

COUNTRY CHAPTER: LIBERIA

Author of Country Chapter

Augustus V. Goanue
(MSc. Reg. Sc., BA Eng.)

Coordination and Review of the Country Chapter

Anton Hofer, (MSE, Dipl.-Ing./FH, M.A.)
WIP-Renewable Energies
www.wip-munich.de
Munich, Germany

Editor

Deutsche Gesellschaft für Technische
Zusammenarbeit (GTZ) GmbH
Department Water, Energy, Transport
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
www.gtz.de

On behalf of

Federal Ministry for Economic
Cooperation and Development (BMZ)

Editorial staff

Diana Kraft
Tel: +49 (0)6196 79 4101
Fax: +49 (0)6196 79 80 4101
Email: diana.kraft@gtz.de



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ACRONYMS AND ABBREVIATIONS

LIBERIA

CBL	Central Bank of Liberia
CPA	Comprehensive Peace Agreement
EC	European Commission
EE	Energy Efficiency
EPA	Environmental Protection Agency
EPP	Emergency Power Program
FDA	Forestry Development Authority
GDP	Gross Domestic Product
GEF	Global Environment Facility
GoL	Government of Liberia
IMC	Inter-Ministerial Committee
IMPTC	Inter-Ministerial Petroleum Technical Committee
IPRS	Interim Poverty Reduction Strategy
LACC	Liberia Anticorruption Commission
LCC	Liberia Chamber of Commerce
LEAP	Liberia Energy Assistance Program
LEC	Liberia Electricity Corporation
LIBA	Liberia Business Association
LPG	Liquefied Petroleum Gas
LPRC	Liberia Petroleum Refining Company
MIC	Ministry of Industry & Commerce
MLME	Ministry of Lands, Mines and Energy
NEP	National Energy Policy
NIC	National Investment Commission
NTGL	National Transitional Government of Liberia
PPP	Public-Private Partnership
PRS	Poverty Reduction Strategy
PST	Petroleum Storage Terminal
PV	photovoltaic
RE	Renewable Energy
RESCos	Rural Energy Service Companies
RFTF	Results Focused Transitional Framework
RREA	Rural and Renewable Energy Agency
SME	Small and Medium Enterprise
UN	United Nations
UNDP	United Nations Development Program
USD	United States Dollars
WAPP	West African Power Pool



MEASUREMENTS

°C	degree Celsius
dam ³	cubic decameter (1 dam ³ = 1000 m ³)
GWh	gigawatt hour
Kg	kilogramm
km	kilometer
km ²	square kilometer
kVA	kilovolt ampere
kW	kilowatt
kWh	kilowatt hour
kWp	kilowatt peak
m ²	square meter
m ³	cubic meter
mm	millimeter
MW	megawatt
yr	year



SUMMARY

The Country Study of Liberia is to provide an overview of the country's energy market and to support decision-making for private investments for the Renewable Energy (RE) sector in Liberia. The study is structured as follows:

Chapter one provides **Background Information on Liberia**. This includes an overview of geographical and climatic conditions, as well as the most important facts in view of political, economic and socio-economic conditions of Liberia.

Chapter two summarizes facts and figures of Liberia's **Energy Market** including stakeholders and market actors involved as well as sector related regulations.

Chapter three presents the currently existing **Political Framework for Renewable Energies** in Liberia. This includes an overview of support mechanisms for photovoltaic (PV) as well as already existing regulations, incentives and legislative framework conditions for other RE technologies.

Chapter four provides a brief overview of the **Status Quo and Potential for Renewable Energies** in Liberia.

Chapter five summarizes the existing and potential **Market Risks and Barriers** in general with focus on RE.

Chapter six presents a compilation of the most relevant **Renewable Energy Business Information and Contacts** of Liberia.



1 COUNTRY INTRODUCTION

1.1 GEOGRAPHY AND CLIMATIC CONDITIONS

Liberia is situated on the southwestern corner of the West Coast of Africa between longitudes 7° 30' and 11° 30' West and latitudes 4° 18' and 8° 30' North. The country is bounded by the Atlantic Ocean in the South, by Côte d'Ivoire in the East, by the Republic of Guinea in the North and by the Republic of Sierra Leone in the West. Liberia covers an area of 111,370 km² split into 15,050 km² of water and 96,320 km² of land. The total land boundaries extend to 1,585 km (Guinea 563 km, Côte d'Ivoire 716 km and Sierra Leone 306 km).

There are four tropical regions each with its own distinct physical features and height above sea level. The Coastal Plain stretches along the seacoast for 563 km. It consists of an almost unbroken sand strip rising up to 30 meters above sea level. The Coastal Plain flanked by a belt of flooded plateaus followed by a belt of high lands and rolling hills in the North and Northwest. The maximum elevation of Liberia is Mount Wutivi in the Northern highlands with a height of 1,350 meters. The average annual rainfall along the coastal belt is over 4,000 mm and declines to 1,300 mm at the forest/savanna boundary in the North. The relative humidity is generally high throughout the country.

FIGURE 1

Map of Liberia



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1 PRS, AS OF 2008

2 LISGIS, CWIQ, AS OF 2007

3 SEE ALSO UNITED NATIONS/WORLD BANK, AS OF 2005

4 IMF, AS OF 2007

ters. The average annual rainfall along the coastal belt is over 4,000 mm and declines to 1,300 mm at the forest/savanna boundary in the North. The relative humidity is generally high throughout the country.

