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Liberia Energy Sector Support Program (LESSP)

Subproject Briefs



8 July 2013



LESSP Subprojects Introduction

- Seven Infrastructure Subprojects
 - **OBJECTIVE 2 – Pilot RE Subprojects**
 - Two hydro (one Micro [15 kW] and one Mini [1,000 kW])
 - Two biomass power generation
 - **OBJECTIVE 3 – Support to Liberia Energy Corporation (LEC)**
 - 1000 kW Photovoltaic Power Station interconnected to LEC's grid
 - 15 km Electric Distribution Line Extension to University of Liberia (UL) Fendell Campus
 - **OBJECTIVE 3 - Grants – Public Private Partnership**
 - One Biomass Power Generation Research and Demonstration (70 kW)
- Total Cost: \$ 13.97 Million USD (Engineer's Estimate)
- Service to: More than an estimated **72,000 Liberians** (3,600 households and over 160 businesses and institutions)



Subprojects Summary Data

No	LESSP Subprojects	County	Project Cost, USD Million	kW	Beneficiaries	Service Population
1	Mein River Mini Hydropower Subproject	Bong	7.25	1,000	Over 3000 households, 150 businesses and institutions	Over 25,000
2	Wayavah Falls Micro Hydropower Subproject	Lofa	0.45	15	150 households and 4-5 businesses/institutions	Over 1,000
3	Kwendin Biomass Electricity Subproject	Nimba	0.487	60	248 households, a clinic, and a school	Over 2,000
4	Sorlumba Biomass Electricity Subproject	Lofa	0.24	35	206 households, 8 institutions and businesses	Over 1,500
5	Grid connected 1 MW Solar PV Subproject	Montserrado	3.95	1,000	LEC grid	Over 15,000
6	MV Distribution Line Extension to Fendell Campus	Montserrado	1.12		Fendell Campus	Over 25,000
7	Establishment of the Liberia Center for Biomass Energy at BWI	Margibi	0.467	70	BWI Campus, RREA	Over 2,200
	TOTAL	5 counties	13.97	2,161	3,600 households and over 160 businesses and institutions	Over 72,000



Liberia Energy Sector Support Program

Subproject Brief: Mein River 1 MW Mini-Hydropower Subproject

Location	Suakoko District, Bong County (7° 8' 11"N 9° 38' 27" W)
General Site Description	The power house is 3 km uphill from the nearest road, outside the eco-tourism area of the Lower Kpatawee Falls. The diversion structure is on Mein River.
Design Data	Gross Head = 35.80 m, Design Flow = 4.00 m ³ /s
Power Output	1,000 kW (7 months), Average 300 kW (dry season) Institutions and businesses to meet their power needs during dry season through their existing diesel generators with possibility of supplying communities.
Main Load Centers (Customers)	About 2,000 residential and 150 commercial consumers, Cuttington University, Phebe Hospital and Central Agriculture Research Institute in Suakoko District. Average Distance to Load Centers = 27 km
Ownership Structure	An independent power company (IPC), the Mein River Power Company will be established under concession from RREA/MLME. Cuttington University, Phebe Hospital and local Farmers' Cooperative and other interested investors are shareholders of such a company.
Environmental Impact	Minimum impact on the aquatic ecology due to no reservoir, short canal length (210 m) and penstock length (297 m) and a very short stretch of the river (600 m downstream of the weir) will have a reduced flow. EPA, Liberia has issued Environment Permit. USAID BEO approved EA in December 2012.
Project Cost	7.25 M USD (estimated) GEF/UNIDO contributing 1.25 M USD as co-financers
Project Status	Feasibility study completed in September 2011. Final drawings and specifications will be completed in June 2013. IPC will be registered in June 2013. Bids for construction released in July 2013. Construction planned to start in Oct 2013.



