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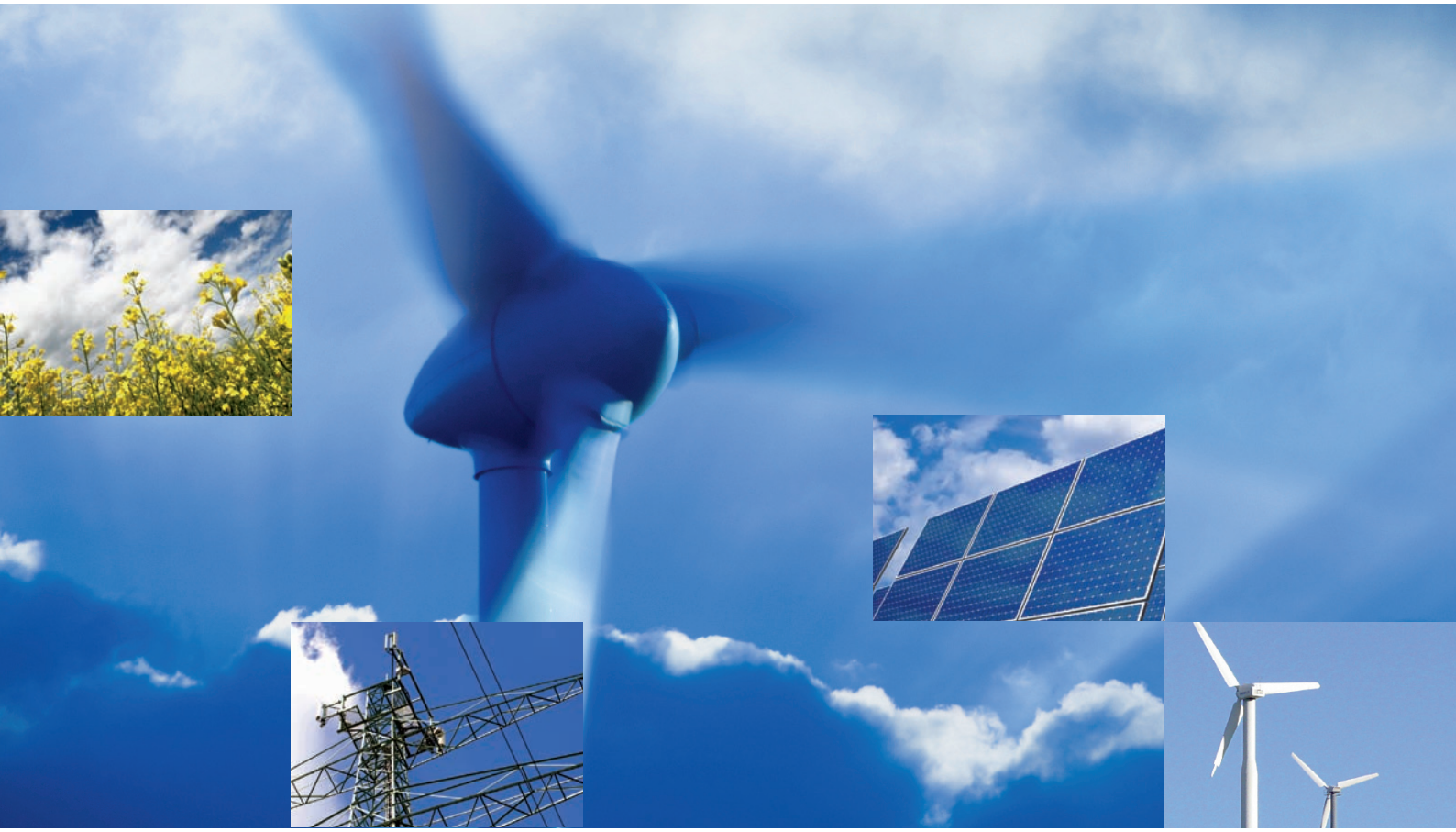

Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

16 Country Analyses

Eschborn, November 2009

Energy-policy Framework Papers,
Section »Energy and Transport«

gtz TERNA Wind Energy Programme

On behalf of
Federal Ministry
for Economic Cooperation
and Development

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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 2008, renewable energy resisted the credit crunch more successfully than many other sectors for much of the year and new investment reached $120 billion, up 16 percent over 2007. However, by the end of the year, the impact of the crisis was beginning to show.

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 volatile 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 information released by the Renewable Energy Policy Network for the 21st Century (REN21), by early 2009, policy targets existed in at least 73 countries and at least 64 countries had policies to promote renewable power generation. Feed-in tariffs were adopted at the national level in at least five countries in 2008/early 2009, including Kenya, the Philippines and South Africa.

During 2008 the existing wind power capacity grew by 29 percent to reach 121 GW. The US and European market acted as the driving force for the wind energy industry and provide still an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries: China doubled its wind power capacity for the fifth year in a row, ending 2008 at 12 GW, and breaching China's 2010 development target of 10 GW two years earlier. It is the successes in countries such as China, India and Egypt which encourage commitment beyond the borders of industrialised nations. In those 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 16 developing and emerging countries.

This latest country survey and the previous editions are available on our homepage: www.gtz.de/wind. 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, November 2009

THE COUNTRIES		
Latin America	Africa/Middle East	Asia
Argentina	Egypt	Indonesia
Brazil	Morocco	Pakistan
Caribbean States	Namibia	Viet Nam
Chile	Senegal	
Mexico	South Africa	
Panama	Tunisia	
Peru		

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 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 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 potentials 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 funding sources from national and international donors. If required, CDM baseline studies can be prepared. 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 2009, TERNA has been active in over ten countries around the world. Further information on GTZ's TERNA wind energy programme is available at www.gtz.de/wind or directly from:

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List of Abbreviations

ADF	African Development Fund
AFD	Agence Francaise de Devéloppement-French bilateral cooperation agency
AfDB	African Development Bank
AREED	African Rural Energy Enterprise Development Program
ASER	Agency for Rural Electrification
BOOT	Build, Own, Operate and Transfer
BV Cert	Bureau Veritas Certification Holding
CEGELEC	CGEE (Compagnie Générale d'Entreprises Electriques) -Alsthom
CER	Certified Emissions Reduction
CERER	Centre d'Études et de Recherches sur les Énergies Renouvelables
CDCF	Community Development Carbon Fund
CDM	Clean Development Mechanism
CRSE	Commission de régulation du secteur de l'électricité
CSS	Compagnie Sucrière du Sénégal
DNA	Designated National Authority
DNV	Det Norske Veritas
EB	Executive Board
EDBI	Export Development Bank of Iran
ECOWAS	Economic Community of West African States
EIA	Energy Information Administration
ENDA	Action Environnement-Développement (Environmental Development Action)
ERPA	Emissions Reduction Purchase Agreement
FCFA	Franc de la Communauté Financière Africaine
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOS	Government of Senegal
HV	Hight Voltage
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
ICS	Industries Chimiques du Sénégal
IDA	International Development Association
IEA	International Energy Agency
IPP	Independent Power Producer
Km	Kilometer
kV	Kilo Volt
kWh	Kilowatt-hour
kWp	Kilowatt-peak
LPG	Liquefied Petroleum Gas
MV	Medium Voltage
MW	Mega Watt
MWh	Mega Watt Hour
N/A	Not Available
OHADA	Organization for the Harmonization of Business Law in Africa
OMVG	Organization for the Development of the Gambia River Basin
OMVS	Organization for the Development of the Senegal River
PIN	Project Idea Note
PDD	Project Design Document
PERACOD	Program to Promote Rural Electrification and a Sustainable Supply of Domestic Fuel
PJ	Petra Joule
PPA	Power Purchase Agreements
PPER	Rural Electrification Priority Program
RE	Renewable Energy
RES-E	Electricity made from Renewable Energies
RECIPES	Renewable Energy in emerging and developing countries
REEEP	Renewable Energy & Energy Efficiency Partnership
SAR	Societe Africaine de Raffinage
SEMIS	Services de l'Energie en Milieu Sahélien
SENELEC	Société National d'Éléctricité du Sénégal
SGS	Société Générale de Surveillance
SHS	Solar Homes Systems
SONACOS	Société Nationale de Commercialisation des Oléagineux du Sénégal
UK	United Kingdom
UNDP	United Nations Development Program

UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
US	United States
USD	United State Dollar
V	Volt
WAEMU	West African Economic and Monetary Union
WAPIC	West African Power Industry Convention
WAPP	West African Power Pool
WB	World Bank
WEI	Wind Energy International
Wp	Watt-peak

11.1 Introduction

FIGURE 1:
MAP OF SENEGAL

Source: CGIAR 2004

Senegal is a Western African country bordered by the Atlantic Ocean to the west and Mauritania, Mali, Guinea, Guinea-Bissau and The Gambia (see figure 1).

Senegal is characterized by a tropical climate. Especially in Dakar the characteristic heat and humidity are moderated by cool ocean wind. The rainy season, between June and November, brings heavy precipitations along with strong south-easterly winds. The dry season, from December to May, is exacerbated by the hot, dry Harmattan[1] winds.

Senegal is a republic under multiparty democratic rule. The president of Senegal is the head of state, government and commander-in-chief of the armed forces, and serves a five-year term. The president can be re-elected twice. In the presidential election of 2000, after 19 years of presidency, Abdou Diouf was defeated in a free and fair election by opposition leader Abdoulaye Wade. Mr Wade was reelected in 2007.

Senegal has supported functional integration among French-speaking West African states through the West African Economic and Monetary Union (WAEMU). Senegal has a high profile in many international organizations and was a member of the UN Security Council in 1988 – 89. It was elected to the UN Commission on Human Rights in 1997.[3]

Senegal is also a member of the Organization for the Harmonization of Business Law in Africa (OHADA). The stated purpose of OHADA is to facilitate and encourage both domestic and foreign investment in the member states.

The main industries include food processing, mining, cement, artificial fertilizer, chemicals, textiles, refining imported petroleum, and tourism. Exports include fish, peanuts, petroleum products, phosphates, and cotton. The principal foreign market is Mali at 19.5 percent of exports (as of 2008). Other foreign markets include India (5.9 %), France (5.5 %), The Gambia, (5.4 %) and Italy (4.9 %). The main import products are food and beverages, capital goods and fuels. In 2008, Senegal mainly imported from the following countries: France (20 %), UK (15.4 %), China (7.5 %), Belgium (4.6 %), Thailand (4.5 %) and the Netherlands (4.1 %).[4]

Table 2 shows that the Senegalese GDP has been growing constantly more than 5 % annually between 1995 and 2008. In 2008, the inflation rate was 6.6 %. The percentage of the population living below the poverty line at na-

TABLE 1:
2008 STATISTICS

Area	Population	GDP	GDP per capita	Export	Import
196 722 km²	13.7 million	9.15 billion € (2008)	1 092.3 € per capita (2008)	1.3 billion € free on board (f.o.b.) (2008 est.)	3.1 billion € free on board (f.o.b.) (2008 est.)

U.S. Department of State 2009 and IMF 2009[2]

[1] The Harmattan wind is a dry and dusty West African trade wind. It blows south from Sahara into the Gulf of Guinea between the end of November and the middle of March (winter).

[2] Original prices are given in US Dollar, Exchange rate 2008: 1 US Dollar = 0.6827 Euro, (CIA World Factbook, 2008)

[3] U.S. Department of State 2009

[4] CIA World Factbook, 2008

TABLE 2:
GDP OF SENEGAL 2000- 2008

	Units	2000	2002	2004	2006	2008
GDP (current prices)	Billions €	3.2	3.7	5.5	6.4	9.1

Source: IMF

tional level fell from 57.1 % in 2001 to 54 % in 2004. The per capita income in Senegal was 1 600 US Dollars in 2008.

Senegal is part of the BCEAO (Banque Centrale des États de l'Afrique de l'Ouest, »Central Bank of the West African States«) and uses the West African CFA franc[5] (French: franc CFA or simply franc, ISO 4217 code: XOF).

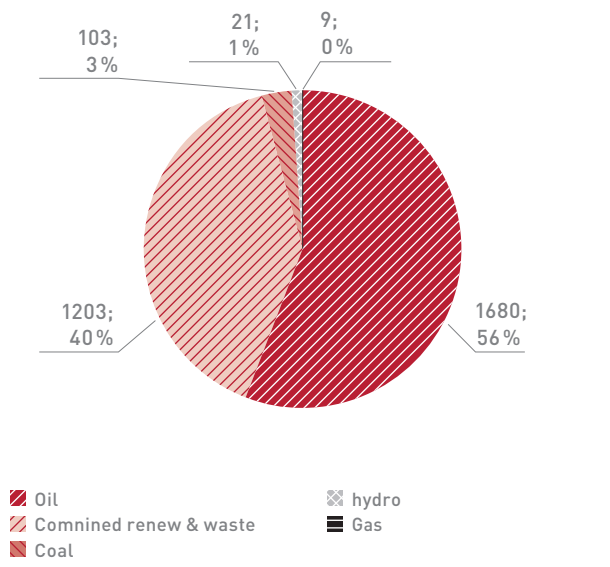
11.2 Energy Market

Overview Energy Market

The development of the total primary energy supply experienced a steady increase during the last years. Starting at 1 300 ktoe in 1970 of which more than 50 % were provided by combined renewables and waste. Over the last thirty years, the share of coal and oil increased much stronger than the other sources. The primary energy supply in Senegal reached 3 016 ktoe (equal to 126 PJ or 35 076 GWh) in 2006. Senegal's primary energy supply is dominated by oil (55.7 %), followed by combined renewables and waste (39.9 %) (i.e. waste materials, biomass and geothermal energy), coal with 3.4 %, hydro with 0.7 % and gas with 0.3 %. The split into the various sources can be seen in figure 2.

Senegal relies heavily on wood fuel consumption which reached 60 % of the country's total energy consumption and accounts for about 90 % of households' energy needs.