1.2 POLITICAL, ECONOMIC AND SOCIO-ECONOMIC CONDITIONS

After winning the 1997 presidential elections following an eight-year civil war, former President Charles Taylor did not manage to keep rebel groups from trying to oust him by force. Rebel attacks in Monrovia, coupled with two years of sanctions imposed by the UN crippled the Taylor-led Government, thus prompting Taylor's handing over power to his successor in August 2003. A transitional Government – composed of rebel factions, government, political parties and civil society groups – took control in October 2003 after the signing of the Accra Comprehensive Peace Agreement (CPA). Gyude Bryant, who had a two-year mandate to coordinate efforts to restore peace and rebuild Liberia, headed the transitional Government as its Chairman. Since then, Liberia has steadily been making progress towards political stability in conditions of peace and security. Successful multiparty presidential and legislative elections, held in October and November 2005, culminated in the formal inauguration of President Ellen Johnson Sirleaf and a new 94 member legislative body constituted by 14 political parties and 8 independent candidates in January 2006. Thanks to uninterrupted political and civil stability, the Government of Liberia (GoL) has been able to vigorously pursue an agenda of reconstructing post-war Liberia since 2006.

Liberia has a population of 3.5 million people. With a GDP of about 190 USD¹ per capita, Liberia is one of the poorest countries in the world. Poverty is pervasive, and is particularly acute in rural and remote areas of the country. 63.8% of the country's population live below the poverty line². Poverty has many dimensions, including low levels of income and consumption, poor nutrition and food security, low health and education indicators as well as inadequate infrastructure. It is reinforced by inequities, especially in access to juridical and economic opportunities.

The Government of Liberia has embarked on a number of national development initiatives with external assistance. These development initiatives have been structured around the Results Focused Transitional Framework (RFTF)³ of February 2004–January 2006, the 150 Day Deliverables or Action Plan of February–June 2006 and the Interim Poverty Reduction Strategy (IPRS) of July 2006–June 2008⁴, offering guidance to donor interventions as an addition to continuing programs and activities previously initiated on an emergency relief scope employing short-term recovery strategies.

In April 2008, the Government of Liberia finalized the Poverty Reduction Strategy (PRS) as a macro-economic policy framework document to guide socio-economic development activities and national reconstruction between 1 July 2008 and 30 June 2011. The PRS was designed around four major objectives: (i) consolidating peace and security, (ii) revitalizing the economy, (iii) strengthening governance and the validity of law and (iv) rehabilitating infrastructure and delivering basic services.



The Liberian economy is characterized by a structural imbalance between a modern enclave and the traditional sector. The modern sector basically depends on foreign investment and technological skill and is geared towards mining, rubber and forest products. Before the war, this sector accounted for 70% of export earnings and almost 50% of the Gross Domestic Product (GDP). The traditional sector, on the other hand, is rural based and relies in general on indigenous capital and rudimentary technology for subsistence agriculture supports and comprises nearly 70% of the population. There is no connection between the two sectors whatsoever. The modern sector's link to the rest of the economy is generally weak and exists mainly in the form of profit sharing with the Government, the payment of royalties, income tax levied on employers and duties on imported materials in some instances.

2 ENERGY MARKET IN LIBERIA

2.1 OVERVIEW OF THE ENERGY SITUATION

The current energy market in Liberia is dominated by petroleum products imported in refined forms and traditional wood biomass consumed primarily for cooking and heating as in most Sub-Saharan African countries. The market for petroleum products is considered as formally institutionalized, while that of wood biomass is rather informal. Currently, there are no sufficient disaggregated data on the overall energy mix of Liberia in view of production and consumption.

2.2 ENERGY CAPACITIES, PRODUCTION, CONSUMPTION AND PRICES

Electricity Sector

Before the civil war, the total installed electricity generation capacity – including the private sector – was about 412 MW. The Liberia Electricity Corporation (LEC) provided approximately 191 MW, while the concessionaires delivered 212 MW. The installed capacity of the rural electrification program totaled 13 MW and consisted of small isolated rural systems powered by plants ranging from 300 to 1,300 kW. All facilities were completely damaged during the 14-year civil war. Figure 2 presents the available electricity generation capacities before and after the civil war.

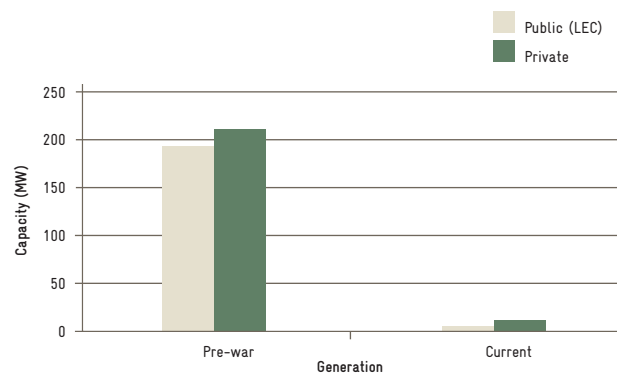
The LEC small scale operations started in late November 2003 after the inauguration of the National Transitional Government (NTGL) with the financial and fuel supply support of the European Commission (EC). They ended by the first week of April 2004 as a result of the LEC's inability to finance the fuel oil supply component of its operation. The high electricity theft rate in the LEC distribution network was the main reason for the utility's inability to sustain its operations. 22.6% of the energy production could not be accounted for during the period January 1 to 31 March 2004⁵.

