
38 rue Kamel Attaturk 1080 Tunis  
Postal address: B.P. 190, 1080 Tunis cedex  
Tel. +216 (71) 341 311  
Fax +216 (71) 330 174/349 981/341 401  
www.steg.com.tn

**Agence Nationale pour la Maîtrise de l'Énergie (ANME)**  
3, Rue 8000 Mont Plaisir  
1073 Tunis  
Tel. +216 (71) 78 77 00  
Fax +216 (71) 78 46 24  
E-mail: boc@anme.nat.tn

**Centre International des Technologies de l'Environnement de Tunis (CITET)**  
Boulevard LAYDER Yesser ARAFAT  
1080 Tunis  
Tel. +216 (71) 206 646  
Fax +216 (71) 206 655  
www.citet.nat.tn

**Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) Tunisia Office**  
Centre Babel, Entrée Olivier  
12, rue du Lac Turkana  
2045 Berges du Lac de Tunis, Tunisie  
Tel. +216 (71) 860 320/860 935/861 741  
Fax +216 (71) 860 719  
E-mail: gtz-tunesien@gtz.de  
www.gtz.de/tunisie

**Ministere de l'Environnement et du Developpement Durable**  
Centre Urbain Nord  
1080 El – Menzah  
Tel. +216 (71) 704 000  
Fax +216 (71) 704 340  
E-mail: boc@mineat.gov.tn  
www.environnement.nat.tn

**Ministere de l'Industrie et de l'Énergie et des Petites et Moyennes Entreprises**  
Immeuble Beya  
40 rue 8011, Montplaisir  
1002 Tunis  
Tel. +216 (71) 791 132/842 343/894 216  
Fax +216 (71) 782 742  
E-mail: mind@ministeres.tn

**Ministere du Developpement et de la Cooperation Internationale**  
Place Ali Zouaoui  
1069 Tunis  
Tel. +216 (71) 240 133, 350 753  
E-mail: boc@mdci.gov.tn

**Embassy of the Federal Republic of Germany in Tunisia**  
1, Rue el Hamra, Mutuelleville  
1002 Tunis Belvédère  
Tel. +216 (71) 78 64 55  
Fax +216 (71) 78 82 42  
www.tunis.diplo.de

**Embassy of the Republic of Tunisia**  
Lindenallee 16  
D-14050 Berlin  
Tel. +49 (30) 3 64 10 70  
Fax +49 (30) 30 82 06 83

**German-Tunisian Chamber of Commerce and Industry Immeuble "le Dôme"**  
1st Floor, Rue du Lac Léman  
1053 Les Berges Du Lac  
Tel. +216 (71) 965 280  
Fax +216 (71) 964 553  
E-mail: info@ahktunis.org  
www.ahktunis.org



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>

