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Report No:

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT

IN THE AMOUNT OF SDRXX MILLION
(US$2 MILLION EQUIVALENT)

AND A

PROPOSED STRATEGIC CLIMATE FUND SCALING UP RENEWABLE ENERGY PROGRAM GRANT

IN THE AMOUNT OF US$27 MILLION

TO THE

REPUBLIC OF LIBERIA

FOR A

LIBERIA RENEWABLE ENERGY ACCESS PROJECT

November 6, 2015

ENERGY AND EXTRACTIVES GLOBAL PRACTICE
AFRICA REGION

CURRENCY EQUIVALENTS

(Exchange Rate Effective XX, 2015)

Currency Unit	=	Liberian Dollars
LRD	=	US$1
US$	=	SDR 1

FISCAL YEAR

July 1 – June 30

ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AFREA	Africa Renewable Energy and Access Program
AWPB	Annual Work Plan and Budget
BD	Board of Directors of RREA
CESMP	Contractor Environmental and Social Management Plan
CoA	Chart of Accounts
CPS	Country Partnership Strategy
CQS	Consultants' Qualifications
DA	Designated Account
EU	European Union
EHSG	General Environmental, Health and Safety Guidelines
ESIA	Environmental and Social Impact Assessment
ESMAP	Energy Sector Management Assistance Program
ESMF	Environmental and Social Management Framework
FBS	Fixed Budget Selection
FIRR	Financial Internal Rate of Return
FM	Financial Management
GEF	Global Environment Facility
GIMPA	Ghana Institute of Management and Public Administration
GRS	Grievance Redress Service
IC	Individual Consultants
ICB	International Competitive Bidding
IFRs	Interim Un-audited Financial Reports
IPF	Investment Project Financing
IPRE	Investment Plan for Renewable Energy
IPSAS	International Public Sector Accounting Standards
ISA	International Standards on Auditing
LCS	Least Cost Selection
LEC	Liberia Electricity Corporation
LIB	Limited International Biding
LIRENAP	Liberia Renewable Energy Project

LLL	Lighting Lives in Africa
MLME	Ministry of Lands, Mines, and Energy
NCB	National Competitive Biding
NPV	Net Present Value
NRECA	National Rural Electric Cooperative Association
O&M	Operation and Maintenance
PAP	Project Affected People
PDO	Project Development Objective
PIM	Project Implementation Manual
PMT	Project Management Team
PPCA	Public Procurement and Concessions Act
PV	Photovoltaic
QBS	Quality Based Selection
QCBS	Quality and Cost Based Selection
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
RREA	Rural and Renewable Energy Agency
SCF	Strategic Climate Fund
SHS	Solar home systems
SOE	Statement of Expenditure
SREP	Program for Scaling Up Renewable Energy in Low Income Countries
SSS	Single-Source Selection
TTL	Task Team Leader
USAID	United States Agency for International Development

Regional Vice President:	Makhtar Diop
Country Director:	Henry G. Kerali
Senior Global Practice Director:	Anita Marangoly George
Practice Manager:	Meike van Ginneken
Task Team Leaders:	Clemencia Torres de Mästle
	David Vilar Ferrenbach

LIBERIA
LIBERIA RENEWABLE ENERGY PROJECT (LIRENAP)

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PAD DATA SHEET

Liberia

Liberia Renewable Energy Access Project (P149683)

PROJECT APPRAISAL DOCUMENT

AFRICA

Report No.: PAD1618

Basic Information			
Project ID P149683	EA Category B - Partial Assessment		Team Leader(s) Clemencia Torres de Mästle, David Vilar Ferrenbach
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [X] Financial Intermediaries [ ] Series of Projects [ ]		
Project Implementation Start Date 28 January 2016	Project Implementation End Date 28 January 2021		
Expected Effectiveness Date 30 April 2016	Expected Closing Date 30 June 2021		
Joint IFC: No			
Practice Manager	Senior Global Practice Director	Country Director	Regional Vice President
Meike van Ginneken	Anita Marangoly George	Henry G. Kerali	Makhtar Diop

Approval Authority
Approval Authority: Board of Executive Directors of the World Bank. According to the Board Paper Climate Investment Funds: The Clean Technology Fund and the Strategic Climate Fund (World Bank. 2008), all SREP-funded projects needs to be approved by the Board, regardless of whether there is IDA lending associated with SREP co-financing.