Liberia Energy Sector Support Program Subproject Wayavah Falls Micro Hydro Subproject

Location	Salayea District, Lofa County (07° 43' 14"N 09° 25' 56" W)
General Site Description	Power house is close to the main load centers, on the main road leading to Zorzor and 3.5 km from Gbarnway town. The diversion structure is on Wayavah Creek.
Design Data	Gross Head = 53.5 m Design Flow = 44 L/s (20-40 L/s during 5-6 month dry season)
Power Output	15 kW (6-7 months), 0-8 kW (5-6 months of dry season)
Main Load Centers (Customers)	About 150 households and few institutional/commercial consumers in Gbarnway town. Average distance to load centers is 2 km
Ownership Structure	Gbarnway Woeyah Electric Cooperative representing the community of Gbarnway is legally registered. The project once completed will be handed over to the Cooperative, who will own and manage the power plant. The Cooperative members are undergoing various trainings.
Environmental Impact	No major impoundment, mainly pressure pipe to channel the flow to the power house (instead of canal). Environmental release to be made to have minimum impact on the aquatic life.
Project Cost	USD 194,800 80% USAID grant, 20% community in kind contribution
Project Status	Feasibility study report completed, environmental permit issued by EPA, USAID has approved Environment Review report. Project on hold under redesign.

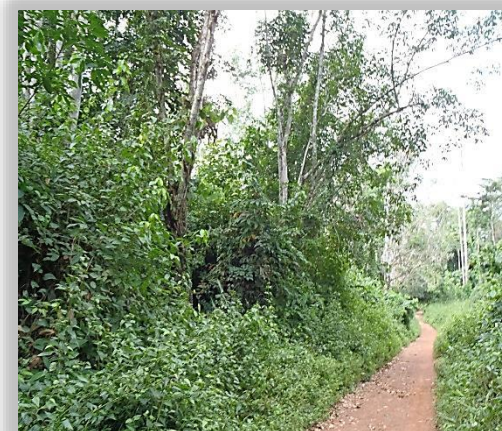




Liberia Energy Sector Support Program

Project Brief: Kwendin Biomass Electricity Subproject

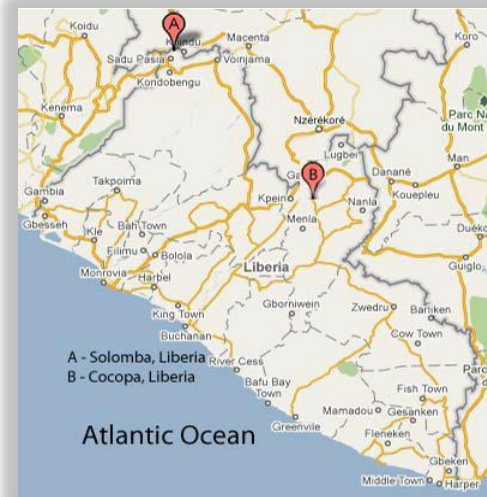
Location	Yarwein Mehnsonnoh District, Nimba County (6° 27' 17"N 8° 57' 5"W)
General Site Description	Project site is located along the Tapita – Rivercess Highway, 192 km from Monrovia
Project Type	Biomass gasifying electricity generation using old rubber wood chips as fuel
Source of Fuel	Kwendin surroundings
Estimated Fuel Consumption	Annual wood chip requirement is 466.56 ton. Assuming 81 tons of trees per hectare and assuming 54% yield, the annual requirement is 10.67 hectares of rubber trees.
Power Output	60 kW, Year 1 estimated energy generation 87,600 kWh
Main Load Centers (Costumers)	Kwendin community households (~250), a clinic and an elementary school
Ownership Structure	Kwendin Lorkiah Electric Cooperative to own and manage
Environmental Impact	No dislocation of people or any harmful emission is envisaged. Sufficient excess biomass from rubber trees plantation exist so that no harm will result in the resources in the area
Project Cost	487,300 USD
Project Status	Feasibility study approved by USAID. Load demand and willingness to pay survey completed. EPA Environmental Permit received. Application to the USAID Bureau Environmental Office to be submitted soon. Several trainings to cooperative members carried out. Construction planned to start in Oct 2013 and expected to be completed in Jun 2014.