Launched in 2006, the Emergency Power Program (EPP) was designed to re-establish public power supply in Monrovia and its immediate environs. The EPP initially installed a total

power of 2.5 MW, which has now been increased to 9.6 MW. There is no generation capacity outside Monrovia besides privately owned generators and scattered donor-funded solar power pilot projects. A very large number of diesel generating units (ranging from 15–250 kVA) are in everyday use throughout the country. All institutions, agencies, commercial entities and a large number of private households generate their own electrical power. A combined capacity of small diesel units is conservatively estimated to be over 15 MW. There are no reliable data on the overall electrical energy consumption in Liberia as there are numerous privately owned generators of various capacities scattered across the country. Recently obtained production and consumption data from the LEC are presented in Table 1.

The current electricity tariff is fixed irrespective of consumer type (residential, commercial or industrial). Although only laid out to cover operational and maintenance costs, the current electricity prices are relatively high. Due to dependence on fossil fuel and fuel price instability, electricity tariffs have been ranging between 0.34 USD and 0.60 USD per kWh (based on fuel adjustment costs) since the inception of the EPP. Current tariffs stand at 0.43 USD per kWh. This price, however, is lower than the cost of self-generation, which is estimated at a minimum of 0.75 USD per kWh. Currently, there are no tariffs for RE implemented as RE projects still are in a rudimentary and non-commercial stage.

FIGURE 2
Pre-War vs. Post-War Electricity Generation (MW)



Source: Liberia Electricity Corporation (LEC), as of 2004–2008

TABLE 1
Annual Electrical Energy Production and Consumption (GWh)

Year	Energy Production	Energy Consumption
2004	1.95	1.51
2005	0.00	0.00
2006	2.05	1.64
2007	8.23	6.70
2008	11.25	9.16

Source: Liberia Electricity Corporation, as of 2004–2008



Petroleum Sector

Yearly volumetric imports of approximately 35.2 million US gallons consist mainly of gasoline, diesel fuel and to a lesser extent jet fuel and kerosene. Presently, a number of large and small vendors hold licenses to import and distribute petroleum products. Although the Liberia Petroleum Refining Company (LPRC) is the major player in the downstream petroleum sector, the wholesale and retail business is dominated by the private sector, namely West Oil Investment, Monrovia Oil Trading Company, Aminata & Sons, SRIMEX Enterprise, Origin Oil & Gas, TOTAL International, Gulf Trading Company and LIB-AFRIC. West Oil is the leading importer with a market share of about 34%. Table 2 presents an overview of imports in the petroleum sector.

TABLE 2
Annual Petroleum Imports in US Gallons

YEAR	GASOLINE	DIESEL	KEROSENE	JET-A1
2000	11,528,818	15,089,206	456,408	1,472,509
2001	9,961,590	15,299,071	260,011	1,119,020
2002	8,837,731	12,290,039	328,047	1,535,958
2003	7,209,339	10,797,827	435,446	2,025,402
2004	13,170,250	21,595,384	640,862	6,381,150
2005	17,107,913	24,657,097	644,046	6,115,622
2006	20,487,703	30,678,151	1,054,258	5,156,645

Source: Liberia Petroleum Refining Company (LPRC), as of 2006

TABLE 3
Comparative Petroleum Product Prices per US Gallon, 1997–2005

YEAR	GASOLINE			DIESEL			KEROSENE		
	Whole-sale	Distributor Price	Pump Price	Whole-sale	Distributor Price	Pump Price	Whol-sale	Distributor Price	Pump Price
2005	3.02	3.07	3.25	3.12	3.17	3.25	2.49	2.55	2.70
2004	2.39	2.45	2.60	2.44	2.50	2.65	2.49	2.55	2.70
2003	No data available								
2002	No data available								
2001	2.79	2.85	3.00	2.69	2.75	2.90	2.49	2.55	2.70
2000	2.12	2.18	2.30	2.12	2.18	2.30	2.12	2.18	2.30
1999	1.89	1.88	2.00	1.82	1.88	2.00	1.82	1.80	2.00
1998	1.58	1.64	1.75	1.58	1.64	1.75	1.58	1.64	1.75
1997	1.33	1.39	1.50	1.33	1.39	1.50	1.33	1.39	1.50

Source: LPRC Petroleum Storage Terminal (PST) Status Report, as of 2007

Local pricing of petroleum products in Liberia is subject to external fluctuations in the price of oil on the world market. Import tariffs, port handling charges and storage fees also affect the price of petroleum products. The current pump prices of gasoline, diesel and kerosene are 2.50 USD, 3.00 USD and 2.90 USD per US gallon respectively. Table 3 provides wholesale, distributor and pump prices of petroleum products between 1997 and 2005.

The use of kerosene and Liquefied Petroleum Gas (LPG) for heating and cooking is limited to a very small number of expatriate workers and wealthy Liberians who reside in Monrovia. The price per kg of LPG is about 2.5 USD.

Biomass Sector

Traditional wood biomass (firewood and charcoal) is the primary energy source for cooking and heating. In 2004, it was estimated that over 95% of the population relied on firewood, charcoal and palm oil for their energy needs⁷. According to the Central Bank of Liberia (CBL), the charcoal production amounted to 255,600 kilograms in 1999. Data obtained from the National Charcoal Union of Liberia (NACUL) in 2005 revealed that 36,500,000 kg (36,500 tons) of charcoal were produced per annum. Though there are no reliable data on firewood consumption in Liberia, forecasts for the country estimate an annual increase in demand of about 0.6 m³ per household⁸.

⁶ LPRC ANNUAL REPORT, 2006

⁷ CSET, AS OF 2004

⁸ CSET, AS OF 2004



2.3 MARKET ACTORS AND REGULATION STRUCTURES

Electricity Sector

Under the current legislation, the Liberia Electricity Corporation is the only institution responsible for the generation, transmission, distribution and sale of electricity under policy guidance of the Ministry of Lands, Mines and Energy (MLME). LEC used to supply the major cities and towns connected to the grid or with stand-alone diesel plants. Additional power was produced within the various mining and agricultural concessions. Due to the LEC monopoly, private investments have not been attracted to the electricity sub-sector. The draft National Energy Policy (NEP), however, has stressed the need for the liberalization of the electricity market.

