South Sudan

OVERVIEW

The Republic of South Sudan became an independent nation on July 9, 2011, after Southern Sudanese voted overwhelmingly for secession in a January 2011 referendum agreed to under the 2005 Comprehensive Peace Agreement (CPA) that ended decades of civil war.

United States Hosts International Engagement Conference for South Sudan

Outcomes of the International Engagement Conference for South Sudan

As South Sudan embarks on nationhood, USAID seeks to help make the new nation increasingly stable while helping the government deliver basic services to citizens; provi inclusive, and accountable governance; diversify the economy; and combat

Increasing stability in South Sudan will depend on a combination of strengthening core governance institutions and processes and making them more inclusive, responding to the expectations of the population for essential services and improved livelihoods, as well as containing conflicts and addressing the grievances behind them.

South Sudan Celebr Independence.
Photo Credit: Timoth

PROGRAMS

PEACE AND SECURITY

Country Program Materials

2010 Congressional Budget Justification (pdf,5.3mb)
The CBJ summarizes USAID activities and funding in Sudan and South Sudan beginning on page 165.

Fact Sheet (pdf,40kb)
A printable summary of USAID-State foreign assistance appropriations for Sudan and South Sudan

Democracy and Governance (pdf,156kb)

Economic Growth (pdf,167kb)

Education (pdf,152kb)

Health (pdf,162kb)

Transition and Conflict Mitigation (pdf,159kb)

USAID South Sudan Links

U.S. State Department Background Information

U.S. Embassy in Juba

Abyei

USAID South Sudan Mission

Mission Director
Kevin Mullally

Deputy Mission Director
Peter Natiello

Local Address:USAID South Sudan
c/o U.S. Embassy
Juba, Sudan

A woman holds up her new voter card at a registration site in Juba, South Sudan.

USAID programs will work to address the causes of conflict and promote co peace and community security in conflict-prone regions of South Sudan. Thi supporting the establishment of community-based conflict mitigation mecha of local leaders, women and youth, which build democratic processes for ad conflict without violence.

GOVERNING JUSTLY AND DEMOCRATICALLY

USAID has supported key Government of South Sudan (GOSS) institutions when many GOSS ministries and commissions were established, and will c with the GOSS to strengthen central institutions and systems in order to mee and extend public services and governance systems to state and county lev In addition, USAID will strengthen the capacity of citizens, civil society, medi nongovernmental actors to engage constructively with the GOSS to hold the accountable at all levels and ensure it is responsive to the needs and interes USAID provided technical support for the drafting of and public outreach on constitution, and will provide support for creation of a permanent constitutio participation and oversight.

INVESTING IN PEOPLE

The vast majority of the population of South Sudan lacks access to essential education, health, nutriti and sanitation services. USAID will support the ongoing delivery of essential services and build the c government to deliver effective and increasingly sustainable essential services that meet the needs a all Southern Sudanese.

ECONOMIC GROWTH

The lack of economic opportunity, particularly among marginalized youth, is a potential driver of confli Sudan. USAID will support sustained and inclusive agriculture sector-led growth to enhance resilienc stability, by increasing agricultural productivity and linking communities to markets, providing access agribusinesses and small-scale farmers, and building strategic partnerships to better enable Souther capture market opportunities and enhance stability in areas where lack of economic opportunity is pa dynamic.

HUMANITARIAN ASSISTANCE

USAID is responding with lifesaving assistance to the urgent needs of those displaced and affected b including the Abyei crisis that erupted in May 2011, and other emergencies, such as floods. This assis food aid; cooking, shelter, and basic hygiene materials; and livelihood activities. USAID is also assisti hundreds of thousands of Sudanese of southern origin who have returned from northern Sudan to the in South Sudan before and since the January 2011 referendum. This includes helping returnees to rea areas, providing livelihoods support to help them begin productive lives in South Sudan, and support

services, including food security, shelter, water, health, and sanitation in states with the largest numbe returnees.

Back to Top ^

About USAID Our Work Public Affairs Careers Business/Policy

Locations

What's New : FOIA Requests : Privacy Policy : Email This Page : Plug-ins : FAQs : Help Desk : Co

Last Updated on: January 30, 2012

Sustainable Energy Options and Planning For South Sudan

James Leidel
Oakland University
November 2008

Introduction

The country of South Sudan has ample natural resources. Both conventional mineral, agricultural, and petroleum resources are being developed to provide for a growing economy.

In addition, South Sudan has ample renewable energy resources in the form of solar, wind, and biomass. Developing these vast resources with modern alternative energy technologies could place South Sudan at the forefront of sustainable energy infrastructure development worldwide. This can be done for electrification, motor vehicle biofuels, and for rural home cooking fuel needs.

Whereas the United States, Europe, and other developed nations have invested hundreds of billions of dollars over the past century to install fossil fuel burning power plants, electric transmission lines, and distribution systems, South Sudan has the remarkable opportunity to design a master plan that can will outline a leap over this old technology into the next generation of clean, self sufficient, renewable energies.

This concept is similar to telecommunications development. Instead of investing millions of dollars in copper wiring and land based communications infrastructure, developing nations are installing wireless communications networks which are cheaper, more advanced, and more adaptable to a growing economy's changing needs. The same holds true for energy infrastructure.

Distributed generation from a mix of solar, wind, biomass, hydro, and conventional diesel can provide a robust, reliable, and self sufficient infrastructure to power South Sudan well into the next century. The following paper will discuss options, obstacles to overcome, and the need for an energy master plan for the country to move forward.

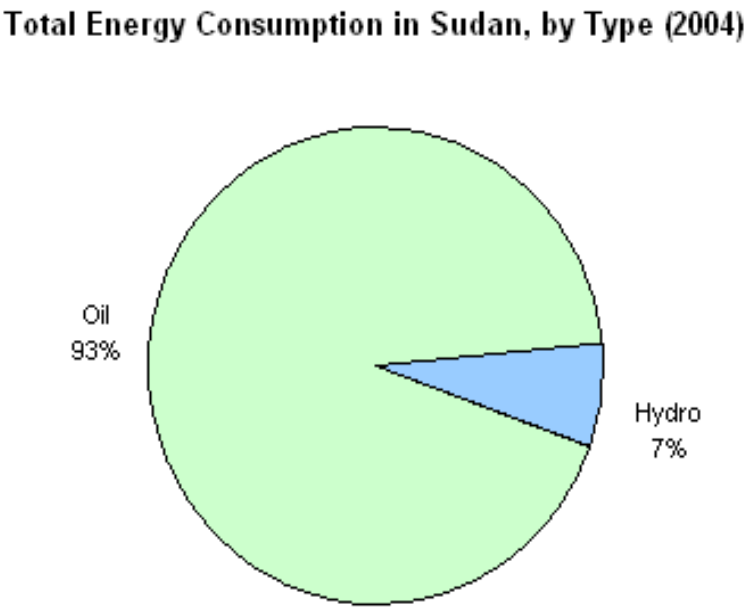
Sudan Energy Background

Source: US Department of Energy, Energy Information Administration, 2004

Revenues from Sudan's increasing hydrocarbon (petroleum) exports represent 70 percent of the country's total export revenues.

Sudan is developing its significant hydrocarbon resources. The country's oil exports, which have increased sharply since the completion of a major oil-export pipeline in 1999, account for 70 percent of total export revenues. Additional growth in Sudan's hydrocarbon sector will likely occur with a refurbished infrastructure, which has seen little improvement since the beginning of the country's civil conflicts in 1955. As of January 2007, according to the Sudanese Minister of State for Energy and Mines, Sudan is considering joining the Organization of Petroleum Exporting Countries (OPEC) at some point in the future.

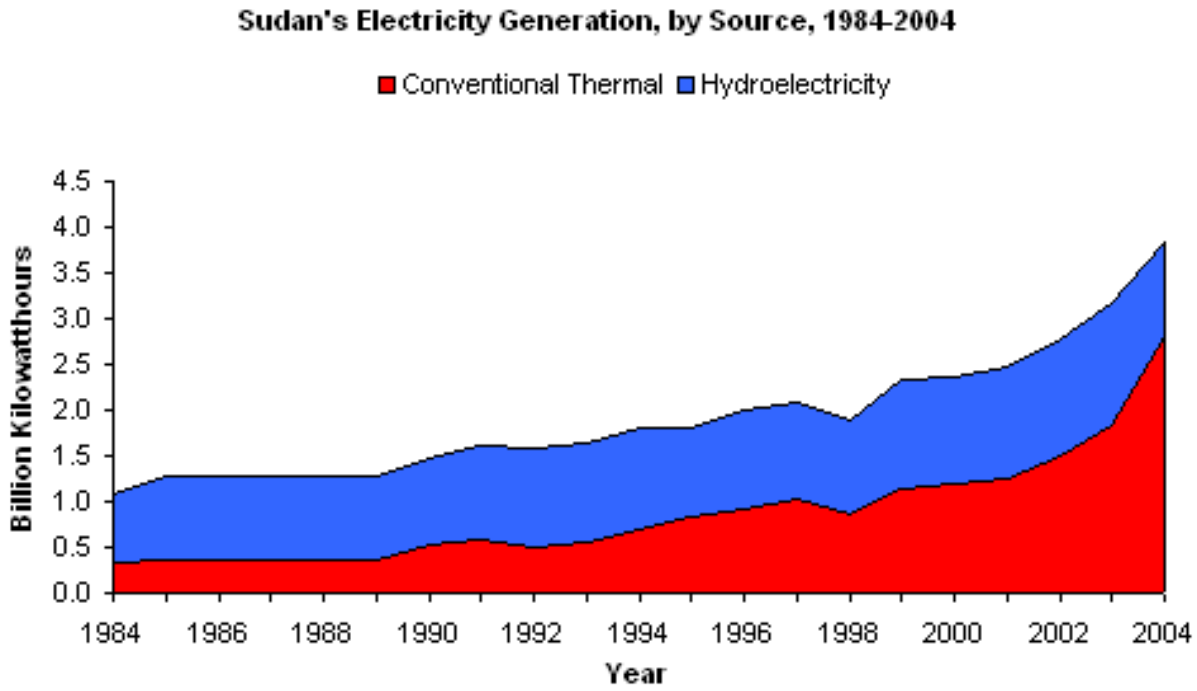
In January 2005, the Sudanese government in Khartoum and the Sudan People's Liberation Army (SPLA) in the south signed the Comprehensive Peace Agreement (CPA), which ended 21-years of civil war. Prior to the signing, several important issues were agreed upon by the two parties including the sharing of oil revenues (50:50). Also in 2005, President Bashir formed a border commission tasked with defining the border between northern and southern Sudan, in accordance to the CPA. Much of Sudan's oil producing region lies in the disputed border area.