FIGURE 2:
SHARE OF TOTAL PRIMARY ENERGY SUPPLY
[3 016 KTOE] IN SENEGAL IN 2006



Source: IEA 2006

TABLE 2:
FINAL ENERGY CONSUMPTION ACCORDING
TO END USE SECTORS IN 2006

	Final Energy supply [ktoe]	Share [%]
Total final energy supply	3 016	
Industry	302	10
Transport	1 207	40
Residential	1 387	46
Commercial and Public Services	90	3
Non- Energy	30	1

Source: IEA 2008

Senegal has a very large Liquified Petroleum Gas (LPG) market. The LPG-Consumption of Senegal amounted to about 150 000 t in 2008 and Senegal is by far the largest LPG-importer in West Africa. In 2006, the natural gas consumption of Senegal accounted 50 million cubic metres and was covered by exploiting its own reserves. The overall oil consumption of 36 200 barrels per day was covered by imports thus leading to high import dependency of fossil fuels. Up to now, there are no proven oil resources in Senegal, but own exploration efforts as well as by neighbouring countries are conducted.[6] Coal neither exists as proven reserves nor as primary energy source.[7]

[5] The West African CFA franc is besides Senegal the national currency in the following states: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, and Togo. The franc CFA is pegged with the Euro

[6] Potential offshore oil resources are around 700 Mio barrels, estimated, GTZ 2007a

[7] IEA 2006

The Electricity Grid

SENELEC (Société National d'Éléctricité du Sénégal) had a monopoly for the grid-connected generation, transmission and distribution of Senegal's electricity. Now an unbundling is planned so that generation and distribution are opened for private investors. SENELEC will continue to hold the monopoly for transmission (see Fehler! Verweisquelle konnte nicht gefunden werden.Fehler! Verweisquelle konnte nicht gefunden werden.).[8]

In 2005, the high voltage transmission grid of SENELEC consisted of 1 036 km power line of which 760 km are designed for a voltage of 225 KV and 276 km for 90 KV. There are four HV/MV injectors equipped with 19 transformers for an installed capacity of 757 MVA and 2 HV distribution stations. The OMVS system on the Senegalese territory had three (03) 225 /30 KV stations (Matam, Dagana and Sakal) and one (01) 225/90 KV station (Tobène).[9] In 2005, the electricity distribution system of SENELEC was constituted as follows:

- A MV network at 6.6 KV and 30 KV with a total length of 6 827 km;
- A LV network with a total length of 6 761 km;
- 13 HV/HV substations and 3 285 MV/LV substations.

The electrical system of SENELEC consists of two subsystems: the interconnected system network and that of the non-interconnected system (see figure 3).

SENELEC is currently planning various projects to develop the transmission and distribution network. For instance, the project »Boucle« 90 KV from Dakar with 28.63 km of 90 kV underground cables, four stations 90/30 kV shielded isolated in sulfur hexafluoride (SF6) and 29.5 km of fiber optic cable is under construction and financed by the People's Republic of China for an amount of 23.4 billion Francs CFA (35.6 millions Euros). It is planned to be commissioned in 2010.[10]

In 2000, as a member of the Economic Community of West African States (ECOWAS), Senegal had signed the West African Power Pool (WAPP) agreement[11], where it

FIGURE 3:
ELECTRICITY TRANSMISSION GRID OF SENEGAL

Source: WAPP 2007

was decided to develop energy production facilities and interconnect the respective electricity grids. According to the agreement, the WAPP was accomplished in two phases but was planned to be fully implemented by 2005. The first phase involved countries that are already interconnected, including Nigeria, Benin, Burkina Faso, Cote d'Ivoire, Ghana, Niger and Togo. The second phase involved countries which are yet to have interconnection facilities, which include Guinea, Guinea-Bissau, Liberia, Mali, Senegal, Gambia and Cape Verde. Under the agreement, WAPP is expected to harmonize the regulatory framework that governs the electricity sector in each member country.

Under this project, the Organization for the Development of the Senegal River (OMVS), which consists of Mali, Mauritania and Senegal, has constructed two dams. The Diama dam, located in Senegal, was completed in 1986 and its primary function is to stop the upstream encroachment of seawater from the Atlantic Ocean. The Manatali dam, built by the OMVS on the Bafing River, the main tributary of the Senegal River in Mali, was completed in 1987. The Manatali project also includes a 200 MW power station and a 1 300 km grid of transmis-

[8] Pers. Information Mr. Mansour Assani Dahouenon, GTZ Senegal, 20th of October 2009
[9] WAPP 2007
[10] SENELEC 2007
[11] Archive 2003

sion lines to the capitals of Mali (Bamako), Mauritania (Nouakchott) and Senegal (Dakar).
Since around 2000, the two systems, Organization for the Development of the Gambia River Basin (OMVG) (region of Gambia, Guinea, Guinea Bissau and Senegal) and OMVS implement projects as the construction of hydropower plants and the development of transmission lines.
In 2007, OMVG Energy Project consists of the development of hydropower sites at Sambangalou (128 MW) in Senegal at an approximate cost of 292 million Euros,[12] and a 1 677 km 225 kV transmission line interconnecting the national power systems of Senegal, The Gambia, Guinea and Guinea Bissau.[13] Pre-investment studies had rendered the project techno-economically feasible with mitigable environmental and social impacts. Projected commissioning of the project is within the period 2011 –2012.

The capacity of power transmission of Senegal with one hundred percent increment has reached 750 MW in 2008.[14]

Installed Capacity

In 2007, the installed electrical generation capacity in Senegal was estimated at 561 MW, mostly supplied by thermal power plants and Diesel powered generators. However, due to modernisation deficits the usable capacity is reduced to about 485 MW. Renewable energies do not play a significant role for grid-connected electricity supply. Existing capacities are not sufficient to cover the increasing electricity demand which has been growing by 8.4 % on average between 2005 and 2007.[15]
The state-owned utility SENELEC plans to develop new thermal power plants. For instance, the Sendou (Bargny) project consists of a coal-fired power plant of 125 MW planned for 2011 and a 70 MW diesel power plant at Tobène in the Tivaoune region planned for 2010.[16]
Until 2012, additional 520 billion FCFA (793 million Euros) are planned to be invested including a new coal power plant and a hydro power project developed jointly with Guinea in Souapéti. According to these plans, overall installed capacity will reach 600 MW in 2012.
The number of SENELEC clients has increased by 9.2 % from 2006 to 2007.[17] However, the electricity produced by SENELEC and private companies still does not satisfy electricity demand. Firstly, the existing capacity is insufficient to meet demand, which is continuing to grow, while secondly many of the power stations are obsolescent, and consequently have to be shut down at frequent intervals for maintenance or essential repairs.

TABLE 3:
POWER PLANTS AND INSTALLED CAPACITY

Producer	Type of power plant	Installed capacity
SENELEC	**TOTAL**	395 MW
	Thermal power plants	138.7 MW
	Diesel generators	208.3 MW
	Gas turbine power plant	48 MW
Private generation	**TOTAL**	166 MW
	Diesel generators	48 MW
	Hydro power (Manantali)	66 MW
	Combined cycle power plant (GTI)	52 MW

Source: GTZ 2007a

Electricity generation

Electricity generation in Senegal amounted to 2 370 GWh in 2006 jointly produced by SENELEC and private companies and was estimated at 3 110 GWh in 2008.[18] The development of electricity generation in 2006 by different fuel sources can be seen in Table 4.