Petroleum Sector

The Government's institutional framework for the petroleum sector comprises an office responsible for hydrocarbons in the MLME and two state-owned enterprises dedicated to upstream and downstream operations. NOCAL and LPRC are the two Government institutions established by law to administer and regulate the petroleum sector of Liberia under the policy guidance and supervision of the MLME. NOCAL is responsible for the upstream petroleum sector, while the downstream petroleum is under the jurisdiction of the LPRC. In the upstream sub-sector, petroleum exploration and development is one of the Liberia's top priorities. Although the current law does not provide for separation of policy-setting, monitoring and operation roles, in practice the MLME is involved in policy-setting in the upstream sector as it chairs the Inter-Ministerial Petroleum Technical Committee (IMPTC) in charge of analyzing applications for licenses and negotiating concession agreements. The IMPTC is the executive body of the Inter-Ministerial Committee (IMC) chaired by the Minister. In accordance with regulations and procedures, it decides on the granting of licenses and concessions. NOCAL receives applications from interested investors, submits them to the IMPTC (to which it provides technical advice) and then supervises the implementation of the resultant concession agreements. In the downstream sub-sector, the LPRC is responsible for the importation, refining, storage and distribution of petroleum products. At present, there is no operational refinery in the country. All of the country's refined products are imported by companies licensed by the LPRC and through LPRC's offloading and storage facilities. Even though there is no detailed study currently available indicating whether the refinery can be retrofitted or not, it is obvious that the requisite financial resources for any restorations are not available, even if it made sense from an economic point of view.

Biomass Sector

Although there is no public entity established by law to plan and regulate the biomass sector where charcoal and firewood predominate, the Forestry Development Authority (FDA), a Government entity created by law in 1976, is responsible for the regulation and management of the forestry sector. One

of the FDA's objectives is to stop waste and destruction of forests and the associated natural resources by bringing about the profitable harvesting of all forest products while assuring that supplies of these products are perpetuated. However, FDA's mandate does not include any explicit policy and regulatory oversight for the biomass energy sector. The already mentioned National Charcoal Union of Liberia (NACUL), a holding group of commercial charcoal producers established in 2005, is working closely with the FDA in order to coordinate the production and sale of charcoal in the sector.

3 POLICY FRAMEWORK FOR RENEWABLE ENERGIES

3.1 POLICIES, STRATEGIES AND PROGRAMS FOR RENEWABLE ENERGY PROMOTION

The formulation of Liberia's first NEP started in early 2006 with provisions in the 150 Day Plan deliverables, followed by a National Energy Stakeholders Forum in October 2006, the publication of the National Energy Sector White Paper, the interim Poverty Reduction Strategy Process and the final Poverty Reduction Strategy. NEP contains Liberia's national vision for the energy sector from the emergency phase, which is nearing completion, to the capacity building and development phases. As part of its policy and strategy, the Government is considering various international models based on best practices in order to develop and ensure that its poverty reduction policy is fully supported by the provision of sustainable energy services to all consumers. The Government believes that the private sector and Public-Private Partnership (PPP) arrangements will play a key role in the medium to long-term development of the energy sector. The Government began to transform the National Energy Sector White Paper into a National Energy Policy in mid 2007. The Renewable Energy (RE) and Energy Efficiency (EE) Policy and Action Plan for Liberia is to:

- Establish a legal/regulatory framework for the development of RE & EE sub-sector in Liberia
- Attract private investment to the RE sub-sector through fiscal and tax incentives
- Develop and expand the RE market in Liberia through PPP
- Transfer technology and build local capacity in the RE & EE sub-sector through training

Following the drafting of the RE and EE Policy and Action Plan of Liberia, the Government embarked on the formulation of the broader National Energy Policy, which comprehensively addresses key policy issues needed to reform the overall energy sector of Liberia. NEP addresses access, quality, cost and institutional framework as the major strategic issues implied in the principal policy objective for energy supply. These issues refer to the overall necessity for energy products and services to be available, acceptable, affordable and adequate.



NEP reaffirms the Government's conviction that economic development is impossible without access to reliable, accessible, affordable and environmentally friendly energy. Increased commercial energy access and use will contribute to the growth of Liberia's economy. According to the NEP, the Government shall establish by legislation the appropriate institutional framework and special incentives and financing mechanisms to facilitate the availability of affordable electricity supplies in remote and low-income rural communities. The development and growth of private and community-owned rural energy service companies (RESCOs) shall be supported. The Government also recognizes the need to provide efficient non-electric energy resources or off-grid electricity for those communities that cannot be connected to the grid in the near future due to affordability and resource constraints. Examples of potential non-electric energy resources include high-efficiency charcoal or biomass stoves for cooking. Low-cost but highly efficient solar lights will be promoted. To generate employment and help to raise incomes for such communities, the Government – according to NEP – will prioritize the use of modern energy services for productive activities. With increased incomes, the demand for modern energy services ensuring a better quality of life will also grow.

3.2 REGULATIONS, INCENTIVES AND LEGISLATIVE FRAMEWORK CONDITIONS

There has been no explicit regulation/legislation for facilitating the development of RE in Liberia. Legislative framework for rural electrification is restricted to the Government-owned LEC, which has never been able to provide sufficient capital to develop RE technologies.