In 2004, Sudan's energy consumption mix was dominated by oil (93 percent), with the remainder coming from hydro-electricity (7 percent). Natural gas, coal, nuclear and other renewables are currently not part of the country's energy consumption mix. Between 1984 and 2004, the share of oil in Sudan's energy mix increased from 86 percent to 93 percent. Hydroelectricity consumption experienced a decrease, during the same time period, from 14 percent to 7 percent.

Electricity

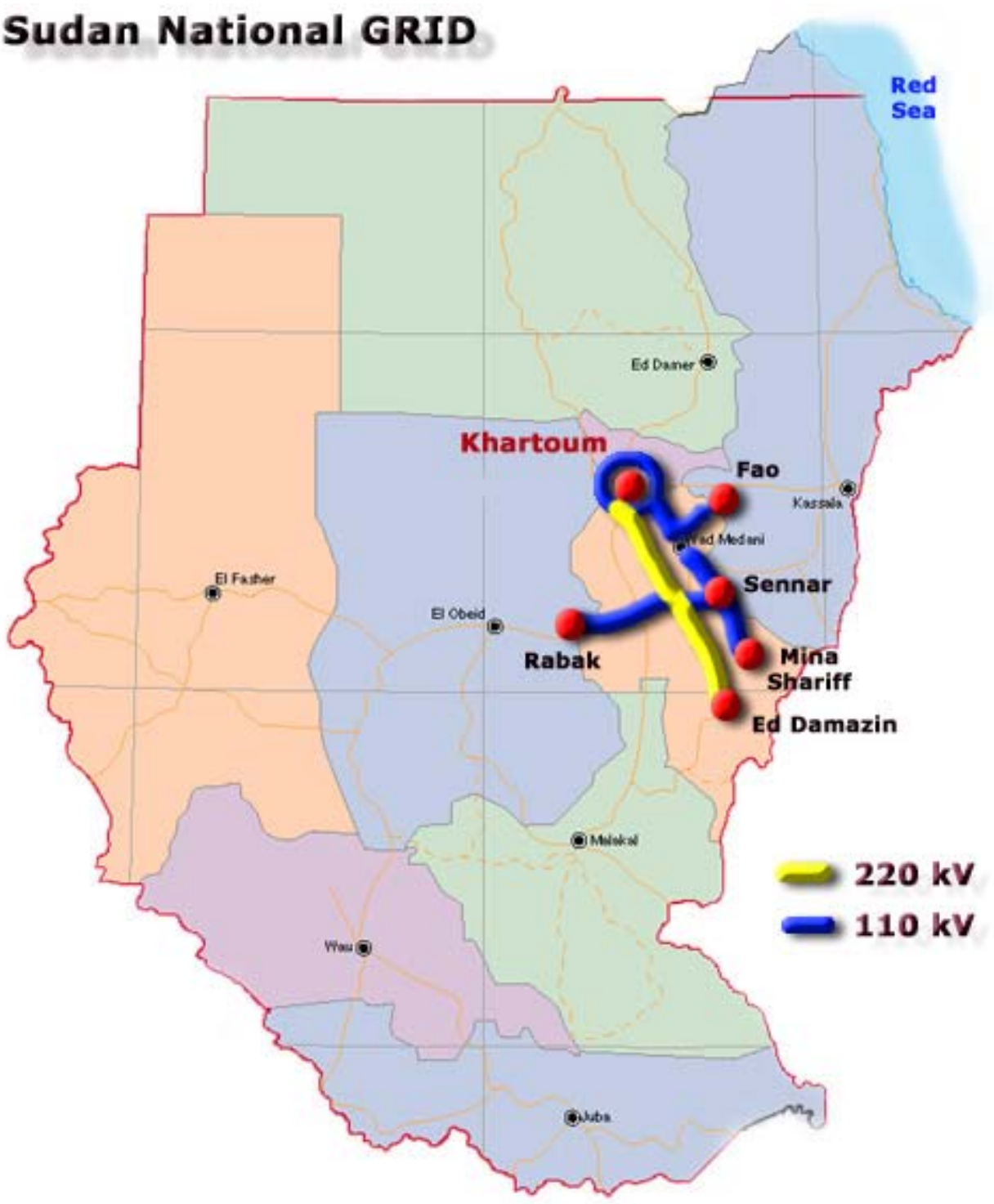
Sudan generates the majority of electricity by conventional thermal sources.
In 2004, Sudan had 760 megawatts (MW) of electricity generation capacity. Sudan generated 3.8 billion kW hours of electricity in 2004, and consumed 3.6 billion kW hours. The majority of electricity in Sudan is generated by conventional thermal sources (76 percent), with the remainder coming from hydroelectricity (24 percent). The country's main hydroelectricity generating facility is the 280 MW Roseires dam located on the Blue Nile river basin, approximately 315 miles southeast of Khartoum. The facility has frequently been attacked by rebel groups, and low water levels often cause its capacity to fall to 100 MW.



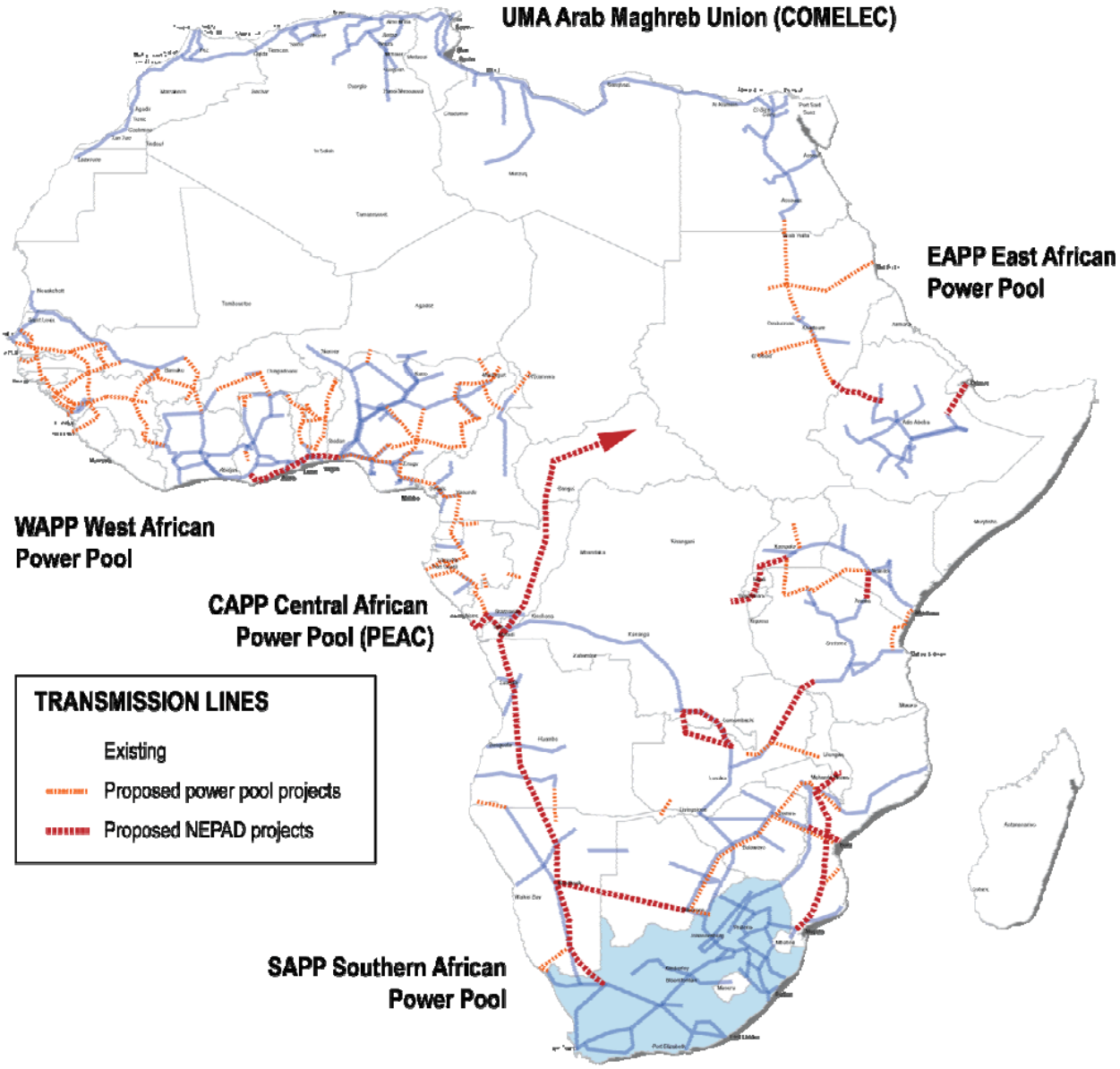
Source: International Energy Annual, 2004

Sector Organization

The north Sudan, state-owned National Electricity Corporation (NEC) is responsible for electricity generation, transmission and distribution around the capitol city of Khartoum. NEC transmits electricity through two interconnected electrical grids, the Blue Nile Grid and the Western grid, which cover only a small portion of the north Sudan. Regions not covered by the grid often rely on small diesel-fired generators for power.


Sudan National GRID
Red Sea
Ed Damer
Khartoum
Fao
Kassala
Wad Medani
Sennar
El Fasher
El Obeid
Rabak
Mina Shariff
Ed Damazin
Malakal
Wau
Juba
220 kV
110 kV

African Continent Electric Transmission Grid System



Possible Types of Systems Needed

The table below lists a number of energy supply applications, from small to large size. The rural home has needs for lighting, communications, and cooking at a minimum. Solar and biomass resources would be most appropriate for these applications.

Street lighting, individual buildings of all sizes, and entire village power systems can be designed to utilize clean, sustainable energy systems with solar, wind, biomass, and diesel.

Larger cities will most likely be powered by a mix of distributed and central station power sources. Also, the production of ethanol and biodiesel transportation fuels is possible from locally grown crops such as sugar cane and Jatropha.