[12] And at Kaleta (240 MW) in Guinea at an approximate cost of 178 million Euros
[13] WAPIC 2007
[14] EDBI 2008
[15] GTZ 2007 a
[16] GTZ 2007 a
[17] SENELEC 2007
[18] IEA 2008, World Perspective Monde 2009

In 2006, the thermal power generation share accounts for 87 % in the total national electricity generation, hydro-power accounts for 9.6 %, biomass for 2.1 %, solar energy for 0.1 % and other sources for 1.2 %.[19]

Senegal is neither importing nor exporting electricity.[20]

In 2006, the residential sector accounted for the largest share of electricity consumption (around 37 %). The industry sector accounted for 30 %; the commercial and public services sector for 33 %.

Electricity consumption in Senegal has risen at an average of 6 % per annum over the past ten years. The projected annual growth rate for the next ten years is even higher, amounting to an average of 10 %.[21]

A part of the generated energy is not supplied to the transmission and distribution systems due to switching disruptions and outages. These losses amounted to 29.74 GWh in 2005 compared with 13.74 GWh in 2004 and 6.98 GWh in 2003. The sharp increase in energy losses is based on system malfunctions (at a rate of 88 %), insufficient production capacities and cancellations from big clients (contracts between the electricity utility of Senegal and big clients such as industrial companies have been cancelled).[22]

TABLE 4:
DEVELOPMENT OF THE ELECTRICITY GENERATION IN SENEGAL, 1971-2006, IN GWH

Oil	1971	1976	1981	1986	1991	1996	2001	2006
Combined Renewables & waste	400	500	600	750	900	1 000	1 600	2 000
Gas	50	50	50	50	50	50	50	50
Hydro	0	0	0	0	20	100	0	50
Geothermal/ solar/ wind	0	0	0	0	0	0	10	250
Total electricity Generation	0	0	0	0	0	0	100	20

Source: IEA 2008

TABLE 5:
FINAL ELECTRICITY CONSUMPTION ACCORDING TO END USE SECTORS IN 2006

	Electricity [GWh]	Percentage
Total final consumption	1 757	100 %
Industry	531	30.2 %
Transport	0	0 %
Residential	646	36.8 %
Commercial and Public Services	580	33.0 %
Agriculture / forestry	0	0 %
Fishing	0	0 %
Other Non-Specified	0	0 %

Source: IEA 2008

Renewable Energies

Currently, the use of (new) renewable energies is not widely spread in Senegal. Electricity produced from hydro power accounts for 234 GWh (9.6 %), electricity from biomass for 50 GWh (2.1 %), and solar energy for only 4 GWh (0.1 %).[23]

Senegal has a very high yet still unexploited solar energy potential. However, the Senegalese government expects to increase the role of renewable energies in the future.[24]

In 1986, the technically feasible hydropower potential of Senegal was estimated at 4 250 GWh /year.[25] Construction of the 200 MW Manantali plant (800 GWh /year),[26] as part of the Senegal River project was scheduled to begin in September 1997 and was successfully completed in 2001.

Furthermore, Schott Solar, SMA Solar Technology and Kaïto have successfully completed their pilot project in Africa: the first solar emergency power system for a hospital in Senegal was officially started up on October 18th 2008, together with the village community in Baïla. On the roof of the clinic, 102 Schott Solar modules produce approximately 8 MWh of electrical energy a year, and any surplus energy is stored in batteries.[27]

[19] IEA 2009
[20] IEA 2009
[21] GTZ 2007a
[22] WAPP 2007
[23] IEA 2009
[24] GTZ 2007a
[25] Recipes 2006
[26] Senegal controls 60 MW oft the total installed capacity of 200 MW.
[27] Schottsolar 2008

Electricity Prices

A 10 percent increase in electricity prices was imposed in 2002 to reduce the government subsidy needed. The variable cost per kWh is 59.70 FCFA / kWh for the whole interconnected system (including procurement) while units from the SENELEC interconnected network reach 58.14 FCFA / kWh. The cost differs from 52.49 FCFA / kWh for the Kounoune power station to 91.73 FCFA / kWh for the Aggreko SOGEM power plant, both thermal power plants. In contrast, the production costs for electricity from the Manantali hydroelectric power station amount to only 18.41 FCFA / kWh.

The average electricity purchase costs for Senegalese end consumers were 111 FCFA / kWh in 2007 against 90 FCFA / kWh in 2006, which is an increase of 12.2 %. Table 6 shows the average electricity price for end consumers.

TABLE 6:
AVERAGE ELECTRICITY PRICE FOR END CONSUMERS, 2003 TO 2007, IN FCFA / KWH AND EURO / KWH

	2003	2004	2005	2006	2007
Price (FCFA/kWh)	83	82	79	90	101
Price (Euro/kWh)	0.126	0.125	0.120	0.137	0.154

Source: SENELEC 2007

Liberalisation

In December 1996, the Government of Senegal embarked on a privatization-focused electricity sector reform with the technical and financial support of the World Bank (WB) and other donors. The government was eager to transform its electricity sector and expand coverage for both its rural and urban populations. It initiated institutional, legal and regulatory reforms. In March 1999, it sold 34 % of the shares of SENELEC to a joint consortium of Hydro-Quebec International and Elyo (HQI/ Elyo). Considerable conflicts ensued, especially over investment and pricing.

SENELEC's partial privatisation lasted only eighteen months. In September 2000, the new government announced that it would re-purchase HQI/Elyo's shares. In 2001, it tried to re-privatise SENELEC with a new model designed to address flaws that marred the first relationship. Though two consortia eventually bid under this model, and despite active negotiations with both, a deal could not be struck with either and the privatisation attempt was abandoned. SENELEC remains fully state-owned, albeit operating in a new regulatory environment.[28]

The situation for Independent Power Producers (IPPs) is still quite difficult in Senegal. In 1998, the Senegalese government began to open the power sector for private investors. Government-owned SENELEC was transformed to a stock company and power production was opened to IPPs. However, SENELEC will keep a monopoly on purchase and distribution of electricity until 2009. In practice, this complicates market access for IPPs, as SENELEC is not paying adequate electricity rates. Also, SENELEC impedes power trading with third parties as the transmission of electricity through the grid owned by SENELEC is not possible.[29]

According to the German technical cooperation Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), three large industrial enterprises in Senegal (the chemical company Industries Chimiques du Sénégal (ICS), sugar producer Compagnie Sucrière du Sénégal (CSS), and the peanut processing company Société Nationale de Commercialisation des Oléagineux du Sénégal, SONACOS) all have own generating facilities which mostly generate electricity for their own consumption. Feed-in of the electricity in the SENELEC grid has not been achieved due to contractual difficulties with SENELEC.[30]

As of today, it is not yet clear how the situation in the power market will develop after 2009. A major impediment for further market liberalization remains the lacking privatization of SENELEC. Currently, Power Pur-

[28] Gokgur 2006
[29] GTZ 2007 a
[30] GTZ 2007 a

chasing Agreements (PPA) between SENELEC and IPPs are mostly Build-Own-Operate (BOO) type contracts.[31]