To facilitate RE development and rural electrification, the NEP proposes to establish a Rural and Renewable Energy Agency (RREA) by law to facilitate the economic transformation of rural Liberia through the development of RE technologies. The RREA will be complemented by a Rural Energy Fund designed to support all economically sensible, socially acceptable and environmentally friendly rural energy projects and programs regardless of financial viability. The focus on RE is due to the fact that off-grid and RE technologies offer the best solution for remote communities and will complement the targeted subsidies that will address the issue of affordability.

In this regard, a Bill to Adopt Liberia's Energy Law has been drafted for submission to the National Legislature for enactment. The Draft Energy Law highlights the regulation promotion and development of the RE sub-sector and to establish the RREA and the Rural Energy Fund. Given that RE development is still generally in its basic stage as most of its resources have not been recently assessed on the scale needed for national development, the NEP highlights the need to conduct resource assessments and a National Energy Strategy and Master Plan. This will direct the future course for RE development in Liberia as highlighted in Table 4.

TABLE 4

Phases of Renewable Energy Development in Liberia

PHASE	PERIOD	COMMENT
Emergency/pilot	2006–2008	Launched in 2006 and ended in 2008 with the finalization of the NEP
Capacity building	2009–2015	Building of local capacity for implementation of the National Energy Policy
Development	Beyond 2015	Developing the achievements of the capacity building phase to scale up RE development on a sustainable basis

Source: National Energy Policy of Liberia, as of 2008

Major developments for the use of RE are expected in the areas of hydro- and biomass power systems. In the case of the former, the long-term program involves Hydro Power for domestic consumption and interconnection with WAPP for export. The most promising site is the St. Paul River Basin, which has the potential to produce 824 MW. The planned rehabilitation of the Mount Coffee plant, which is part of the St. Paul River Basin, aims to produce 100 MW within 7–10 years. Moreover, the GoL has signed a concession agreement with Buchanan Renewable Energies for the construction of a 35 MW rubber wood-fired power plant (biomass power plant) to supply Monrovia and other nearby communities. Additionally, solar power systems for health, education and Small and Medium Enterprise (SME) development also form part of the medium term program.

4 STATUS AND POTENTIAL FOR RENEWABLE ENERGIES

Generally, the development of RE is still at a low level in Liberia. There has been no previously defined long-term target for RE in the overall energy supply mix. The NEP, however, declares that by 2015, the share of RE in the overall energy consumption shall account for 30% of the electricity production, 10% of the overall energy consumption, and 5% of the biofuels used for transport. There is no topical inventory of RE resources and no specific technology targets have been set. In addition, no evaluation of the RE utilization rate has been conducted. Regulatory and market/economic incentives for RE are non-existent.

4.1 BIOMASS/BIOGAS

Liberia is endowed with abundant biomass resources – rich forest, rubber plantations, oil palm, cassava, sugarcane, rice, and other crop residues. Wood biomass is the primary energy source used for domestic cooking and heating. More than 95% of the population (most of whom are rural inhabitants) rely on firewood, charcoal and palm oil for their energy needs. Recently, the Liberia Energy Assistance Program (LEAP), funded by the United States Agency for International Development (USAID), initiated a biomass resource assessment in July 2008. The only biogas digester in Liberia, which was destroyed during the civil conflict, was located in Galai (Suakoko District, Bong County), just a few miles from the Cuttington University campus.



The recent USAID funded biomass resource assessment revealed that a variety of biomass resources exist in the country in large quantities and with opportunities for expansion. It states that these resources are more than enough to cover the country’s annual electricity consumption of 297 GWh and oil consumption of 206 dam³. The study further estimates that of the total cropland in Liberia, only 6% is currently cultivated and that the remaining cropland amounts to some 3 million hectares. While the contribution of food crop residues, animal manure and municipal solid waste is small in comparison to other resources within the country, they could still play a valuable role in stand-alone electricity applications and be particularly effective for households in remote rural areas. On the other hand, cash crop and forest residues, resulting mainly from medium and large enterprises, provide opportunities for large-scale centralized power generation. Table 5 provides an overview of existing and potential biomass resources.

TABLE 5
Biopower and Bio Fuels from Existing and Potential Biomass Resources

EXISTING RESOURCES	BIOWATER (GWH/YR)	BIODIESEL (DAM ³ /YR)	ETHANOL (DAM ³ /YR)
Food crop residues	188	-	-
Cash crop residues	5,889	-	-
Biogas from animal manure	219	-	-
Forest residues	15,248	-	-
MSW (biogenic material only)	52	-	-
Total	21,596	-	-
POTENTIAL RESOURCES			
Vegetable oils*	4,946	2,473	-
Sugarcane**	-	-	1,527
Crop residues***	21,923	-	5,385

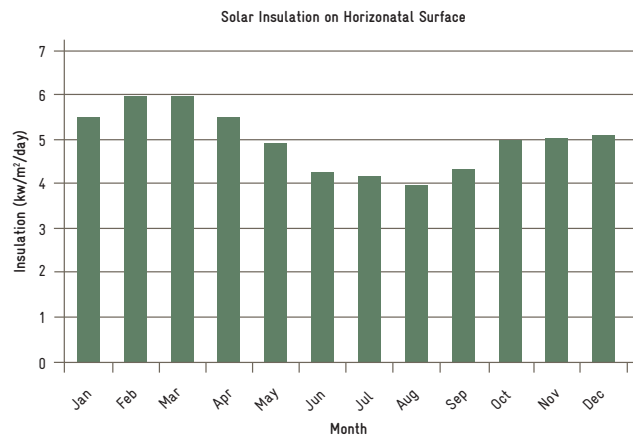
Sources: Assessment of Biomass Resources in Liberia, as of 2008

4.2 SOLAR ENERGY

Liberia is endowed with solar resources that could be used for the benefit of the entire population. Due to the country’s equatorial position, Liberia receives vertical radiation at noon throughout the year giving rise to intensive insulation in all parts of the country with little monthly variations. Although Liberia has high rainfall, the annual solar insulation shows good prospects for the application of solar technologies. The global solar insulation map shows that the average solar radiation on horizontal surfaces in Liberia is between 4.0 and 6.0 kWh/m²/day. Figure 3 visualizes the available solar insulation throughout the year.