Liberia Energy Sector Support Program Project Brief: Sorlumba Biomass Electricity Subproject

Location	Sorlumba in Foya District, Lofa County (8° 29' 45"N 10° 09' 39"W)
General Site Description	Project site is 116 km NW from Foya, 2 km of Guinea border. People are subsistence framers producing crude palm oil
Project Type	Biomass electricity generation using Crude Palm Oil (CPO) as fuel in a straight vegetable oil engine and a generator
Source of Fuel	Crude Palm Oil
Estimated Fuel Consumption	Annual requirement of 30,600 liters in Year 1 to 69,000 liters in Year 16
Power Output	35 kW; Year 1 estimated generation 111,096 kWh
Main Load Centers (Customers)	206 households within 3 km from Sorlumba town. Include public schools, community centers, medical centers, churches and small businesses. All these are located along the highway to Guinea from Foya.
Ownership Structure	Sorlumba Community Electric Cooperative Society to own and manage
Environmental Impact	The project site is located in agricultural land. No dislocation of people or any harmful emission is envisaged. The sufficient crude palm oil stock is available to produce electricity in the region. Use of CPO carbon neutral as compared to the use of hydrocarbon
Project Cost	240,000 USD
Project Status	Feasibility study approved by USAID. EPA Environmental Permit and USAID Bureau Environmental Office environment approval received. A small lister engine is under test to determine final operating conditions on the 60 kW generator to be procured. Construction from October 2013 and expected to be completed in June 2014

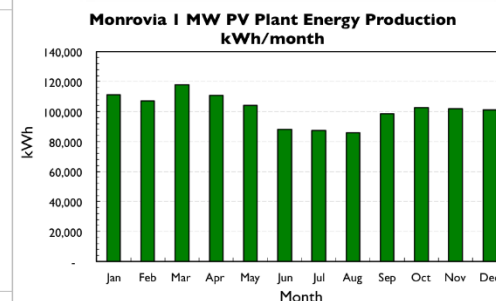




Liberia Energy Sector Support Program

Subproject Brief: Utility Interconnected 1 MW Solar Photovoltaic Power Subproject

Location	LEC Bushrod (6° 21' 45"N 10° 47' 22"W)
Project Objective	To demonstrate that solar power plants are technically and economically feasible for increasing the Monrovia power grid capacity by serving in the role of a daytime peaking plant
Current Situation	<p>Monrovia population ~ 1.5 million people</p> <p>Peak demand ~ 8.6 MW</p> <p>Peak load hours from 11:00 to 14:00 and from 18:30 to 22:00</p> <p>LEC installed capacity = 22 MW diesel high-speed generators</p> <p>Effective power supply available = 16-18 MW</p> <p>LEC Customers = 14,079</p> <p>Demand forecast ~ 100 MW by 2020</p>
Solar Resource	Average annual solar resource = 4.7 kWh/m ² /day
Technical Specifications	<p>PV array ~15% efficiency</p> <p>Size of PV Array = 1,000 kWpdc</p> <p>PV Array Area ~ 1 hectare</p> <p>Total Area for PVPS ~1.5 hectare</p> <p>Array Slope = 10 degrees</p> <p>Array Azimuth = 0 degrees</p> <p>No Energy Storage</p> <p>Overall Efficiency = 71%</p>
Power Output	<p>Annual PV Energy Generation = 1,200 MWh/year (Yr 1)</p> <p>PV penetration of 8.25% (PV power generation relative to the current peak load)</p>
Ownership	LEC
Estimated Cost	<p>Estimated Installed Cost ~US\$3,950,152</p> <p>PV Amortized Energy Value ~US\$0.14/kWh</p> <p>Investment Recovery ~7 years</p>
Project Status	Concept study completed in April 2013. A 1-MWp PVPS for Monrovia could be procured and installed in approximately nine months





Liberia Energy Sector Support Program

Subproject Brief: Medium Voltage Distribution Line Extension Subproject – From Paynesville To University of Liberia Fendell Campus, Monrovia

Location	From Paynesville substation (6° 17' 39"N 10° 41' 17"W) to Fendell Campus (6° 22' 36"N 10° 37' 10"W)
Project Objective	To supply a more reliable and less expensive electric power option to the UL Fendell Campus other than diesel power generators by extending the aerial medium voltage distribution line from Paynesville substation
Load Center	Engineering and Science Colleges at Fendell Campus: Classrooms, libraries, laboratories and general facilities need power to be functional
Current Situation	Weekly diesel consumption = ~4.5 m ³ (~US\$5,000) Peak load = 250 kW Availability of power = 8 to 10 hours, six days per week only in 2% of the science building and 3 to 5% of the academic building
5-Year Demand Forecast	Peak load = 807 kW Non-Peak load = 403 kW Estimated energy demand = 2,369 MWh per year Number of beneficiaries = 25,000 people plus future LEC customers in between Fendell project limits
Technical specifications	Length of extension=15 km Power distribution voltage= 22 kV Low voltage for users= 400 V Number of poles=260 Units Transformer = 22/0.40-0.23 kV 1,000 kVA 3 Phase
Ownership	LEC
Estimated Project Cost	Cost per km = \$ 74,934 USD Cost per pole = \$ 4,323 USD Total cost = \$ 1,124,017 USD
Project Status	Concept study completed in June 2013. Proposal schedules completion by July 2014