Borrower: Republic of Liberia			
Responsible Agency: Rural and Renewable Energy Agency			
Contact:	Augustus Goanue	Title:	Executive Director
Telephone No.:	231886559266	Email:	gusgoanue@yahoo.com

Project Financing Data(in US$ Million)					
[ ]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[X]	Credit	[X]	Grant	[ ]	Other

Total Project Cost:	27.00	Total Bank Financing:	27.00
Financing Gap:	0.00		

Financing Source	Amount
Borrower	0.00
Strategic Climate Fund – SREP Grant	25.00
International Development Association (IDA)	2.00
Total	27.00

Expected Disbursements (in US$ Million)

Fiscal Year	FY16	FY17	FY18	FY19	FY20	FY21
Annual	0.1	0.7	1.0	10.5	12.7	2.0
Cumulative	0.1	0.8	1.8	12.3	25.0	27.0

Institutional Data

Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Cross Cutting Topics

[X] Climate Change
[X] Fragile, Conflict & Violence
[X] Gender
[ ] Jobs
[ ] Public Private Partnership

Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and mining	Hydropower	70		100
Energy and mining	Other Renewable	10		100
Energy and mining	Transmission and	20		90
Total		100		

☐ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Financial and private sector development	Infrastructure services for private sector development	40
Urban development	City-wide infrastructures and service delivery	50
Rural development	Rural services and infrastructure	10
Total		100

Proposed Development Objective(s)

The Project Development Objective (PDO) is to increase access to electricity and to foster the use of renewable energy sources.

Components

Component Name	**Cost (US$ Millions)**
Component 1: Decentralized electrification in Lofa County	US$ 22.00 million
Component 2: Technical assistance to strengthen rural electrification institutions and regulations	US$ 2.00 million
Component 3: Market development of stand-alone solar systems	US$ 3.00 million
TOTAL	**US$ 27.00 million**

Systematic Operations Risk- Rating Tool (SORT)

Risk Category	**Rating**
1. Political and Governance	Substantial
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	High
5. Institutional Capacity for Implementation and Sustainability	High
6. Fiduciary	Substantial
7. Environment and Social	Moderate
8. Stakeholders	Moderate
9. Other	Moderate
OVERALL	**High**

Compliance		
Policy		
Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]	
Does the project require any waivers of Bank policies?	Yes [ ] No [X]	
Have these been approved by Bank management?	Yes [ ] No [ ]	
Is approval for any policy waiver sought from the Board?	Yes [ ] No [X]	
Does the project meet the Regional criteria for readiness for implementation?	Yes [X] No [ ]	
Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	**X**	
Natural Habitats OP/BP 4.04	TBD	TBD
Forests OP/BP 4.36	TBD	TBD
Pest Management OP 4.09		**X**
Physical Cultural Resources OP/BP 4.11	**X**	
Indigenous Peoples OP/BP 4.10		**X**
Involuntary Resettlement OP/BP 4.12	**X**	
Safety of Dams OP/BP 4.37		**X**
Projects on International Waterways OP/BP 7.50	**X**	
Projects in Disputed Areas OP/BP 7.60		**X**

Legal Covenants

Name	**Recurrent**	**Due Date**	**Frequency**
Hiring of auditor for the Project			Once

Description of Covenant
The Recipient shall, within four (4) months from the Effectiveness Date, hire an external auditor with terms of reference and qualifications satisfactory to the Association (Section II.B.4 of Schedule 2 to the Financing Agreement).

Name	**Recurrent**	**Due Date**	**Frequency**
Board of Directors of RREA		15 December 2016	Dated covenant

Description of Covenant
The Government of Liberia has appointed all the members of the Board of Directors of RREA.