The current solar energy applications in Liberia are limited to donor-funded pilot projects with small-scale solar power systems for schools, health centers and small businesses. Table 6 presents an overview of the current use of PV installations.

FIGURE 3
Solar Insulation per Month



Source: Solar Technology, Inc., Monrovia, as of 2007

TABLE 6
Current Use of PV Installations

CAPACITY	INSTALLATIONS	APPLICATION
29.22 kWp	50	Electricity for health clinics, schools, community centers, local Government offices, street lighting, small businesses, homes and entertainment
59.04 kWp	246	Refrigeration
0.96 kWp	3	Water pumping

Source: Center for Sustainable Energy Technology, as of 2008

4.3 WIND POWER

There is little or no data available on wind speeds in Liberia as no formal assessment has been performed to date. Liberia, however, is situated in a low wind region, and except for mountainous and coastal areas, wind resources are expected to be relatively insignificant in most rural areas. Observations along the coastal regions have indicated good prospects for the development of wind power. Unlike in the case of solar energy, no wind energy pilot project has been conducted in the country so far.

4.4 HYDRO POWER

Liberia has six major rivers running 66% of the country’s water, namely the Mano, St. Paul, Lofa, St. John, Cestos and Cavalla Rivers. Before the Liberian civil war, there were three operational hydroelectric power plants in the country: Mount Coffee Hydro Power plant on the St. Paul River 27 km North East of Monrovia (64 MW); Firestone Rubber Plantation in Harbel (4 MW) and Yandahun, a community microhydro in Lofa County (30 kW). Apart from the privately owned 4 MW plant in Harbel, there is currently no working Hydro Power plant in the country. The United States Government funded a Feasibility Study for the rehabilitation of the Mount Coffee Hydro Power Plant. The long-term plan is to generate electricity for domestic consumption and export through the West African Power Pool (WAPP). Moreover, the United Nations Development Program (UNDP) and the GoL have signed a Memorandum of Understanding to conduct a feasibility study for the development of small Hydro Power plants in rural Li-



beria. In addition, within the framework of the Global Environment Facility (GEF) and its new “Regional Programmatic Approach to Climate Change in Focal Areas of West Africa”, support is expected for small Hydro Power development in rural Liberia. Several pre-feasibility studies were conducted before the war identifying a number of potential Hydro Power sites as shown in Table 7.

TABLE 7
Potential Hydro Power Sites

RIVER BASIN	REGION	SITE NAME AND CODE	DESIGN FLOW m ³ /SEC	HEAD (m)	POTENTIAL kW
Mano	Grand Cape Mount, Gbarpolu and Lofa	Mano River 1	10.4	30.0	2,474
		Mano River 2	9.47	30.1	2,252
		Mano River 3	8.09	25.0	1,603
		Mano River 4	3.61	20.0	572
		Mano River 5	2.43	12.0	231
Lofa	Lofa, Gbarpolu and Grand Cape Mount	Lofa River 1	55.7	17.0	7,508
		Lofa River 2	37.10	20.0	5,884
		Lofa River 3	3.48	55.0	1,517
		Lofa River 4	3.42	10.0	271
		Lofa River 5	3.35	7.0	186
		Lofa River 6	3.25	6.0	153
Farmington	Margibi	Farmington River 1	16.90	15.0	20,100
St. John	Bassa, Bong and Nimba	St. John River 1	60.40	33.0	15,806
		St. John River 2	57.50	28.0	12,767
		St. John River 3	37.70	28.0	8,370
		St. John River 4	2.32	25.0	460
Timbo	Rivercess	Timbo River 1	6.51	12.0	619
Cestos	Grand Gedeh and Nimba	Cestos River 1	8.30	12.0	789
		Cestos River 2	7.35	10.0	582
		Cestos River 3	6.51	15.0	774
Senkweh	Grand Kru	Senkwen River 1	5.78	12.0	550
		Senkwen River 2	3.47	12.0	330
Buto	Grand Kru	Buto River 1	0.26	20.0	44
Cavalla	River Gee	Cavalla River 1	0.66	25.0	130

Source: GEOSCIENCE srl, as of 1998

5 MARKET RISKS AND BARRIERS

The stagnation of the Liberian economy due to the prolonged internal conflict has created numerous impediments to investment and market development. The lack of energy policy and infrastructure (especially electricity), roads and good transport systems are major barriers for investment and trade. Moreover, the current monopoly of the National Power Utility continues to be an obstacle to private investment in the power sector. And last, but not least, endemic corruption on all levels of the society continues to be a major risk for the national market. The establishment of the Liberia Anti-Corruption Commission (LACC) by law designed to fight corruption within both the public and private sector demonstrates the government’s commitment to fight corruption within the society.