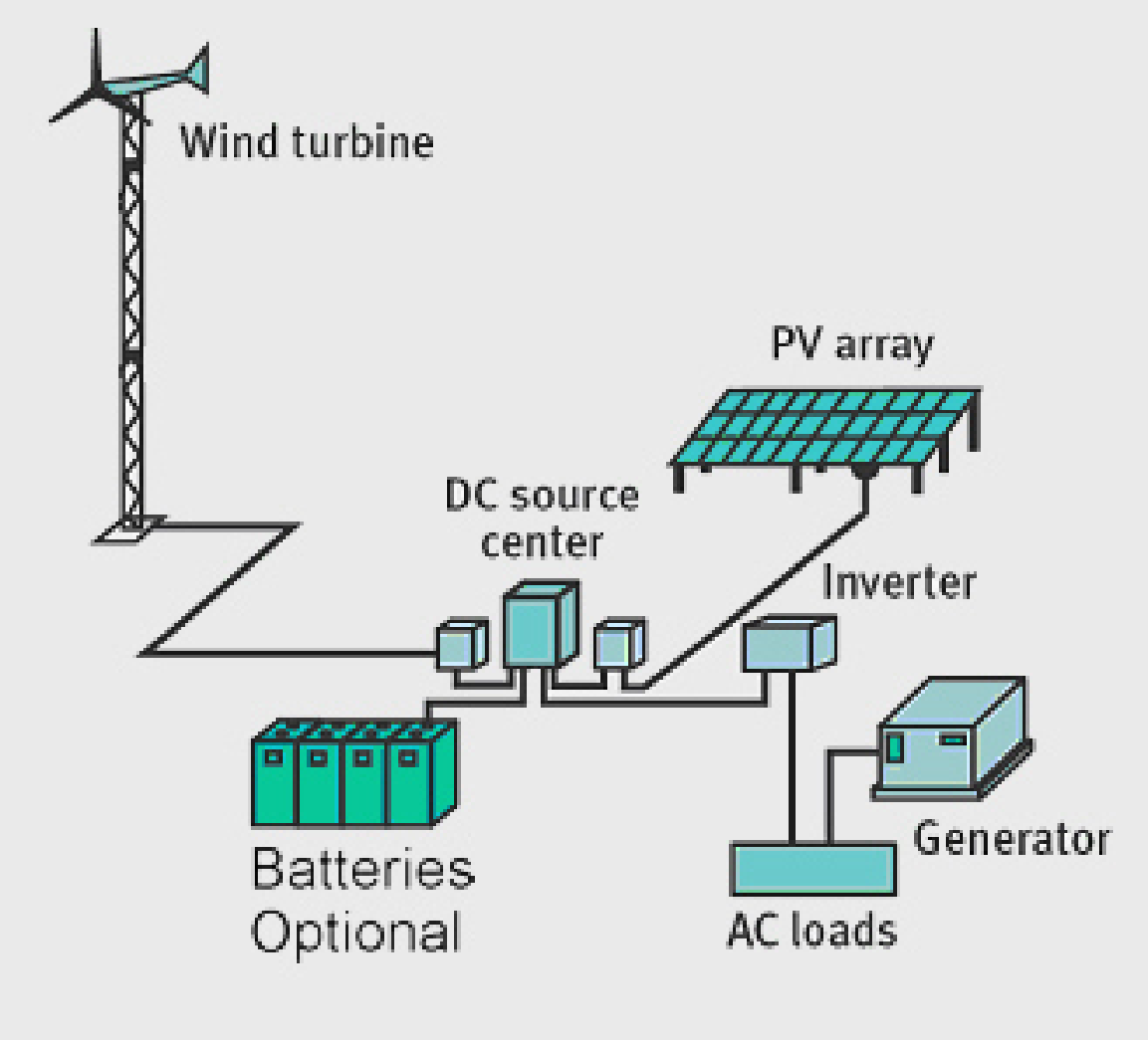
Application	**Grid**	**Energy Source**	**Equipment**	**Size**
Portable lighting	off grid	solar	LED lantern	5-10 W
Rural home	off grid	solar	lighting and communications	50-100 W
Rural home cookstove	off grid	biomass briquette, bottled gas, solar	cookstove	
Solar street lighting	off grid	solar	LED lighting	50-100 W
School, church, or small building	off grid	solar, wind, diesel	lighting, communications, computers	1-5 kW
Office or other larger building	off grid	solar, wind, diesel	lighting, communications, computers	5-25 kW
Rural village	off grid	solar, wind, hydro, diesel, biomass	lighting, communications, computers, refrigeration	25-250 kW
Larger city	ON GRID	solar, wind, hydro, diesel, biomass	lighting, communications, computers, refrigeration, air conditioning, industry	multiple MW
Transportation fuel	ON GRID	Jatropha or sugar cane	Biodiesel or ethanol plant	millions of gallons per year

Rural Village Power

The United States Renewable Energy Laboratory, located in Golden, Colorado, has done extensive work on renewable energies for complete village power systems. These village power systems can supply energy to rural communities in a clean, cost-competitive way without the need for costly transmission lines and central power stations.

Their work has shown that social issues dominate over technical issues in the development of rural energy systems. Some important issues are:

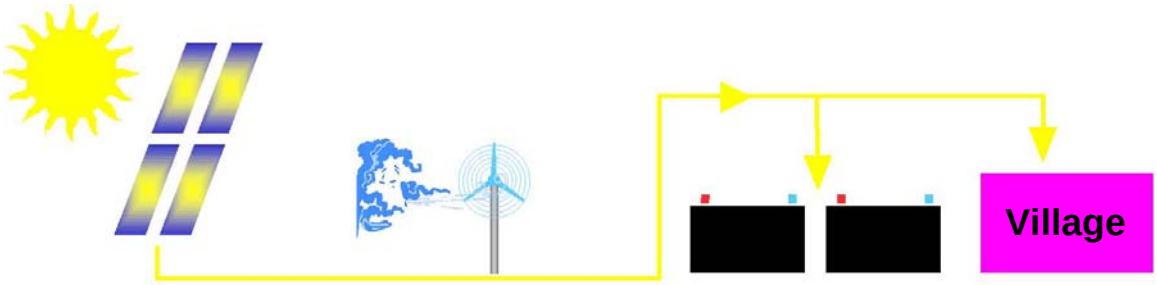
- Master planning
- Individual project planning
- Ownership of equipment
- Metering and billing
- Tariffs
- Responsibilities of maintenance, operation, etc…



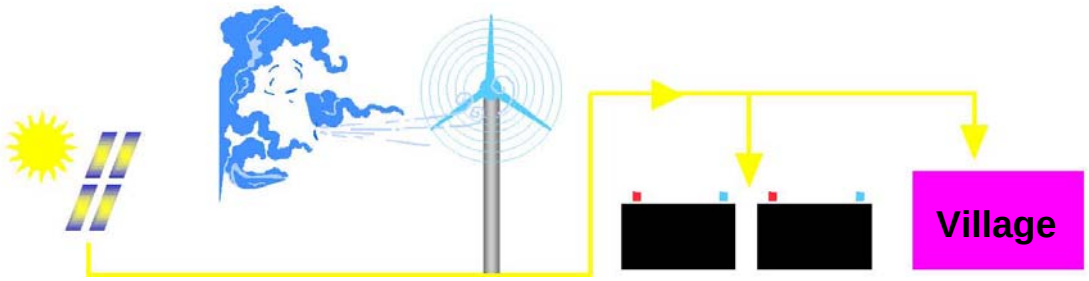
Schematic of hybrid power system schematic uses wind, solar, and diesel

The Benefit of Hybrid Solar, Wind, Diesel Systems

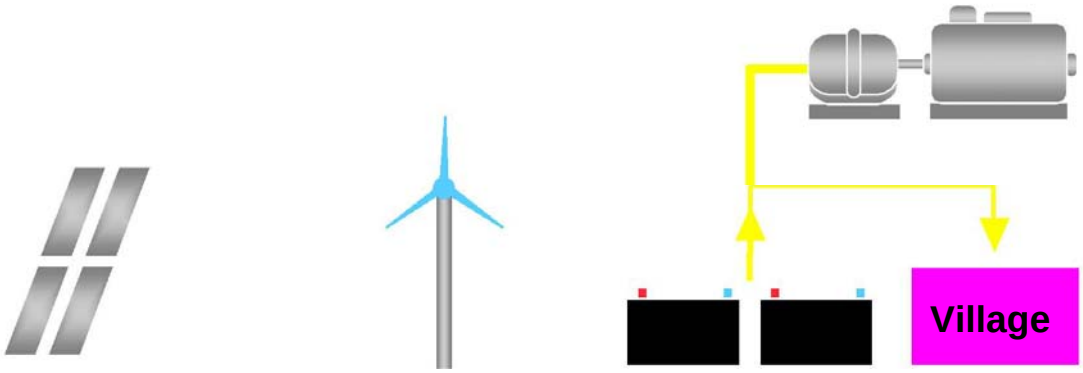
In the design of a remote energy system, not connected to a central grid system, the design for maximum reliability is very important. Multiple energy sources are a necessity. The sun and wind compliment each other very well. The wind often blows on a cloudy day, and sunny days are often less windy. Batteries and diesel generators carry the system through cloudy, still days and times of peak power needs. The level of reliability added by the multiple energy sources provides a very robust and self sufficient system with out connection to a central grid system.



Sunny days produce energy from the solar arrays.



Windy days produce energy predominantly from the wind turbines.