Rural Electrification

In 2008, Senegal's electrification rate was approximately 33 %, not having improved much compared to 32 % in 2001.[32] In 2007, rural electrification amounted to 12.5 % of households compared to 8 % in 2001. Rural electrification is mostly limited to areas close to large population centres. However, 56 % of the population (5 350 000 inhabitants) live in rural areas in 13 200 villages.
The Senegalese Agency for Rural Electrification (Agence Sénégalaise d'Electrification Rurale, ASER), which was founded in 2000, developed a concession model together with the World Bank (WB). The rural regions of Senegal which have not been electrified yet have been divided into a total of 11 geographical concession areas. The electrification of these areas is put out to public tender by ASER and is undertaken by private-sector enterprises. The concession model includes the following elements: grid expansion, isolated networks and single homes supply (mainly solar home systems).[33] The financing of these areas is secured through the Senegalese State and international donors - World Bank (3 concessions), KfW Entwicklungsbank (1 concession), AfDB (1 concession), AFD (1 concession) and 5 concessions are not financed yet.[34] Renewable energies offer economic and ecologic advantages in sparsely populated rural areas and e.g. the KfW Entwicklungsbank settled a minimum share of 25 % for renewable energies in its concession.[35]

In 2003, assisted by the World Bank (WB), the government adopted the Rural Electrification Priority Program (PPER).[36] Senegal's PPER aims to improve access to electricity in rural areas from the 2003 level of 12.5 percent of households to 62 percent by 2022. The bidding process for the first concession, Dagana-Podor, was launched in early June 2006 by the rural electrification agency (ASER). IDA will provide a 5.58 million US Dollars subsidy, including 350 000 US Dollars for PREMs, GEF will provide an additional 1.1 million US Dollars subsidy.

To support rural electrification, the Senegalese Government is also developing programs of rural photovoltaic electrification.[37] It has chosen this system to electrify the large number of remote small villages (more than 13 000 villages) whose average population does not exceed 460 inhabitants. The Foundigne region has been chosen as pilot concession project and in 2003, Isofoton supplied and installed the first 10 000 Solar Homes Systems (SHS) of 50 Wp and 4 power plants of 10 to 20 kWp.
Small-scale isolated networks for the electrification of villages are a specification for Senegal. These so called ERILs (Electrification Rural par des Initiatives Locales) offer high chances for the implementation of renewable energies.[38]

11.3 Market Actors

Following institutional reform in 1998, Senegal's electricity sector was split into three entities: the national utility SENELEC, the Agency for Rural Electrification (ASER) and the Electricity Regulatory Board.

Ministére de l'Energie (Ministry of Energy)
The Ministry of Energy has the overall responsibility for the energy sector of Senegal and contains inter alia a division for renewable energies (Direction des Energies Renouvelable). For more information see webpage: http://www.energie.gouv.sn/index.php.

Ministère de l'Environnement, de la Protection de la nature, des Bassins de rétention et des Lacs artificiels (Ministry of Environment, nature protection, retention basins and artificial lakes)
The Ministry of Environment is responsible for the whole environmental sector. It is in charge of the implementation of legislation and regulations. This Ministry hosts the Designated National Authority (DNA) for Clean Development Mechanism (CDM) projects (see section 1.5) For more information see webpage:
http://www.environnement.gouv.sn/

[31] Jensen 2009
[32] UNDP 2008
[33] GTZ 2007
[34] Pers. Information Mr. Mansour Assani Dahouenon, GTZ Senegal, 20th of October 2009
[35] GTZ 2007 a
[36] De Gouvello 2007
[37] Gonzalez 2003
[38] GTZ 2007 a

SENELEC (Société nationale d'électricité du Sénégal)

SENELEC is the national electricity company of Senegal and was established in 1983 after the nationalization and merger of Électricité du Sénégal and Société sénégalaise de distribution d'électricité. In 1998, the Agency for Rural Electrification (ASER) and the Electricity Regulatory Board were split from SENELEC and the company was put into privatization. In 1999, the consortium of Hydro-Québec and Elyo (Suez Lyonnaise des Eaux) bought 34 % of SENELEC's shares. The deal was annulled by President Abdoulaye Wade in March 2000, and Hydro-Québec and Elyo withdrew from Senegal in January 2001.

The company has 2 500 employees, 298 executives, 1216 control agents and 978 enforcement officers. In 2007, SENELEC had 711 600 customers and its turnover was 180 500 million FCFA (275 million Euros). In 2006, SENELEC received 88 billion FCFA of subsidies and its arrears alone amount to 1.5 % of GDP.

ASER (Agency for Rural Electrification)

To overcome the low rural electrification, by 1998 the Government of Senegal has introduced significant changes in the electricity sector. These reforms, written down by the Law 98-29 of 14 April 1998, aimed primarily at ensuring the supply of electricity in the country at lower cost and expand access to electricity, particularly in rural areas. The law has established an agency dedicated to rural electrification, the Senegalese Agency for Rural Electrification (ASER), which has the primary mission of promoting rural electrification and to provide the technical and financial assistance required to support initiatives for electrification under the energy policy set by the Minister for Energy.

In 2007, ASER had already mobilized 60 million US Dollars from public contributions to lead the program. Together with the State of Senegal, international partners as the World Bank (equivalent to 15 billion FCFA), the Banque Ouest Africaine de Développement (7 billion FCFA), the German development financing agency Kreditanstalt für Wiederaufbau, KfW (4.2 billion FCFA), the European Union (4.2 billion FCFA, 6.4 million Euros) and the French Agency for Development (AFD) (5 billion FCFA, 7.6 million Euros) support the program.

Commission de régulation du secteur de l'électricité (CRSE) (Electricity Regulatory Board)

Commission de régulation du secteur de l'électricité (CRSE), created by law n° 98-29 of 14 April 1998 on the electricity sector, is an independent authority to regulate the production, transport, distribution and sale of electric energy in Senegal. It also provides consultancy services to the Ministry of Energy.

The Commission seeks the following objectives:

1. Promote the rational development of the supply of electrical energy;
2. Ensure the economic and financial equilibrium of the electricity sector and the preservation of conditions necessary for economic viability;
3. Ensure the conditions of financial viability of the electricity sector, allowing the companies to reach a normal rate of return on their investment;
4. Promote competition and private participation in generation, transmission, distribution and sale of electric energy;
5. Reflect social concerns ensuring safeguarding consumer interests and ensuring the protection of their rights with regard to price, supply and quality of electric power.

Centre d'Études et de Recherches sur les Énergies Renouvelables (CERER)

CERER is a university institute focusing on research on renewable energies. The covered topics are meteorological phenomena, suitable technologies for using solar energy, other types of renewables, radioactivity, etc. The institute carries out studies as well as tests of prototypes and other types of measurements e.g. wind speeds. It covers PV, solar thermal energy, bio energy and wind energy.

Private actors

SENELEC holds a monopoly on transmission and distribution of electricity. Electricity generation, mainly on a Build-Own-Operate (BOO) basis, is open to the private sector, and SENELEC, the sole buyer, signs Power Purchase Agreements (PPAs) with Independent Power Producers (IPPs). The General Electric/GTI Dakar IPP, which supplies approximately 20 % of the electricity sold by SENELEC, was commissioned in 1998. It has an installed capacity of 56 MW. On-line since January 2008, the second IPP Kounoune 1 – 67.5 MW - was partially funded by the International Finance Corporation, Mitsubishi and Matelec S.A.L, a division of the Doumet group from Lebanon, serving as strategic partners.

Other important market participants[39] in the field of renewable energy sources are the consultancy company SEMIS[40], the solar enterprise Total Energie Afrique de l'Ouest (TEAO), among others, along with the Senegalese company AME Solar[41], which sells, installs and maintains solar collectors. EIC, a company from Saint-Louis, produces wind-power-operated water pumps for the local market.