The National Investment Commission (NIC) is the Government’s institution holding the mandate to promote and coordinate all investment-related activities in all sectors of Liberia’s economy. The Investment Code of Liberia defines all economic activities the Government wishes to encourage as well as the types of incentives it will offer to investors engaged in the defined industrial activities. According to the Code, the Government of Liberia encourages industrial enterprises which:

- Utilize Liberian manpower at all levels and contribute to advancing their skills through training schemes (on-the-job) and other incentives to the highest possible extent
- Utilize raw materials and products of Liberian origin to the highest possible extent
- Utilize ancillary activities available in the productive and service sectors of the Liberian economy to the highest possible extent
- Contribute to make Liberia independent of imports of basic goods to the extent of being economically feasible, thus saving foreign exchange
- Contribute to the extension and diversification of Liberia’s exports
- Contribute to increased employment all over the country

Both domestic and foreign investors may invest and participate in any business enterprise in Liberia unless explicitly prohibited. Foreign investors may buy the shares of any Liberian business. Any individuals or companies desiring to engage in commercial and/or industrial activities in Liberia should be registered with the Ministry of Commerce and Industry before taking up business operations.

Liberia’s Investment Laws are globally competitive. The country offers 100% repatriation of funds and no currency exchange restrictions e. g. profits and dividends (net of taxes), remittance of money (net of taxes) in the event of the sale or liquidation of the business, repayments of loans acquired from foreign banks etc. There is an overwhelming local acceptance of RE technologies. The major limitation is the low level of awareness and the limited number of trained local experts. The two main local universities (University of Liberia and Cuttington University) along with the Stella Maris Polytechnic plan to cooperate with local and international re-



search institutes and other private institutions to promote and develop RE technologies.

Liberian business law does not restrict business establishment but provides the basis for a range of businesses managed by both local and international investors. Business organizations include partnerships and sole proprietorships, joint stock and limited liability corporations as well as holding companies. A new business may be incorporated locally or abroad, its ownership can be a combination of foreign and local ownership or foreign-owned.

Liberia has signed several international conventions on the protection of intellectual and industrial property rights. The act adopting the New Copyright Law of Liberia, approved on 23 July 1997, provides the legal and administrative framework for the effective implementation of programs intended to protect intellectual and industrial property rights in Liberia. Depending on the amount of capital, the sector and the location of the investment, investors may be eligible for investment incentives offered by the NIC.

The Customs and Revenue Code of Liberia provides the regulatory regime for custom duties and standards. Duties on imported goods range from 2.5 to 25%. Import duties on RE equipment are about 2.5 to 10%. In order to minimize the time it takes to clear goods from various ports of entries, businesses are requested to acquire a pre-shipment inspection certificate.

In the 2009 “Doing Business” assessment of the World Bank and the International Finance Corporation, Liberia ranks 157 out of 181 in the respect of “ease of doing business”. This is a positive indicator as Liberia was ranked 167 out of 181 in the previous year. All countries are assessed based on local regulations that govern different stages of setting up a business. Table 8 presents Liberia’s ranking and its corresponding shift for 2008 and 2009.

TABLE 8
Ease of Doing Business in Liberia

INDICATOR	RANK		CHANGE IN RANK
	2009	2008	
Doing business (overall)	157	167	+10
Starting a business	88	145	+57
Dealing with construction permit	177	179	+2
Employing workers	105	105	0
Registering property	172	170	-2
Getting credit	131	141	+10
Protecting investors	142	141	-1
Paying taxes	59	51	-8
Trading across borders	115	108	-7
Enforcing contracts	165	166	+1
Closing a business	146	147	+1

Source: World Bank/IFC, Doing Business, as of 2009



6 RENEWABLE ENERGY BUSINESS INFORMATION AND CONTACTS

TABLE 9

Local Business Related Institutions

NAME	CONTACT INFO	PROFILE
Ministry of Commerce & Industry (MCI)	Ashmun Street, P.O. Box 9041 Monrovia, Liberia	A GoL ministry responsible for issuing policies and regulating the commerce and industry sector
Ministry of Lands, Mines and Energy (MLME)	Capitol Hill, P. Box 9024 Monrovia, Liberia	A GoL ministry responsible for issuing policies and regulating the land, mineral and energy sector of Liberia
National Investment Commission (NIC)	Sinkor 12 th Street Tubman Boulevard, P.O. Box 9043 Monrovia, Liberia info@nic.gov.lr	A GoL institution promoting and coordinating investment-related activities in all sectors of the Liberian economy
Liberia Business Association (LIBA)	C/o Corina Hotel 24 th Street Sinkor Tubman Boulevard Monrovia, Liberia	A consortium of small and medium Liberian businesses
Liberia Chamber of Commerce (LCC)	Capitol Hill, P.O. Box 9 Monrovia, Liberia Phone: +231-77857-805 www.liberiachamber.com	An institution seeking to promote trade and investment in Liberia and ensure that businesses get fair treatment in their dealings with the government
Liberia Petroleum Refining Company (LPRC)	Bushrod Island Monrovia, Liberia	A Government owned company with the mandate to import and refine crude oil for distribution of the products on the Liberian market
Liberia Electricity Corporation (LEC)	Francis Cooper Chairman, LEC P.O. Box 10-165 Waterside-1000 Monrovia 10 Monrovia-Liberia Telephone: +231-6971934 e-mail: fbcoopers@gmail.com	A Government owned company with the mandate to generate, transmit, distribute and sell electrical energy
National Oil Company of Liberia (NOCAL)	Episcopal Plaza Randall Street Monrovia, Liberia www.nocal-lr.com/	A Government owned company with the mandate to administer petroleum exploration program in Liberia
Environmental Protection Agency (EPA)	4 th Street Sinkor Tubman Boulevard Monrovia, Liberia www.epa.gov.lr/	A Government agency with the mandate to manage and regulate the environment