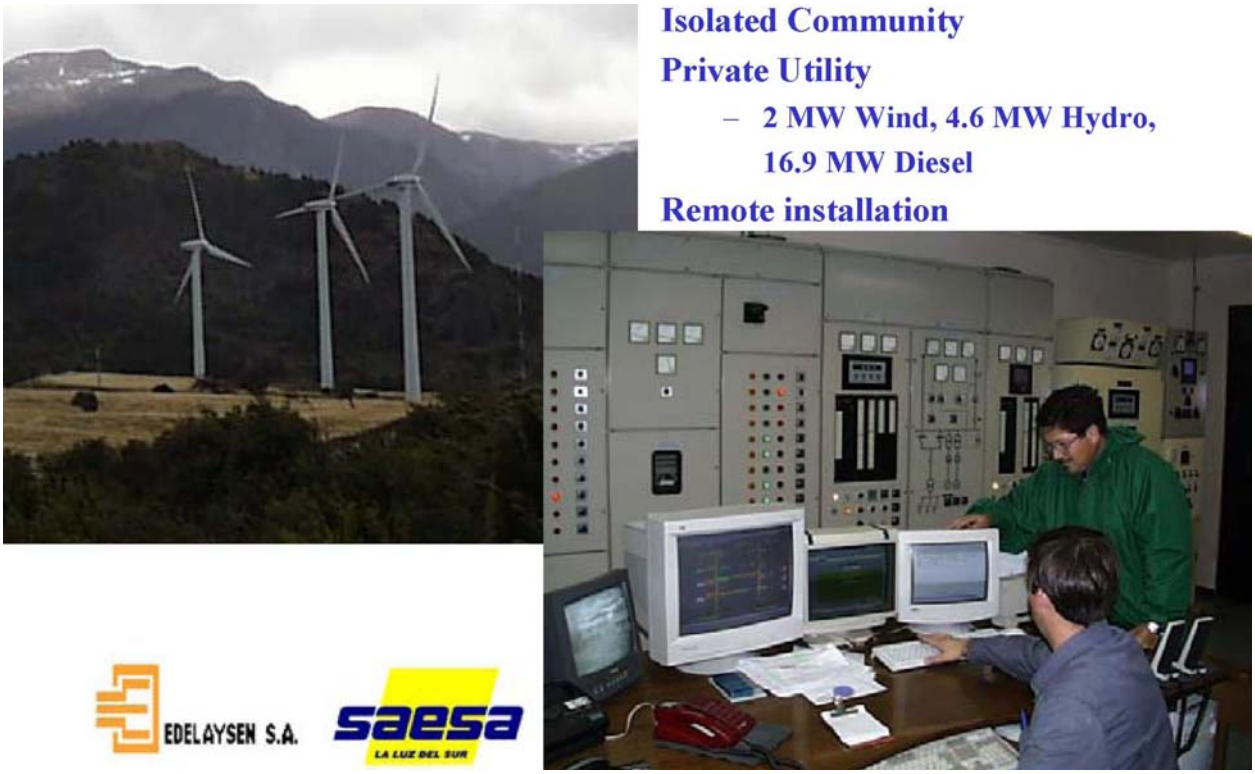
On still, cloudy days the batteries or diesel backup will serve the village power load.

Examples of Hybrid Village Power Installations

San Juanico, Mexico is a remote fishing & tourism community of 400 people

Power System

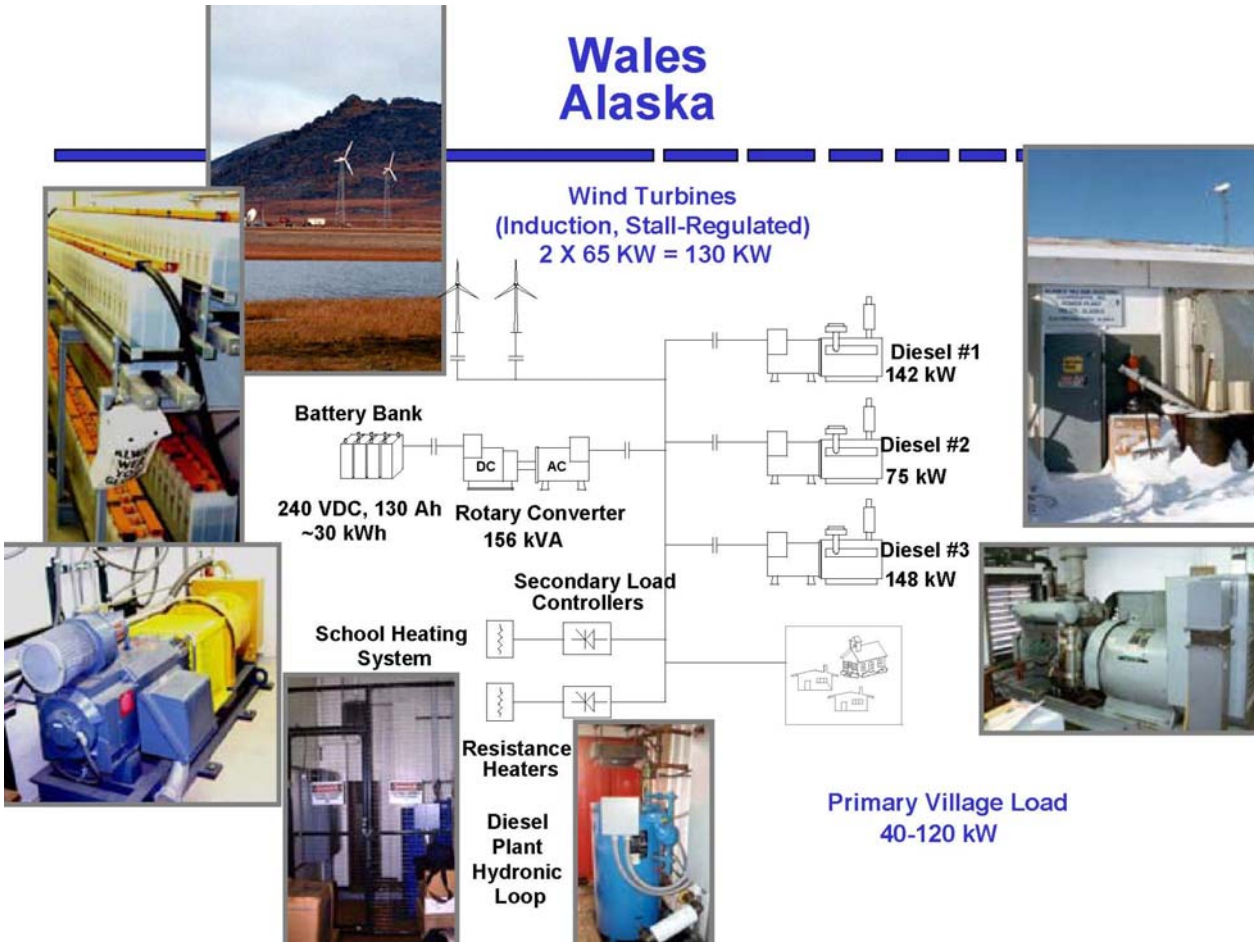
- 17 kW solar electric
- 70 kW wind (seven 10kW wind turbines as shown here)
- 80 kW diesel generator
- 100 kW power converter/controller
- Advanced monitoring system



Coyaique, Chille system using wind, hydro, and diesel at a remote utility installation

Power System

- 2,000 kW wind
- 4,600 kW hydro
- 16,900 kW diesel generator



Wales, Alaska, USA is a remote village power system.

<u>Power System</u>

- 130 kW wind
- 365 kW diesel generator
- Small battery storage
- 40 to 120 kW village load

Village Power Challenges

A number of challenges are present with any energy or utility company operations. Many of the following are common to any utility operation, centralized or remote.

- Higher installation costs (offset by lower operation costs)
- Operation, performance and reliability issues
- Operation & maintenance
- Payment for kWh
- Manufacturer technical and sales support
- Regional infrastructure
- Lack of institutional oversight
- Non payments
- Illegal connections
- Inadequate or non-existent tariffs
- Unmanaged load growth
- Maintenance ignored
- Corrosion
- Battery maintenance
- Long response time to component failures
- Remote site – difficult access
- Institutional issues -availability of qualified personnel

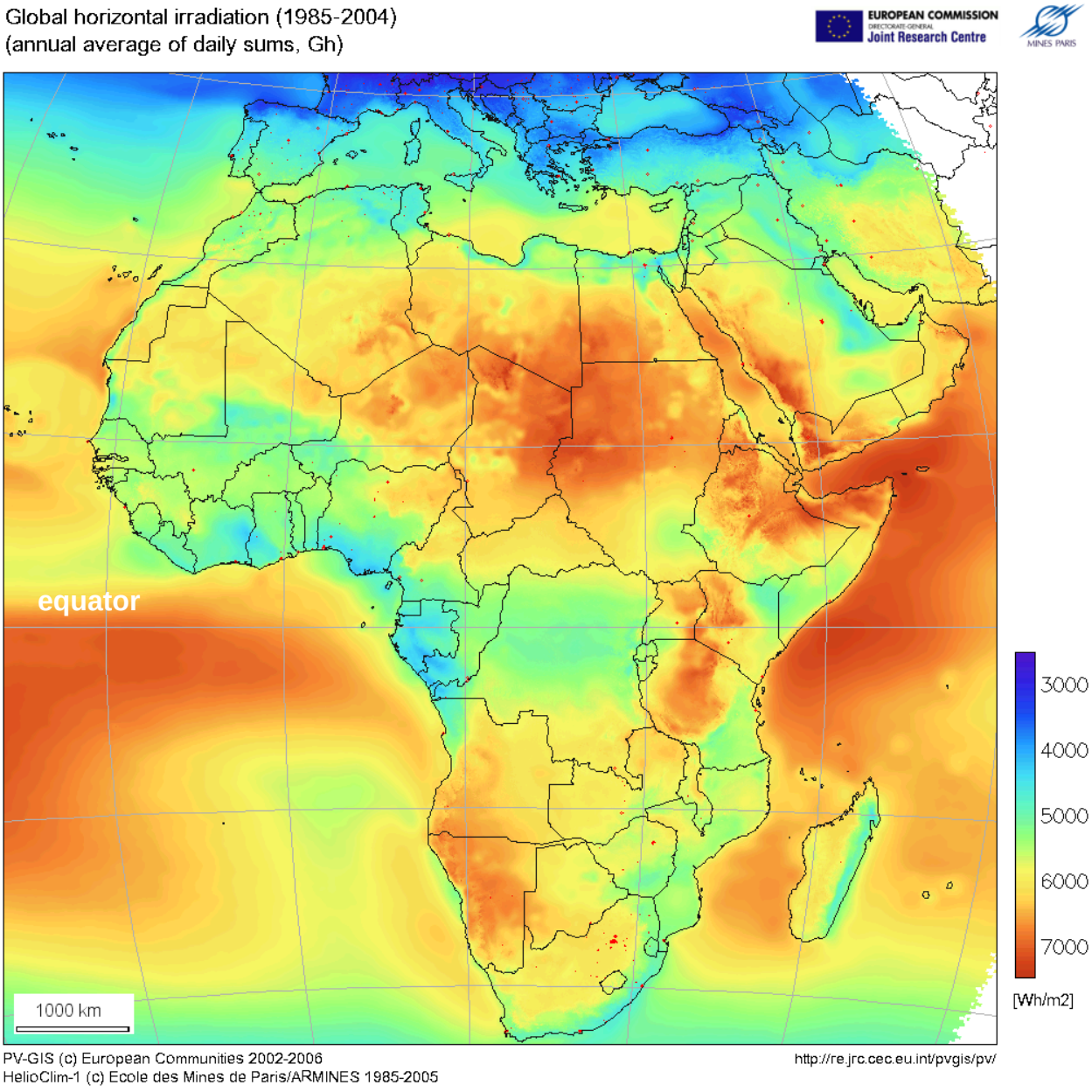
Potential methods to deliver and maintain Village Power

- Retailers and individual entrepreneurs
- “McWind” (franchise model)
- Traditional rural electric cooperatives (member owned)
- Local or municipal power association
- Rural energy service companies (very small to very large)
  National utility company
- Non-government and private voluntary organizations

The following pages will provide an introduction to the African and South Sudan renewable energy resources: solar, wind, and biomass.