Association

The Société Africaine des Energies Renouvelables (SAER) (Senegalese Renewable Energies Association ASERA) is active in the fields of both wind and solar energy. SAER works mainly for the Senegalese Renewable Energies Association ASERA, but in the past it has also participated in various projects funded by bilateral and multilateral donors (World Bank, UNDP, Government of the Netherlands).

11.4 Political Framework Conditions in the Energy Sector

Senegal's National energy strategy has been published in 2003. The strategy paper on development of the energy sector (Lettre de Politique de Développement du Secteur de l'Energie) of 9 April 2003 identifies the problems of the Senegalese energy sector (i. e. above all the shortfall in electricity generating capacities and the lack of electrification for the majority of the population) and lays down the energy policy framework for the coming years. In Particular, this framework includes the provision of modern forms of energy as a tool in the fight against poverty (especially within the context of rural electrification) and the restructuring of the energy sector (in connection with a greater role for the private sector).

The Senegalese Government began reforming the electricity sector and opening it for private investors in 1998. Two laws in that year (98–29[42] and 98–06) created a state regulatory authority for the electricity sector (Commission de Régulation du Secteur de l'Electricité, CRSE) and converted the state-owned SENELEC into a joint-stock company. At the same time, the electricity production sector was opened up for independent power producers (IPPs). In its strategy paper on the development of the energy sector, the Senegalese Government declared that priority should be given to new power plants being built by private companies. The reason for this is above all SENELEC's chronic shortage of capital. However, until 2009, SENELEC still owns the monopoly for sale and distribution of electricity.[43]

The law 2002-01 weakens the goal of the law 1998-29 that SENELEC needs to buy new production capacities from private suppliers in a tendering process. Legislation and the recent developments of the electricity market regulations are provided by the regulatory body CRSE[44]; e.g. the last Decision No. 2009-04 on charges of retail exclusive power from SENELEC of 1st August 2009.

Rural electrification is one of the priority topics for the Senegalese government and bi- or multilateral donor programs. The objective is to increase electricity access in rural areas from 16 % to 50 % by 2012.[45]

At present the government's efforts are concentrated on expansion of the national power station inventory, preferably with the involvement of IPPs and on rural electrification. In this context, the government is focusing on conventional thermal plants, although the understanding of the importance of diversification and thus of renewable

[39] The addresses of the companies are listed at http://www.areed.org/country/senegal/contacts.pdf

[40] Services de l'Energie en Milieu Sahélien (SEMIS), founded in 1987, compiles studies and expert reports on the subjects of hydropower, electrification, traditional forms of energy and irrigation

[41] AME Solar is planning to set up production facilities for solar collectors in the coming years. The company is receiving financial assistance in the form of a loan from the African Rural Energy Enterprise Development Program (AREED) amounting to US$ 41,000

[42] Loi d'orientation relative au secteur de l'électricité (skeleton law for the electricity sector).

[43] GTZ 2007a

[44] http://www.crse.sn/electricite.php

[45] UNDP 2008

energies is growing. Renewable energy sources are given significant consideration in regard to rural electrification and for the production of biofuels.

11.5 Framework Conditions for Renewable Energies

Strategy and Targets for Renewable Energies

The Ministry of Energy aims at a minimum share of renewable energies in electricity production of 15 % in 2020.[46]

The Senegalese government is currently working on a renewable energy strategy, but results are not available yet.[47] The strategy is planned to be published soon after a study on renewable energies, financed by the French Development Agency (AFD), is finished. This study is in preparation amongst others examining the feasibility of a feed-in tariff for renewable energies in Senegal. The study, due to be published in June 2010, is expected to suggest details of the tariff levels. As a result of the study, implementation of a feed-in law by the Senegalese parliament is hoped to be reached by the end of 2010. GTZ accompanies the whole process to establish a law for renewable energies (incl. the study financed by AFD).

Legal conditions and support schemes for renewable energies

Currently, in Senegal no direct financial support scheme regulating the modalities of grid access and the feed-in of RE-E into neither the national grid nor the tariffs paid for RE-E is in place. Although president Abdoulaye Wade regularly states the importance of renewable energies and the establishment of a feed-in tariff has been discussed for a long time, the introduction of an effective support instrument has up to now been delayed[48], As part of the new renewable energy law which is planned to be implemented by the end of 2010, a feed – in law will be introduced. The Ministry of Energy has decided to establish a new law which is separated from the existing 98-29 law of 14 April 1998 as this is dealing with conventional energies and the electricity sector.[49]

Senegal has defined six preferred sectors for investments (agro-industry, telecommunication, tourism, textile industry, and fish breeding, and mining) – renewable energies are not mentioned. However, other support schemes for investors in renewables exist, especially for solar or wind energy plants. A tax break is available on the income or corporate income tax (30 %) and on the value-added tax (7 %).[50] The Senegalese Government also supports rural electrification (see above). Renewable energies play a significant role in this process as part of the concession model commissioned by the Senegalese government.

The legal conditions for renewable energies have still to be clarified. As no project has been implemented yet, every contract needs to be negotiated individually. For example, standard Power Purchase Agreements (PPAs) only exist for fossil fuelled power plants, but not for renewable energy plants.[51] In Senegal, there are already some companies and joint-ventures in the field of renewable energies, but they will only invest, after the legal framework has been set.[52]

Clean Development Mechanism

Revenues from the Clean Development Mechanism (CDM) could be used as an important incentive to increase the attractiveness of projects using renewable sources of electricity. Senegal has been one of the politically most active countries in Sub-Saharan Africa with regards to CDM.[53] Already in the late 1990s, the secretary of state in the Ministry of Environment organized two CDM workshops in Dakar. Senegal set up its Designed National Authority (DNA) in February 2005 at the Direction de l'Environnement et des Etablissements Classés. A Senegalese (Cheikh Sylla) was member of the CDM Executive Board (EB) until 2007 and Massamba Thioye, a Senegalese consultant, is member of the Methodologies Panel and the Accreditation Panel. In January 2007, a Memorandom of Understanding regarding CDM project development was agreed with France. Despite this political support and a large number of capacity building exercises, Senegal's CDM project pipeline has only developed

[46] Louis Seck (department of renewables energies of the Ministry of Energy) in Jensen 2009
[47] Jensen 2009 and Pers. Information Mr. Mansour Assani Dahouenon, GTZ Senegal, 20th of October 2009
[48] Jensen 2009
[49] Pers. Information Mr. Mansour Assani Dahouenon, GTZ Senegal, 20th of October 2009
[50] Recht kompakt Senegal, bfai, Status: April 2007, in GTZ 2007 b
[51] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[52] Louis Seck (department of renewables energies of the ministry of energy and mining) in Jensen 2009
[53] GTZ 2008

slowly. It currently contains 21 projects, but none of them has been officially registered; only one (landfill) project has its validation terminated and two (biomass) projects are under validation (see table 7). The World Bank's Community Development Carbon Fund (CDCF) recently signed an Emission Reduction Purchase Agreement (ERPA) for 120°000 CERs from a program to distribute 1.5 million compact fluorescent lamps to rural households.

The main barriers that prevent CDM development in Senegal are non involvement of the local financial institutions in the CDM capacity building process, the lack of official data publicly available for demonstration projects, and the eligibility assessments of CDM projects.[54]

To obtain more information about Senegalese CDM projects, the website of the Direction de l'Environnement et des Etablissements Classés[55] provides lists of projects. Three projects have been formulated and submitted in 2008.