Liberia Energy Sector Support Program

Subproject Brief: Establishment of the Liberia Center for Biomass Energy at the Booker Washington Institute (BWI), Kakata, Liberia

Location	BWI Campus, Kakata (6° 31' 46" N 10° 21' 52"W)
Project Objective	Establishment of a public private partnership (PPP) with BWI to: <ul style="list-style-type: none">• Displace at some extent the use of diesel for power generation by using a renewable source of energy,• demonstrate and promote renewable biomass energy in Liberia, and• provide the necessary skills to technicians (instructors and students) to be able to operate and maintain biomass power systems
PPP Partners	EcoPower Liberia (private), BWI (the only publically owned institute in Liberia), and LESSP (USAID funded program)
Ownership	BWI
Project Cost	Total Cost of PPP: 467,385 USD Subcontract with Ecopower 53%, BWI (32%) \$69,250 USD, LESSP Grant to BWI 15%
Infrastructure	Three 20 kW GEK gasifiers and one 10 kW GEK gasifier (70 kW total). Useful Lifetime= 20 years
PPP Collaborations	<ul style="list-style-type: none">• Rewiring BWI electricity system• Enabling panel boards to accommodate the new 70 kW biomass power generator• Rebuilding power house and biomass drying/conditioning unit• Collaboration with Rural & Renewable Energy Agency (RREA)• Implementing biomass power generation curricula at BWI
Total Beneficiaries	Number of beneficiaries = +12,000 people (students and teachers)
Project Status	USAID concurrence in May 2013. Implementation started in June 2013

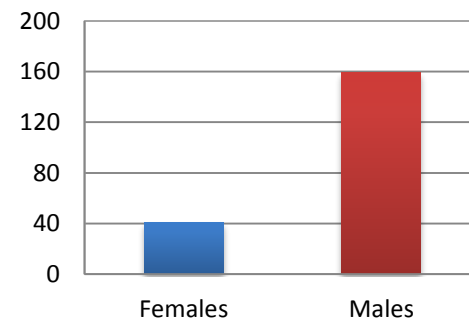




Liberia Energy Sector Support Program Capacity Building Activity Brief

General Description	Winrock International provides a comprehensive package of training and assistance to build and strengthen local capacity and sustainability in Liberia. These activities contribute to LESSP efforts aimed at increasing access to affordable renewable energy services in geographically focused rural and urban areas in order to foster economic, political and social development in the country.
Training Objectives	<ul style="list-style-type: none"> (1) Ensure sustainable operation and maintenance of LESSP renewable energy projects; (2) Promote long-lasting technical capacity; and (3) Coordinate with the Liberian renewable energy sector on training activities to avoid duplication of efforts and maximize results.
Target	<ul style="list-style-type: none"> (1) Government agencies (RREA and MLME) (2) Community groups (in Bong, Lofa and Nimba Counties), (3) Academic institutions (BWI and UL) , and (4) private sector
Training Subjects	<p>Government:</p> <ul style="list-style-type: none"> (1) Project Planning and Management, (2) Financial Planning and Budgeting (3) RETSCREEN clean energy software (4) On-line Master's of Science program in renewable energy technologies. (5) Solar technologies for rural applications with hands on. <p>Academic Institutions, technicians and Private Sector RE Technologies: Hydropower, solar, and biomass power generation technologies</p> <p>Community: How to form cooperatives, management, account keeping, tariff collection</p>
Training Conducted	<p>Completed trainings = 26</p> <p>Total people trained = 200</p>
Expected Outcomes	Number of trainings = 70

Trained People by Gender



Trained People by Education Level