Solar Energy Resource

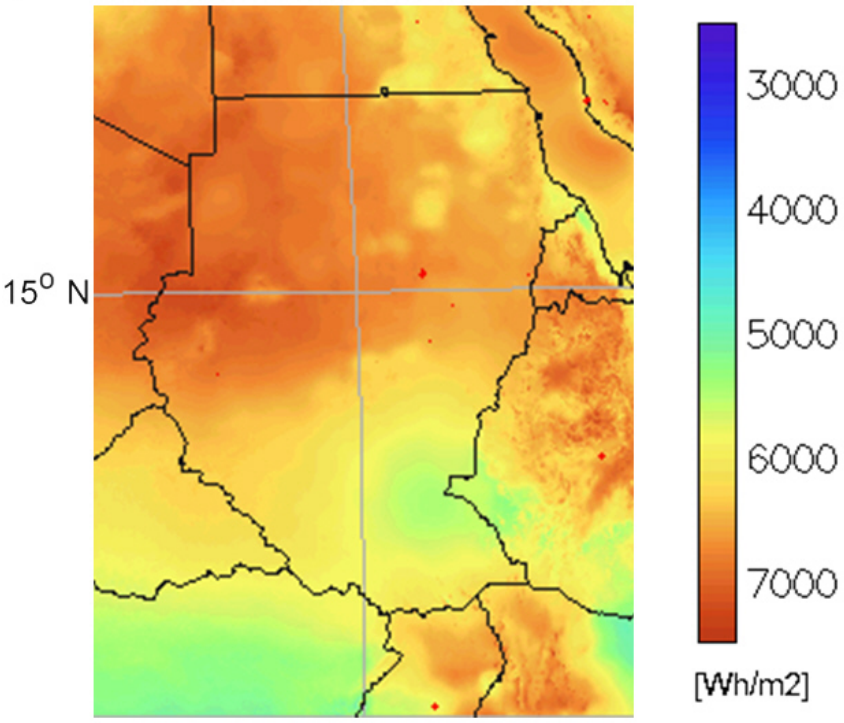
Below is a solar radiation map of the African continent. The solar resource available varies from about 4 to 7 kilowatt hours per day per square meter (annual average).



Throughout South Sudan, the annual average solar energy received is between 5 and 6 kW hours per square meter, each day.

Therefore, each 1 kW of installed photovoltaics will produce approximately 5-6 kW hours per day of energy.(on average throughout the year).

The amount of solar radiation received by the full 2.5 million square kilometers of the old Sudan is over 18,000 quadrillion BTU. This is over 170 times the total annual energy consumption of the United States (oil, natural gas, coal, and nuclear combined).



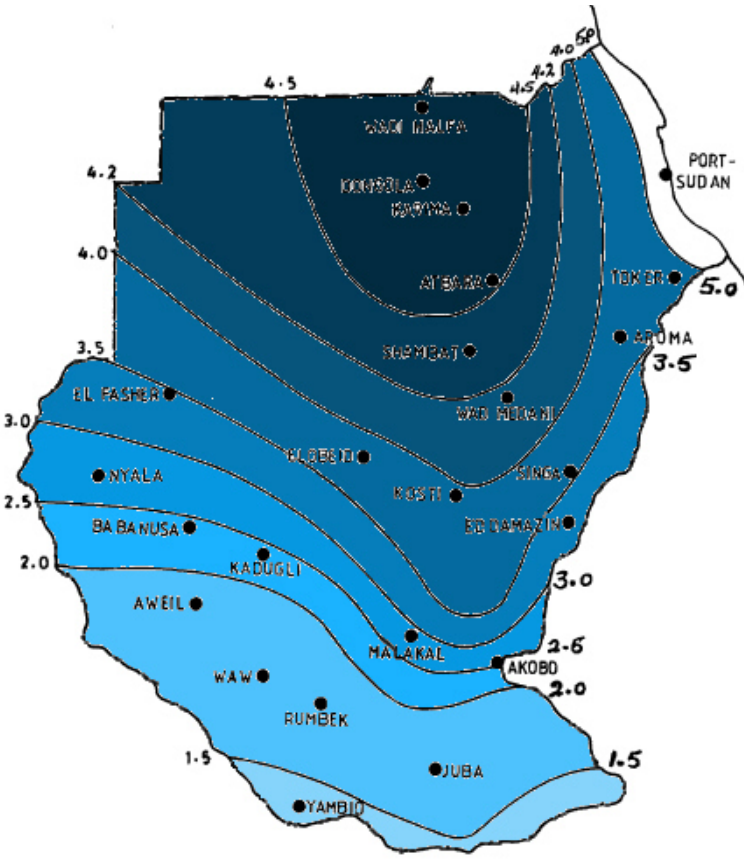
Solar is the most “democratic” of energy resources. A solar panel located anywhere in the country, either on the roof of a rural home or in a megawatt sized central station, will receive the same amount of clean, free, and sustainable solar energy. Unfortunately, solar is the most expensive energy technology. It is very reliable and rather low maintenance, but very costly.

Wind Energy Resource

Wind energy is more site specific. It varies across the country and is also affected by local issues such as elevation, vegetation, terrain, etc… Shown here are the average wind speeds (meters per second) at a 10 meter height. Wind speeds at typical wind turbine hub heights of 30 to 100 meters will be much higher.

Individual microclimates and site terrain require site by site assessments to determine the viability of installing wind power. However, the general prevailing winds and regional wind resource availability will remain constant.

When wind power is available at a given site, it is much more economical than solar energy.



Source: Abdeen M. Omer, "On Wind Energy Resources in Sudan", Renewable & Sustainable Energy Reviews, 12 (2008) pgs. 2117 – 2139.

Table of Wind Energy Stations in Sudan

Station	Altitude (m)	Annual wind speed (V) ms^{-1}	Shape factor (k)	Number of years of observation
Wadi Halfa	190	4.6	1.8	4
Port Sudan	5	5.0	1.6	10
Karima	250	4.7	1.7	10
Atbara	345	4.2	1.75	10
Shambat	380	4.8	2.1	10
Khartoum	380	4.8	1.9	10
Kassala	500	4.0	1.95	10
Wad Madani	405	4.8	1.8	10
El Fasher	733	3.4	1.15	10
El Geneina	805	3.1	1.9	10
El Obeid	570	3.4	1.9	10
Kosti	380	4.0	1.8	10
Abu Na'ama	445	3.1	2.2	10
Malakal	387	2.8	1.2	10
Wau	435	1.7	1.2	10
Juba	460	1.5	1.4	10

Source: Abdeen M. Omer, "On Wind Energy Resources in Sudan", Renewable & Sustainable Energy Reviews, 12 (2008) pgs. 2117 – 2139.

Biomass Energy Resource

There is a vast abundance of bioenergy resources in the African continent as shown here. South Sudan has more than enough bioenergy resources to fuel this growing country's fuel and electricity needs.

The following sections are adapted from an except from a 2005 analysis of the Sudan bioenergy potential by Abdeen M. Omer, "Biomass energy potential and future prospect in Sudan", Renewable & Sustainalbe Energy Reviews, 9 (2005) pages 1-27.

Biomass technologies

Biomass resources play a significant role in energy supply in Sudan. Biomass resources should be divided into residues or dedicated resources, the latter including firewood and charcoal can also be produced from forest residues.

There exists a variety of readily available sources in Sudan, including agricultural residues such as sugar cane bagasse, molasses, cotton stalks, groundnut shells, tree/forest residues, aquatic weeds, and various animal wastes.

The most promising agricultural residues which have high availability factor and high potential for energy production, are cotton stalks and groundnut shells.

The use of biomass through direct combustion has long been, and still is, the most common mode of biomass utilization. Biomass technologies include: biogas, briquetting, gasification, improved charcoal, carbonization, and improved stoves.

Briquetting

Briquetting is the formation of a char (an energy dense solid fuel source) from otherwise wasted agricultural and forestry residues. One of the disadvantages of wood fuel is that it is bulky with a low energy density and is therefore expensive to transport. Briquette formation allows for a more energy-dense fuel to be delivered, thus reducing the transportation cost and making the resource more competitive. It also adds some uniformity, which makes the fuel more compatible with systems that are sensitive to the specific fuel.

Briquetting of agricultural residues in Sudan started in 1980, where a small entrepreneur constructed a briquetting plant using groundnut shells in Khartoum. The second plant was introduced in Kordofan (western Sudan), and the plant had a capacity of 2 tonnes per hour with a maximum 2,000 tonnes per season. Another prototype unit was worked in Nyala with a capacity of 0.5 tonnes per hour (600 tonnes per season). In central Sudan, a briquetting plant of cotton stalks was installed at Wad El Shafie with a capacity of 2 tonnes per hour (2,000 tonnes per season). The ongoing project in New Halfa is being constructed to produce 1,200 tonnes per season of bagasse briquettes. A number of factories have been built for the carbonisation of agricultural residues, namely cotton stalks. The products are now commercialized. More than 2,000 families have been trained to produce their cooking charcoal from the cotton stalks.

Improved cook stoves

In Sudan, most urban households burn charcoals on traditional square 'Canun' stove that have very low fuel-to-heat conversion efficiencies. The following prototypes were all tried and tested in Sudan:

- The metal clad Kenyan Jiko
- The vermiculite lined traditional Kenyan Jiko
- The all-ceramic Jiko in square metal box
- The open draft Dugga stoves
- The controlled draft Dugga stoves
- The Umeme Jiko 'Canun Al Jadeed'

Several, local traditional stoves were tested, improved, and commercially used in Sudan.

- Traditional muddy stoves
- Bucket stoves
- Tin stoves

Gasification

Gasification is based on the formation of a fuel gas (mostly CO and H2) by partially oxidizing raw solid fuel at high temperatures in the presence of steam or air. The technology can use wood chips, groundnut shells, sugar cane bagasse, and other similar fuels.

Biogas

Presently, Sudan uses a significant amount of kerosene, diesel, fire wood, and charcoal for cooking in many rural areas. Biogas technology was introduced to Sudan in the mid seventies when GTZ designed a unit as part of a project for water hyacinth control in central Sudan. Anaerobic digesters producing biogas (methane) offer a sustainable alternative fuel for cooking and lighting that is appropriate and economic in rural areas. In Sudan, there are currently over 200 installed biogas units, covering a wide range of scales appropriate to family, community, or industrial uses. The agricultural residues and animal wastes are the main sources of feedstock for larger scale biogas plants.