There is some local CDM capacity at the organization Environmental Development Action (ENDA) having acquired know-how for CDM project development and Massamba Thioye planning to set up a CDM consultancy.

TABLE 7:
SENEGALESE CDM PROJECTS (OCTOBER 2009)

Project	Location	Status	Type	Annual Savings [ktCO2e/yr]	Validator
M'beubeuss Landfill Methane Recovery Project	Dakar	Validation terminated	Landfill gas	131	SGS
Partial Substitution of Coal by Jatropha Fruits and Biomass Residues in the Production of Portland Cement	Dakar	At Validation	Biomass energy (agricultural residues)	89	DNV
Energy efficiency improvement Project of CSS sugar mill	Saint-Louis	At Validation	Biomass energy (Bagasse power)	38	BV Cert

Source: UNDP Risø 2009

International donor activities

The German Development Cooperation is one of the major donors in Senegal, providing a sum of 36.5 million Euro in the period 2006/2007. The main organisations for realizing the funded projects in Senegal are GTZ and KfW.[56]

GTZ's TERNA Wind Energy Program is the main international actor in the field of wind energy. In course of an ongoing project, wind measurements were carried out for two sites (Kayar and Potou on the coastline between Dakar and St. Louis) and a feasibility study for Potou is currently being conducted.[57]

Furthermore, the GTZ PERACOD program supports ASER and the relevant directorate of the Ministry of Energy in carrying out their off-grid rural electrification program as well as training communities and the private sector in implementing the measures. The program began in 2003 and will last until 2015. The program also makes use of funding from the EU Energy Facility and the »Energising Development« program of the Netherlands Directorate-General of Development Cooperation – DGIS.[58] An improved stove roll-out project and advice on the establishment of a favourable regulatory framework for the promotion of renewable energies (together with the French development cooperation) are also part of the program.

Renewable energy and energy efficiency will form a new focal area in the German-Senegalese development cooperation; a corresponding strategy is currently under elaboration.

International donors play a major role in financing activities for rural electrification. The main international donors

[54] UNDP 2008
[55] http://www.denv.gouv.sn/
[56] Auswärtiges Amt 2009
[57] GTZ 2009
[58] Baur 2009

are World Bank and KfW Entwicklungsbank (see above). Other international assistance organizations are also active in Senegal. For example the French Development Agency is funding a study on the feasibility of a feed-in tariff for renewable energies in Senegal (see above).
In 2008, the Export Development Bank of Iran paid 32 million Euro to Senegal's State Power Company (SENELEC) for the construction of a power transmission line.[59]

11.6 Market potential for wind energy

Wind energy potential

Senegal's wind power potential is concentrated along the coast, particularly at the north coast between Dakar and Saint-Louis. In a study carried out by the Senegal Meteorological Service, wind velocities in the 50 km-long coastal strip between Dakar and Saint-Louis have been 3.7–6.1 m/s. CERER measured an average annual speed of 5.8 m/s at the north coast and 4.2 m/s at the south coast.[60]
In inland areas average wind speeds are between 2 to 3 m/s and are therefore only interesting for a traditional or combined use of wind energy (wind turbines for water pumps and combined wind/hydro systems).[61]
The African Wind Energy Association (AfriWEA[62]) only mentions the GTZ TERNA Wind Energy Program, a study by InWEnt (»Wind regimes of Africa«)[63] and local measurements by ALIZES (an organization for the use of water pumps operated with renewable energies, including wind)[64] as information sources on the Senegalese wind potential. ALIZE was a large program supported through the EU and the French Development Agency. In the context of ALIZE, CERER together with consultants collected data from several measure points until the middle of the 90ties.
InWent reports average wind speeds on the coast of Senegal between 4.5 and 5.5 m/s in the hub height of our reference turbine (45 m). However, these values are comparably low due to obstacles nearby (other buildings, trees etc.).[65]
From July 2007 to July 2008, wind measurements accompanied through capacity building activities have been carried out by Windguard in the context of the GTZ TERNA Wind Energy Programme at the two coastal locations Kayar and Potou. Potou shows, with an average annual wind speed of 6.4 m/s in 70 m height, far better results than Kayar with 5.8 m/s. These measurements are the first ones which have delivered reliable data, as the other studies did not publish the underlying framework conditions.[66]
Based on the results, GTZ and the Senegalese Partner plan to carry out a feasibility study for a wind farm at the location Potou.[67] Once completed, the study will be made available for interested project developers and investors.
High-level wind data can be found on the webpage of »3tier« (http://firstlook.3tier.com/). They offer an initial wind assessment for different hub heights (20 / 50 / 80 m) and locations.

Framework Conditions for Wind Energy

No specific target for the use of wind energy has been established yet.[68] Wind energy is not supported financially in Senegal yet (see above). As average wind speeds even in favourable locations such as the north coast of Senegal are of medium speed, financial support of wind energy is necessary for realisation of projects.[69]
The permission procedure for wind turbines is not standardised and therefore time-consuming. The necessary permits are similar to procedures in Europe so e.g. a building permit and an environmental permit are needed.[70] Additionally, it seems to be necessary to get the approval of the village council.[71]

59 EDBI 2008
60 GTZ 2007 a
61 TERNA 2004
62 http://www.afriwea.org/en/senegal.htm
63 InWEnt 2004
64 See http://www.alizes-eole.com/senegal/vent.htm
65 InWEnt 2004
66 GTZ 2007 a
67 GTZ 2009
68 personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
69 Personal information by phone, Dr. Rehfeldt, Deutsche Windguardt, 04.09.09 and Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
70 personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
71 Jensen 2009

The grid connection conditions for wind energy plants are unknown, as no wind energy plants exist yet. There is a need for training of governmental authorities and staff from SENELEC on state-of-the-art knowledge of wind energy utilisation (regulatory, technical and economic aspects).[72] The electricity market has officially been separated in the three sectors production, transmission, and distribution – but until 2009 SENELEC stills holds the monopoly for sale and distribution of electricity, which creates legal uncertainty and therefore an impediment for private investors and project developers.[73]

Even large private industrial companies[74] that generate electricity for their own supply (partly from agricultural residues) have not reached an agreement (i.e. power purchase contract) with SENELEC on feeding electricity into the grid.[75]

No information is available on specific grid expansion plans for the north coast of Senegal, where commercial wind energy plants could be implemented.

Current Use of Wind Energy and Project Pipeline

End of 2008, the total installed wind energy capacity in Senegal was between 0 and 10 KW.[76] In 2009, no commercial wind energy plant has been built in Senegal, although plans for pilot projects exist.