Source: Center for Sustainable Energy Technology, as of 2008

TABLE 10

Government Projects and Programs

PROGRAM/PROJECT	CONTACT	COLLABORATING INSTITUTION	ROLE
Emergency Power Project (EPP)	MLME/LEC	Governments of Liberia, Ghana, USA, and Norway, the European Union, and the World Bank	A multilateral project restoring grid electricity to Monrovia and its environs
Liberia Energy Assistance Program (LEAP)	MLME/LEC	Governments of Liberia and the US Government	A bilateral program aiming to facilitate access to energy services and support to transparent energy sector reform and regulatory regimes

Source: data compiled by the author



TABLE 11
Contact Information of Businesses Involved in the Renewable Energy Sector

NAME OF BUSINESS	CONTACT INFO	CONTACT PERSON
Solar Technology Inc.	Old Peugeot Garage Phone: +231 653 959 1 reggigardiner@yahoo.com	Reginald Gardiner
Alternative Energy, Inc.	Randall Street Monrovia, Liberia Phone: +231 652 650 9 aeliberia@yahoo.com	Thomas Kpoto
Center For Sustainable Energy Technology	8 th Street Sinkor Tubman Boulevard Monrovia, Liberia Phone: +231 655 926 6 gusgoanue@yahoo.com	Augustus Goanue
Premier Solar	9 th Street Sinkor Opposite LISGIS Monrovia, Liberia Phone: +231 651 994 3 natereeves1234@yahoo.com	Nathan Reeves
Quantum Logistics	Adj. 101 Gas Station Pynesville City, Liberia Phone: +231 621 338 6 info@quantumgroup-lib.com	Ronald Mitchell
Solar Electricity for Health clinic	Randall Street Monrovia, Liberia www.energyforopportunity.org/projects/health-electricity-for-rural-health-centres/	Momo S. Kpoto
Equatorial Palm Oil	UN Drive Monrovia Phone: +231 561 221 6 ebfliberia@qahoo.com	David Parker
Buchanan Renewable Energy	Buchanan House Congo Town Tubman Boulevard Monrovia Phone: +217 779 841 7 joelstrickland@buchananrenewables.com	Joel Strickland

Source: Center for Sustainable Energy Technology, as of 2008



7 BIBLIOGRAPHY

- Bongers, F., Poorter, L., Van Rompaey, R. S. A. R and Parren, M. P. E. (1999): Distribution of Twelve Moist Forest Canopy Trees Species in Liberia and La Cote d'Ivoire: Response Curves to a Climatic Gradients, IAVS; Opolus Press, Sweden
- Center for Sustainable Energy Technology (2004): Bridging the Energy Gap in Post-war Liberia: The Need for Alternative Energy Services
- Center for Sustainable Energy Technology (2008): Renewable Energy and Energy Efficiency Policy and Action Plan of Liberia
- DECON – Dutch Energy Consultant (1983): Pre-feasibility Study on the Development of Power in the Liberian Rural Areas
- Department of Energy, Ministry of Lands, Mines & Energy, Republic of Liberia (2002): Unpublished Energy Sector Report
- GEOSCIENCE srl. (1998): Electricity Supply in Liberia; Project LBR/7ACP/21–16. European Commission Aid Coordination Office in Liberia
- Liberia Electricity Corporation (2004–2007): Annual Reports
- Liberia Institute of Statistics and Geo-information Services (2007): Core Welfare Indicator Questionnaire
- Liberia Institute for Statistics and Geo-information Services (2008): Preliminary Results of 2008 National Population and Housing Census
- Liberia Petroleum Refining Company (2003–2006): Annual Reports
- Mattick, R. E. (1982): Assessment of the Petroleum, Coal and Geothermal Resources of the Economic Community of West African states (ECOWAS) Region. U.S. Geological Survey
- Milbrandt, Anelia (2008): Assessment of Biomass Resources in Liberia. US National Renewable Energy Laboratory
- Ministry of Lands, Mines and Energy (2008): Proceedings of the National Energy Policy Validation Workshops
- Ministry of Lands, Mines and Energy (2006 & 2007): Annual Reports
- National Investment Commission (2008): Investor's Guide to Liberia (www.nic.gov.lr)
- Republic of Liberia (2001): Customs Revenue Code and Harmonized Description and Coding System of the Customs Tariff Schedules of Liberia Act of 2000
- Republic of Liberia (2004): National Biodiversity Strategy and Action Plan
- Republic of Liberia (2007): Draft Action Plan and Rationale for Renewable Energy and Rural Development
- Republic of Liberia (2008): Draft Final National Energy Policy: An Agenda for Action and Economic and Social Development
- Government of Liberia (2006): 150 Day Action Plan. A Working Document for a New Liberia (www.allafrica.com/peaceafrica/resources/view/00010785.pdf)
- Republic of Liberia (2008): Poverty Reduction Strategy
- International Monetary Fund/Republic of Liberia (2007): Liberia. Interim Poverty Reduction Strategy Paper. Breaking with the Past – From Conflict to Development; IMF Country Report No. 07/60 (www.imf.org/external/pubs/ft/scr/2007/cr0760.pdf)
- National Renewable Energy Laboratory (1998): International Programs Brochure: Global Solar Resource Map, (www.nrel.gov).
- United Nations/World Bank (2005): Liberia. National Transitional Government of Liberia. Results Focused Transitional Framework Revision (www.reliefweb.int/library/documents/2005/ntgl-lib-30apr.pdf)
- World Bank/IFC (2009): Doing Business 2009 (www.doingbusiness.org)