Sugar cane biomass

Residuals from the sugar cane industry represent by far the most important source of current and potential biomass resources in Sudan. The sugar industry in Sudan goes back fifty years and Sudan has been one of the world's leading sugar producers. Sugar cane plantations cover one-fifth of the arable land in Sudan. In addition to raw sugar, Sudanese enterprises produce and utilize many valuable cane co-products for feed, food, energy and fibre. In 2005, there were 5 sugar factories.

Sugar cane bagasse and sugar cane trash already provide a significant amount of biomass for electricity production, but the potential is much higher with advanced cogeneration technologies. Most sugar factories in Sudan can produce about 15–30 kWh per tonne of cane. If all factories were fitted with biomass gasifier-combined cycle systems, 400–800 kWh of electricity could be produced per tonne of cane, enough to satisfy all of Sudan's current electricity demand.

In Sudan there are no alcohol distilleries. The three factories were closed with Islamic Laws in 1983. The current circumstances suggest that Sudan should consider expanding production for use as transportation fuel, but this option has not yet been pursued. The alcohol was used for a variety of applications, mainly for medical purposes and rum production. Blending with gasoline would also have direct environmental advantages by substituting for lead as an octane enhancer.

Jatropha for Bio-Oil

Whereas sugar cane has the potential to fuel an alcohol fuel program in South Sudan, various oil seed crops have the potential to provide the feedstock for a biodiesel industry.

Jatropha curcas is not an indigenous plant to Sudan, but it is known in the country. It grows in arid areas without attention. Since the plant is not browsed by animals, Jatropha is used by the farmers to protect their gardens

against roaming animals. It seems that the plant was introduced to Zambia from Angola and Mozambique, where the plant is widespread.

The Jatropha System is an integrated rural development approach. By planting Jatropha hedges to protect gardens and fields against roaming animals, the oil from the seeds can be used for soap production and as fuel in special diesel engines. In this way the Jatropha System covers four aspects of rural development:

- promotion of women (local soap production);
- poverty reduction (protecting crops and selling seeds).
- erosion control (planting hedges);
- energy supply for lighting and stationary engines in the rural area;

Plantations and/or rural production of Jatropha seeds could supply large scale biodiesel plants that could provide a local biofuel for stationary and on-road diesel engines for Sudan.

NOTES:

Make a list of types of jobs that will be needed

www.nrecainternational.org/news/Publications/TAGs.htm

www.nrecainternational.org/news/video/Sudan/Sudan.htm

Rural Electrification Technical Assistance Guidebooks

NRECA International has initiated the development of a comprehensive series of Technical Assistance Guidebooks (TAGs) that will provide a combination of "best practices" and "how to" guidelines for the design, development, implementation and monitoring of rural electrification systems.

The TAGs are designed for a wide audience, including domestic and international rural electrification policy makers and field practitioners (engineers, economists, project managers, etc.) and will include written guidebooks for each module, select case studies highlighting successful experiences in developing countries, and practical tools, such as economic analysis models and engineering design applications that will be useful to program implementation personnel.

The TAGs are comprised of twelve modules, including:

1. Feasibility Analysis of Peri-Urban Projects
2. Project Engineering Design & Cost Estimation
3. Feasibility Analysis of Grid-Extension & Renewables
4. Project Monitoring & Electric Co-op Performance
5. Material Acquisition & Bidding Procedures
6. Creating an Electric Cooperative
7. Functions of the Board of Directors of ECs
8. Preparation of a Business Plan for ECs
9. Construction Standards for Rural Electrification
10. Construction Standards for PV Systems
11. Analysis of Productive Uses
12. Project Economic Analysis

NRECA International has completed initial drafts of all of these modules and is in the process of revising and editing them for publication.

If you are interested in the TAGs, please contact NRECA International.

NRECA International Programs
General Inquiries
Phone: (703) 907-5645

NRECA International, Ltd.
Eric Gibbs
Senior Program Manager
Phone: (703) 907-5637

NRECA International Foundation
Ingrid Hunsicker
Senior Program Manager
Phone: (703) 907-5629

Myk Manon
Country Director - Sudan

Mr. Manon is NRECA International's Engineer and Operation Manager for Nigeria project. Mr. Manon has over 35 years of experience in supervising and managing rural electrification assignments for government and private clients. Mr. Manon has managed USAID -funded programs in Southern Sudan, El Salvador, Dominican Republic, Bolivia, and Nicaragua that encompass rural line design, construction and supervision; utility organizational development, privatization analysis, and training support.

Mr. Manon has developed work plans, coordinated task assignments with multiple subcontractors, provided overall substantive administrative and logistical support to short term and long term teams in developing countries focusing on donor agencies' strategic objectives and targets and indicators. Mr. Manon has a strong cooperative sector background in promoting rural electrification projects utilizing innovative technology in developing countries.

Mr. Manon received his M.S. and B.S. University of California, Davis.

Energy Information Administration www.eia.doe.gov

COUNTRY ANALYSIS BRIEFS

Sudan and South Sudan

Last Updated: Mar. 19, 2012

South Sudan shut in its oil production just six months after gaining independence, as a result of an ongoing dispute with Sudan over transit fees and other post-independence issues.

Background

After decades of civil war, North and South Sudan signed a Comprehensive Peace Agreement (CPA) in 2005. The CPA set standards for sharing oil revenue (50:50 split) and a timetable toward a referendum on the South's independence. As part of the CPA, a referendum took place in January 2011 in which the people of South Sudan voted to secede from Sudan. In July 2011, Sudan became two countries: Sudan and South Sudan. The capital of Sudan is Khartoum and the capital of South Sudan is Juba.

Source: CIA World Factbook

Although both countries are now independent, they remain interdependent in terms of the oil industry. About 75 percent of oil production (depending on specific field allocations) originates from the South, while the entire pipeline, refining, and export infrastructure is in the North. Thissituation has caused contention between the two countries over pipeline and export transit fees.

The CPA did not set provisions on a post-independence oil sharing mechanism or transit fees. In turn, following the secession, Sudan's government in Khartoum asked for transit fees of $32-36/barrel (bbl), while South Sudan countered with less than $1/bbl, which is more in line with international standards. Primarily as a result of the impasse on transit fees, Khartoum began to divert South Sudan's Nile Blend crude to its Khartoum and el-Obeid refineries in December 2011.

In retaliation, on January 20, 2012, the South announced that it would shut in production until a fair deal was reached on transit fees, or an alternative pipeline was built. At the time of writing, all of South Sudan's production remains shut in. Given the divergent stances on transit fees and other post-independence issues, it is unclear when South Sudan will restart oil production.

Negotiations

Negotiations between the two countries on post-independence issues and transit fees have been occurring intermittently at the African Union (AU) in Addis Ababa, Ethiopia. Negotiations have failed to yield any agreement thus far. The table below describes some of the negotiation topics and each country's respective position.

Sudan (Khartoum)	Negotiation Issue	South Sudan (Juba)
$32-$36/bbl	**Transit fee**	Less than $1/bbl
In late-January, Sudan released four tankers carrying about 3.5 million barrels of South Sudanese crude. Sudan claims that the South owes it $1 billion in unpaid fees since July 2011.	**Release or compensation for oil confiscated by Sudan**	South Sudanese officials have accused Khartoum of stealing $815 million worth of oil revenue and have called for the release of seized oil.
Sudan would like South Sudan to share part of its external debt of $38 million.	**Sudan's external debt**	Juba has declined to share Sudan's external debt.
Sudan controls the Abyei region, but this is disputed by the South. A referendum to decide Abyei's control has been postponed indefinitely.	**Abyei region & border demarcation**	Officials in Juba have stated that they would move closer to restarting oil if the deal covered border security and control over the Abyei region.

The AU has put forward proposals in an attempt to settle the dispute, but they have failed to inspire any compromise thus far. The initial proposal required the South (1) to make a cash transfer in the range of $2.6 billion to $5.4 billion to Sudan as compensation for losing three-quarters of oil output and for the South's use of pipelines, processing, and export facilities that run through Sudan; (2) supply Sudan with up to 35,000 barrels a day on loan; and (3) set aside arrears negotiations for later. The most recent draft AU proposal suggested the South should pay transit fees worth up to $1.1 billion to cover the period until the end of 2014.

At the time of writing, both countries are scheduled to meet again in Addis Ababa in March to continue negotiations on transit fees, an oil revenue sharing arrangement, and the status of the Abyei region and other disputed sections of the border.

Alternative Pipeline

Meanwhile, South Sudan has signed non-binding memoranda of understanding with both the Kenyan and Ethiopian governments on a proposal to build two pipelines through both countries. If constructed, the pipeline through Kenya would go to the port of Lamu and the pipeline through Ethiopia would end at the port of Djibouti.

South Sudan wants the planned pipeline from South Sudan to Kenya's Port of Lamu to be just over 1,000-miles long, with a capacity of 500,000 bbl/d, and completed within 18 months. However, most analysts remain skeptical and believe that, if constructed, the pipeline would take at least 2-3 years to complete, given the general logistics, lack of roads, and security concerns surrounding the pipeline route.

Oil Revenue Loss

Oil plays a major role in the economies of both countries. According to the International Monetary Fund (IMF), oil represented over half of government revenue and 90 percent of export earnings for Sudan. For South Sudan, oil represented 98 percent of total revenues, with most of it spent on defense forces and government salaries. South Sudan's oil shutdown will affect both economies. The IMF estimates that, apart from the oil shutdown, the secession of South Sudan could cost Sudan more than $7.7 billion in lost revenues over the next four years.

Almost a month after shutting in production, the South's government approved austerity measures that aim to cut non-salary spending by 50 percent and reduce monthly grants to states. The Deputy Finance Minister of South Sudan recently reported that the country has enough foreign exchange reserves to sustain the economy from seven months to a year. Nonetheless, it is unclear how long the budget cuts and the country's reserves can sustain South Sudan's economy.

South Sudanese officials have also reported that they are seeking to borrow funds from international markets and use oil reserves as collateral. The country will soon become a member of the World Bank and IMF, but it is uncertain when the South can secure a loan from either entities. South Sudan is also submitting an application to join the five-nation East African Community (EAC) regional bloc.