The use of wind energy with multi-wing wind turbines for water pumping has a long tradition in Senegal. They are mainly installed in a belt parallel to the north coast where fruits and vegetables are planted in a large scale. These mainly locally produced small wind turbines are robust and are often financed through international aid. A supporting aspect is that energy supply and demand in the case of irrigation of agricultural areas fit together. The water demand in the wind intensive, but dry months is high, while it is low in the less wind intensive months due to a higher supply of rain and surface water.[77] In 2004, around 200 serviceable wind powered water pumps were installed. The Senegalese-Mauritanian non-governmental organization Alizés promotes the installation of wind pumps, and receives assistance from the European Union and French Development Agency for this purpose.[78]

Besides that, some small scale (10 – 20 kW each), but old-fashioned wind turbines have been financed through Italian donors and constructed in Mboro some years ago. But due to technical problems, they only worked for a few months.[79]

Two other concepts, in addition to the traditional use of wind energy, are promising for the implementation in Senegal: first, the use of modern commercial wind turbines and second, the use of small-scale wind turbines in combined systems for decentralized rural electrification.[80]

The German company INENSUS has developed a concept for a pilot project for a combined system (solar / wind) in cooperation with the GTZ.

The following steps have already been completed[81]

- Wind/solar monitoring with aeolog at five sites
- Socio-economic analyses
- Business model development
- Foundation of INENSUS West Africa in Dakar, Sénégal

The Next Steps will be:

- Spring/Summer 2009: Setup of demonstration system in Sine Moussa Abdou and proof of concept
- Winter 2009/2010: subscription and issuing of shares
- Winter/Spring 2010: scale-up of village electrification

There is one major project in the planning phase, located north of Potou in the region Saint Louis on the north coastal area of Senegal. The so called Gantour project is planned in two phases, starting with a total capacity of 15 MW which shall then be expanded to 50 MW.[82] The estimated cost of the first phase is about 16.5 Mio. Euro. The project was due to start operation in 2009 and should produce 29 000 MWh of electricity per year

[72] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[73] GTZ 2007 a
[74] Chemical company Industries Chimiques du Sénégal (ICS), sugar producer Compagnie Sucrière du Sénégal (CSS) and the agricultural producer (peanuts) Société Nationale de Commercialisation des Oléagineux du Sénégal (SONACOS)
[75] GTZ 2007 a
[76] Senegal was not ranked in list of WWEA 2008, p. 20; Last position 76: Bolivia 0,01 MW; see also: total installed wind energy capacity in Senegal in 2006: 0 KW (IEA 2006)
[77] GTZ 2007a
[78] TERNA 2004
[79] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[80] GTZ 2007 a
[81] Peterschmidt 2009
[82] Ndiaye, 2007, and Jensen 2009

(phase one).[83] Additional financing is planned to be generated through the sale of Certified Emission Reductions (CERs) as part of a CDM project.[84] According to the responsible project development company CEGELEC Toulouse, the construction did not start yet due to several delays.[85] The project is based on wind measurements which have been carried out between May 2004 and May 2005 in Gandon[86] showing an annual average of 5.25 m/s in 40 m height.[87] As part of the project activity training will be provided for the operation and the maintenance of the wind park.

The project is a cooperation between:[88]

- Responsible authority: regional council Saint Louis
- Project developer: C3E (Dakar) and CEGELEC (Toulouse).
- Project designated by the energy ministry
- Financial support through: Région Midi-Pyrenées (France) and l'AFD (Agence Francaise de Devéloppement - French bilateral cooperation agency)

Business Climate

Around 20 companies in Senegal are dealing with renewable energies, some including wind.[89] In addition to that, several foreign companies try to enter the market. However, as there are no existing plants the companies are just starting the business and are recently only active in the planning stages of projects.

Companies from Senegal:

- C3E, Dakar: project developer
- CERER (Centre d'Etudes et de Recerches sur les Energies Renouvelables)
- Senegalese-Mauritanian non-governmental organization Alizés: promotion and installation of wind pumps

Companies from abroad:

- INENSUS German company with a subsidiary in West Africa, Dakar: project developer of small scale hybrid systems including Solar / Wind
- CEGELEC, Toulouse: project developer
- Producers which are in discussion to deliver the wind turbines for the wind park in Saint Louis: Gamesa, Vergnet und Suzlon[90]

One of the main barriers for the implementation of wind energy projects is the low electricity price in combination with medium wind speeds.[91] Financing opportunities are limited to international donors e. g. the »Région Midi-Pyrenées« and AFD (French Development Agency) from France. However lack of financing is one of the reasons for the delay of the wind park in Saint Louis.[92]

The availability of skilled workers and building materials is limited. As the technical equipment (turbines etc.) is not available in Senegal the project developers for the wind park in Gantour plan to import this from Europe.[93]

The limited know-how about wind energy of SENELEC and governmental institutions is seen as an important factor for experienced delays in project implementations. Project investments could reasonably be complemented with capacity building in the governmental institutions and SENELEC.

The legal conditions for wind energy have still to be clarified. Neither framework nor regulations exist for renewable energies e. g. Power Purchase Agreements (PPAs). That may lead to project delays.

The access to the grid is limited and dependant on a decision by SENELEC who holds the monopoly. SENELEC has to identify a specific site (and demand) first and then find a company in a competitive tender. For Independent Power Producers (IPPs) or project developers, it is very difficult to persuade SENELEC to allow grid access at a not yet identified location.[94] The negotiations between an IPP or a project developer and SENELEC are very time-consuming, even though general support by the Ministry of Energy exists.[95]

However, CRSE has been working on an improvement of

[83] GTZ 2007 c, Draft (chapter Wind energy)
[84] Jensen 2009
[85] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[86] And between January and May 2007 in Gantour, Gandon and Mboye (Ndiaye 2007)
[87] GTZ 2007 c,
[88] Ndiaye 2007
[89] Jensen 2009
[90] Jensen 2009
[91] Personal information by phone, Dr. Rehfeldt, Deutsche Windguardt, 4.09.09
[92] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[93] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[94] Personal information by phone, Dr. Rehfeldt, Deutsche Windguard, 4.09.09 and Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[95] Experience with the planned wind park in Saint Louis, personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009

the regulations during the past three years and e.g. studies have been commissioned. As the legislative procedure in Senegal proves to be very time-consuming, results are hoped to be reached in the end of 2010.[96]

For an understanding of the Senegalese wind market, the wind farm project at Saint Louis will be further explained: The wind park is supported by the Saint-Louis regional authorities and the government of Senegal, through the Ministry for Energy. A contract providing a long-term concession regarding the land on which the wind park will be built has been signed. A draft contract for the sale of electricity was proposed by SENELEC.[97]

According to the project developer delays of the project are caused by:

- difficulties to obtain the authorisation
- no final agreement with SENELEC for the sale of electricity
- lack of financing, due to comparably high risks (country and medium wind speed)
- in general very slow processes as no reference projects exist
- lack of knowledge in the ministries and SENELEC

An evaluation by UNDP in 2008 concluded that mostly legal barriers have impeded the implementation of the project. The project consortium planned to produce electricity for own consumption and pay SENELEC a fee for the transport of the electricity through the transmission grid. But self-production is not provided for in the national energy laws and regulations.[98] In the context of the new regulatory framework for renewable energy production and sale, the consortium plans to sell their entire production to the grid and purchase electricity from the grid. This approach seems to be »more appropriate for SENELEC and will remove the barrier to the implementation of this project«.[99] However, the project developer stated that they could not settle a final agreement with SENELEC yet.[100]

[96] personal information by phone, Mr. Nicolas Martin Granel (CEGELEC Toulouse), 04.09.2009
[97] UNDP 2008
[98] SENELEC still holds the monopoly for sale and distribution (at least until 2009).
[99] UNDP 2008
[100] GTZ 2007 a

11.7 Contacts and Addresses

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