Currently, South Sudan is a member of the United Nations (UN) and does receive development aid. The UN and aid agencies are providing food aid and many of the country's basic services. According to the UN, about 90 percent of the population survives on less than $1 a day and nearly half of the population are expected to struggle to meet their food needs in 2012. It is too early to conclude how the oil shutdown will affect the livelihoods of the already poor population, in which many are relying on basic services from aid agencies. Nevertheless, the shutdown has gained much public support in South Sudan.

Global Oil Supply

Although South Sudan produced a mere fraction of global oil production (0.3 percent in 2011), many analysts believe that its production shutdown has affected global oil prices. South Sudan produces a distinct crude variety sought out by Asian importers because of its low sulfur and high waxy content. Additionally, power shortages in Japan have heightened the demand for South Sudan's two crude oil export grades: the Dar Blend and Nile Blend. As a result, South Sudan's largest crude customers, China and Japan, have had to shop elsewhere for fair substitutes. China has recently increased crude purchases in West Africa, particularly heavy, low sulfur Angolan oil.

Oil

South Sudan's oil shutdown largely effects Asia, as most companies operating oil fields are from China, Malaysia, and India. Additionally, oil exports from Sudan and South Sudan are almost exclusively sent to Asian markets.

Most of Sudan's oil is produced in the South, but the pipeline, refining and export infrastructure is in the North of the country. According to the *Oil & Gas Journal* (*OGJ*), Sudan and South Sudan had five billion barrels of proved oil reserves as of January 2012, up from an estimated 563 million barrels in 2006. Other analysts put reserve estimates as low as 4.2 billion barrels (Wood Mackenzie) or as high as 6.7 billion barrels (BP 2011 Statistical Review). The majority of reserves are located in the oil-rich Muglad and Melut Basins. Oil produced in these basins and nearby fields is transported through two main pipelines that stretch from the landlocked South to Port Sudan. Due to civil conflict, oil exploration prior to independence was mostly limited to the central and south-central regions of the unified Sudan. Natural gas associated with oil production is mostly flared or re-injected. Despite known reserves of 3 trillion cubic feet (Tcf), gas development has taken the backseat to oil development and gas exploration has been limited.

Sector Organization

Foreign companies, primarily from Asia, dominate Sudan's oil sector. They are led by the China National Petroleum Corporation (CNPC), India's Oil and Natural Gas Corporation (ONGC) and Malaysia's Petronas. These companies hold the largest stakes in the leading consortia operating in both countries: the Greater Nile Petroleum Operating Company (GNPOC), Petrodar, and the White Nile Petroleum Operating Company (WNPOC).

- GNPOC is a consortium of CNPC (40 percent), Petronas (30 percent), ONGC (25 percent) and Sudapet (5 percent).
- Petrodar is a consortium of CNPC (41 percent), Petronas (40 percent), Sudapet (8 percent), Sinopec (6 percent), and Tri-Ocean Energy of Kuwait (5 percent).
- WNPOC is a consortium of Petronas (67.88 percent), ONGC (24.13 percent) and Sudapet (8 percent)

The Sudan National Petroleum Corporation (Sudapet), Sudan's national oil company, is active in the country's oil exploration and production. Sudapet remains a minority shareholder in joint ventures with foreign oil companies because of its limited technical expertise and financial resources. The Nile Petroleum Corporation (Nilepet) is South Sudan's national oil company, but its role has yet to be fully determined.

Sanctions

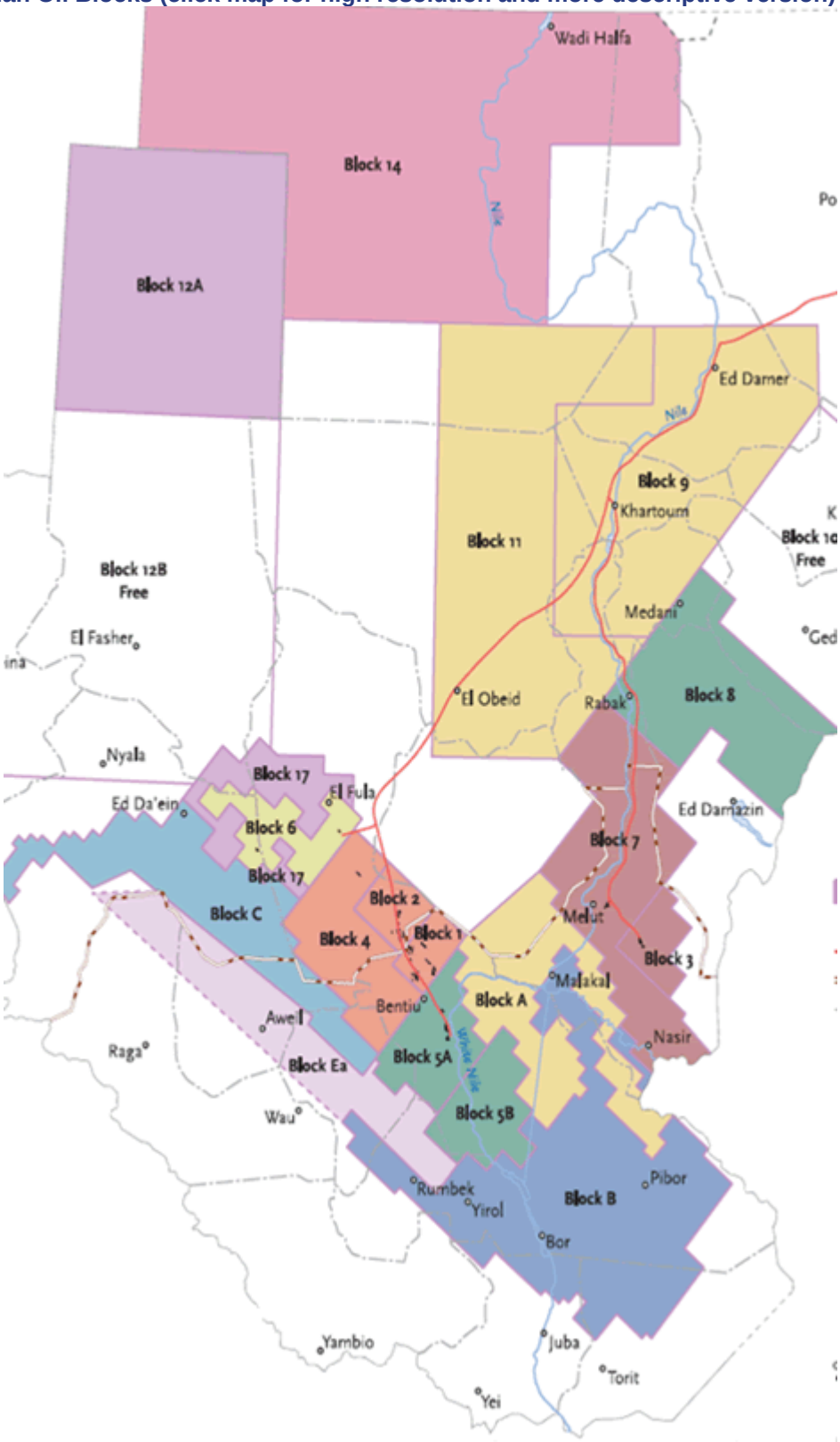
In December 2011, the United States lifted sanctions on South Sudan, but renewed its sanctions on Sudan one month prior, partly due to conflicts in border territories: South Kordofan, Blue Nile, and Abyei. The sanctions prohibit U.S. nationals from engaging in any transactions or activities related to the petroleum or petrochemical industries in Sudan as a result of the conflict in Darfur. For information on full U.S. sanctions, please see the U.S. Treasury Department's Office of Foreign Assets Control.

Exploration and Production

Oil production began in the late 1990s and grew rapidly starting in July 1999 with the completion of an export pipeline that runs from central Sudan to the Port of Sudan. Today, nearly all the oil produced in Sudan and South Sudan originates from Blocks 3 and 7, Block 5A, Block 6, and Blocks 1, 2, and 4. Blocks 3 and 7 and Block 5A are located in South Sudan, while Block 6 falls in Sudan's territory. Oil fields in Blocks 1, 2, and 4, collectively known as the Greater Nile Oil Project, are split accordingly between the two countries, since it covers an area that straddles the North, South, and the disputed Abyei region.

Khartoum recently launched bidding for Blocks 8, 10, 12B, 14, 15 and 18. The blocks are clearly located in Sudan and do not straddle the border, unlike most of the existing blocks. Khartoum hopes that increased exploration into these blocks will spur new finds in the future that will replace the loss of oil from the South and maturing fields in the North.

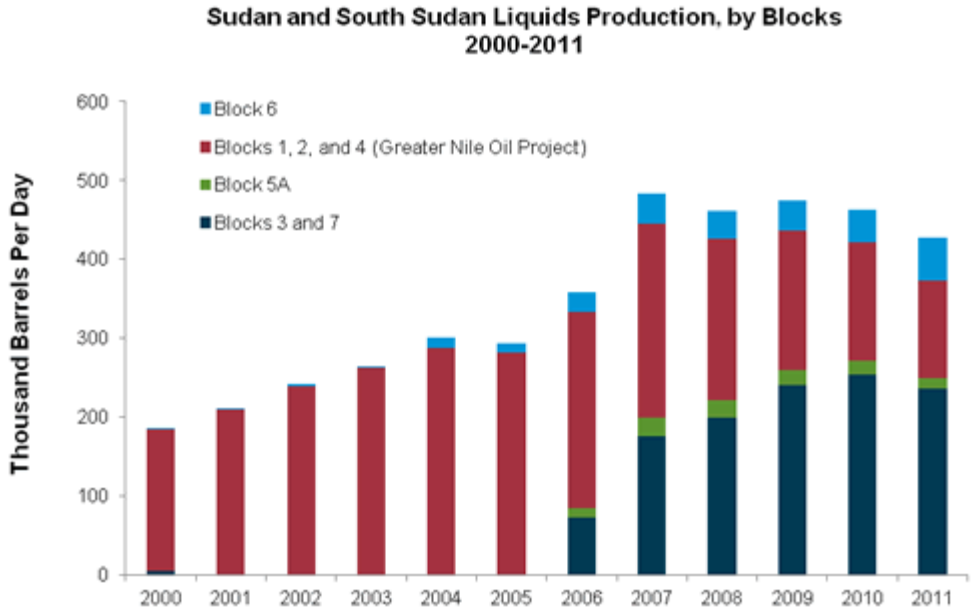
Sudan Oil Blocks (click map for high resolution and more descriptive version)



Source: European Coalition on Oil in Sudan

EIA estimates that crude oil production in Sudan and South Sudan averaged about 425,000 barrels per day (bbl/d) in 2011. In the first quarter of 2011, oil production averaged nearly 470,000 bbl/d, but production increasingly declined throughout the year, partially due to maturing fields, but primarily because of labor shortages at some oil facilities. In April 2011, there was a brief disruption in production when a number of North Sudanese workers in Southern fields were temporally expelled. For the remainder of 2011, some oil facilities experienced labor shortages that adversely affected production, as skilled workers migrated back to the north after the secession.

For the past 10 years, production has been declining in the Greater Nile Oil Project. The decline is driven by maturing oil fields and lack of investment, although one of the project's operators, CNPC, claims that progress in exploration was made in 2010. In 2009, production in Blocks 3 and 7 outpaced declining output in the Greater Nile Oil Project, and those blocks remain the largest current source of oil. After the secession, South Sudan obtained full jurisdiction over Blocks 3 and 7.



Source: *Wood Mackenzie, Annual Liquids Production, by Fields*

Oil Shutdown

In the final weeks of January 2012, South Sudan incrementally shut in all of its oil production. The first production halt occurred in Block 5A, while production in Blocks 3 and 7 and South Sudan's oil fields in the Greater Nile Oil Project were gradually reduced and eventually stopped by the end of January. International oil companies operating in the area have confirmed that water has been injected into the 1,000-mile pipeline that links Southern oil fields in the Muglad Basin to the export terminal in Port Sudan to prevent clogging. Companies have also reportedly sent some of their foreign workforce home.

It is difficult to project how quickly companies will be able to restart production. According to various estimates, it could be a month or longer, depending on the oil facility and the duration of the shutdown. The European Coalition on Oil in Sudan claims the consortium Petrodar, operating Blocks 3 and 7, reported that it estimated "that a minimum of 40 days to six months or possiblylonger is required to resume the production depending on theduration of the shutdown."

At the time of writing this report, production remains completely halted at Blocks 3 and 7, Block 5A, and South Sudan's fields in the Greater Nile Oil Project. According to Sudapet, Sudan's Block 6 was producing almost 52,000 bbl/d and output at the North's field in the Greater Nile Oil Project was nearly 50,000 bbl/d as of mid-February, placing Sudan's current production slightly over 100,000 bbl/d, while South Sudan remains at zero output.

Greater Nile Oil Project

Blocks 1, 2, and 4 (Sudan and South Sudan)

Blocks 1, 2, and 4 are collectively operated by the consortium GNPOC and are located in the oil-rich Muglad Basin, covering an area of 48,388 square kilometers. Production began in 1996 with the development of the Heglig and Unity Fields, which are now the largest fields in the area. A 450,000 bbl/d pipeline stretches 1,000 miles from the Muglad Basin to an export terminal near Port Sudan, transporting oil from the Heglig, Unity, and surrounding smaller fields.

In 2011, combined production from Blocks 1, 2, and 4, was estimated to be around 120,000 bbl/d of Nile Blend, reflecting a decline from a 2004 peak of almost 290,000 bbl/d. Apart from the recent oil shutdown, production is expected to continue to decline in the short-term, mainly from natural declines in the Heglig and Unity fields.

The area's borders are often disputed because oil fields within the blocks straddle both countries. While the Unity field is fully located in the south, there is an ongoing row on whether the Heglig

field in Block 2 is in the north or south. In 2009, the Permanent Court of Arbitration in The Hague ruled that two of Sudan's oil fields from this block (Heglig and Bamboo) belong to the North. The negotiations over the future of these fields and the Abyei region have delayed the investments needed to offset declines.

Block 6 (Sudan)

The Fula oil fields were found in Block 6 in 2001 and began production in March 2004 at a rate of 10,000 bbl/d. In 2011, the block produced about 55,000 bbl/d of highly acidic crude. The block's operator, CNPC, has constructed a pipeline that links the Fula fields to the Khartoum refinery where it is processed largely for Sudan's domestic use. The block is located in the northwest of Muglad Basin. CNPC holds 95 percent equity of the block and Sudapet holds the remaining 5 percent.

Block 5A (South Sudan)

Block 5A is operated by WNPOC, and consists of the Thar Jath and Mala oil fields located in the Muglad Basin. In 2011, the block produced around 15,000 bbl/d of Nile Blend. Oil from the field flows through a 110-mile pipeline to Unity field, where it is shipped to Port Sudan on the GNPOC pipeline.

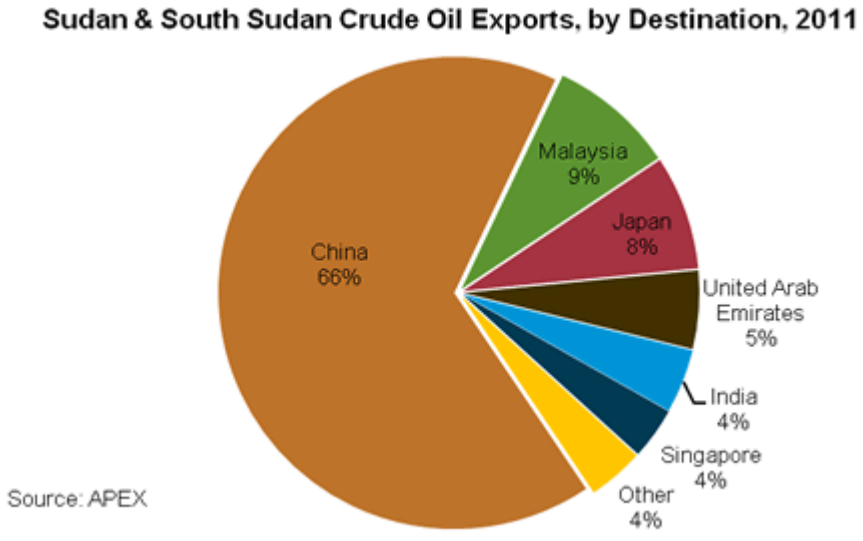
Blocks 3 and 7 (South Sudan)

Blocks 3 and 7 are operated by the consortium Petrodar and are located in the Melut Basin, in the northeast of South Sudan, and cover an area of 72,400 square kilometers. The basin contains the Fal, Adar Yale, and Palogue oil fields. In November 2005, CNPC brought online the Petrodar pipeline linking the two blocks to Port Sudan. The pipeline runs about 850 miles north and has a current throughput of 300,000 bbl/d and maximum capacity of 500,000 bbl/d. In 2011, production from these two blocks was around 230,000 bbl/d of Dar Blend, which is a heavy and highly acidic crude stream.

Exports

South Sudan exports two major oil streams: the Nile and Dar Blends. Nile is a medium, sweet crude while the Dar Blend is a heavy, sour crude. Both are exported mostly to Asian markets and trade at a discount to Indonesian Minas, the Asian benchmark crude.

According to international trade data, Sudan and South Sudan exports averaged 330,000 bbl/d in 2011 and went almost exclusively to Asian markets. China imported around 220,000 bbl/d (two-thirds of total exports and 5 percent of Chinese imports) followed by Malaysia (30,000 bbl/d) and Japan (25,000 bbl/d). Sudan and South Sudan also exported some processed fuels to neighboring countries. Ethiopia imports most of its fuel from them, but official data on trade volumes are not available.



In December 2011, Khartoum blocked exports of South Sudanese oil from leaving Port Sudan. Since then, the Sudanese government has released some shipments to buyers, but South Sudan believes that more cargoes are still awaiting shipment. International trade data shows that in January 2012 about 12.8 million bbl of crude oil were loaded and shipped from Port Sudan to various Asian countries; however, the data does not discern whether the crude's origin is from the North or South.

Some of the oil shipped is being disputed by South Sudan. In mid-February, a tanker arrived off the coast of Japan and was unable to unload 600,000 bbl of Nile Blend because the South claimed it was oil seized by the North. According to the South Sudanese government, the oil was provided by GNPOC in mid-January, and according to industry sources, the crude was sold at a deep discount to an Asian trader. The case was taken to a British court, and almost two weeks after the shipment arrived, the tanker's owner was granted permission by the court to unload in Japan.

At the time of writing, the South also claims that the North has put 1.9 million bbl of Dar Blend onto three tankers, most of which is still on the coast of Sudan and some off the coast of Singapore. The disputed cargoes could present problems to buyers because of the potential litigation and financial costs.

Refining

Sudan has three refineries located in Khartoum, Port Sudan, and El-Obeid; with total refinery capacity just under 122,000 barrels per cal day, according to the OGJ. The largest refinery, located 70 kilometers north of Khartoum, came online in 2000 with a capacity of 50,000 bbl/d. It is a joint venture between CNPC and the Sudanese government.

The Khartoum refinery expanded to 100,000 bbl/d in 2006. This expansion allowed it to process two streams of crude, the Nile Blend and the more acidic, heavier Fula Blend. According to CNPC, the Khartoum Refinery was the first modern refinery with the world's first delayed coking unit for high-acid and high-calcium crude oil. Sudan's refined products primarily feed domestic consumption and smaller quantities of product exports. In 2010, total Sudan and South Sudan consumption was 98,000 bbl/d; most of which was consumed in the north.

There is no refinery in South Sudan. The pipeline project that South Sudan expects to undertake with Kenya includes plans for building a refinery in Lamu. The South Sudanese government has also mentioned potential plans to build domestic refineries to export petroleum products to regional markets, such as Kenya, Uganda, and Ethiopia.

Links

U.S. Government

CIA World Factbook - Sudan
USAID - Sudan
U.S. State Department Consular Information Sheet - Sudan
U.S. Treasury Department Office of Foreign Asset Control

General Information

BBC Country Profile: Sudan
European Coalition on Oil
International Monetary Fund - Sudan
U.S. Institute of Peace
United Nations Security Council Sudan Sanctions Committee
China National Petroleum Company (CNPC)
Greater Nile Petroleum Operating Company (GNPOC)
Oil and Natural Gas Corporation (ONGC
Petrodar
Petronas
Sudapet
White Nile Petroleum Operating Company (WNPOC)

Sources

Africa Energy Intelligence
Africa Oil and Gas Monitor (Newsbase Afroil)
BBC Worl d
BP Statistical Review of World Energy
Business Monitor International
Economist Intelligence Unit
FACTS Global Energy
Global Trade Atlas
Global Witness
IHS Global Insight
International Energy Agency
International Monetary Fund
Lloyd's List Intelligence APEX
Middle East Economic Survey (MEES)
Oil and Gas Journal
Reuters News Service
World Bank
Wood Mackenzie

Contact Info

cabs@eia.gov
(202) 586-8800
cabs@eia.gov