Conditions

Name	**Type**
Subsidiary Agreement	Effectiveness

Description of Condition	
The Subsidiary Agreement has been executed on behalf of the Recipient and of RREA, in accordance with the provisions of Section I.B of Schedule 2 of the Financing Agreement (Section (5.01(a)) of the Financing Agreement).	
Name	**Type**
Project Implementation Manual	Effectiveness
Description of Condition	
The Project Implementing Entity has adopted the Project Implementation Manual that is satisfactory to the Association.	

Team Composition

Bank Staff

Name	Role	Title	Specialization	Unit
Clemencia Torres de Mästle	Team Leader (ADM Responsible)	Senior Energy Economist	Co-TTL	GEEDR
David Vilar Ferrenbach	Team Leader	Energy Specialist	Co-TTL	GEEDR
Jenny Maria Hasselsten	Team Member	Energy Specialist	Renewable Energy	GEEDR
Joseph Tawiah Quayson	Team Member	Energy Specialist	Electricity Engineering	GEEDR
Nicolas Jean Marie Sans	Team Member	Hydropower Specialist	Electricity Engineering	GEEDR
Michael J.Goldberg	Team Member	Lead Operations Officer	Finances Specialist	GFMDR
Mariano Salto	Team Member	Energy Economist	Energy Economist	GEEDR
Charles Taylor	Procurement Specialist	Lead Procurement Specialist	Procurement	GCFDR
Saidu Dani Goje	Financial Management Specialist	Financial Management Specialist	Financial Management	GGODR
Luis M. Schwarz	Team Member	Senior Finance Officer	Financial Management	WFALA
Julie Rieger	Counsel	Senior Counsel	Legal	LEGAM
Paivi Koskinen-Lewis	Safeguards Specialist	Social Development Specialist	Social Development	GSURR
Yeyea Gloria Kehleay Nasser	Team Member	Team Assistant	Administration	AFMLR

Extended Team

Name	Title	Office Phone	Location
Maria Luisa Esteban Meer	Team Member		WB Headquarters, Washington DC
Robert Robelus	Senior Environmental Specialist		The Netherlands
Arsh Sharma	Energy Finance Specialist		WB Headquarters, Washington DC
Inka Schomer	Gender Specialist		WB Headquarters, Washington DC
Susan V. Bogach	Senior Energy Economist		Ottawa, Canada
Alicia Hernandez Muñoz	Team member		WB Headquarters, Washington DC

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Liberia	Lofa County				

Consultants (Will be disclosed in the Monthly Operational Summary) **YES**

LIBERIA

LIBERIA RENEWABLE ENERGY ACCESS PROJECT (LIRENAP)

I. STRATEGIC CONTEXT

A. Country Context

1. Since 2006 when President Ellen Johnson Sirleaf took office for the first time, Liberia has made substantial progress in recovering from the 15-year civil war. Between 2009 and 2013, the economy grew steadily at an average rate of 7.3 percent per year. This performance showed the country's potential for sustainable economic growth and development. However, the economy remains vulnerable to external shocks given its dependence on primary commodities, imported foods and fuel, its limited diversification, and the volatility of commodity prices. Inequality remains high and is exacerbated by the dearth of infrastructure and social services nationwide and by the asymmetry of the reconstruction efforts, mainly focused on Monrovia where a fourth of the population lives.

2. The Ebola crisis that struck Liberia, Sierra Leone and Guinea in mid-2014 increased these vulnerabilities. It caused a substantial loss of lives, dampened economic activity, and weakened social cohesion and safety nets. The announcement on May 9 2015 by the World Health Organization that Liberia is Ebola free means that the Government's attention can gradually return to its development agenda.

3. With the renewed focus on development, increased electricity services are urgently needed to support the country's economic transformation and to improve the lives of the population. Liberia has one of the world's lowest rates of electrification, at less than two percent, combined with one of the highest electricity tariffs, at US$0.52/kWh. Expanding access to reliable and affordable electricity supply is a high priority of Liberia's *Agenda for Transformation 2012-2017*. The Agenda includes a US$3.3 billion infrastructure investment program to overcome the constraints imposed by the lack of access to basic services. Expansion of the electricity sector, a key driver of transformation, is a major component of this program.

4. The Government's economic and social development programs aim to benefit both urban and rural populations and to reduce disparities in services. About 58 percent of Liberia's population lives outside of Monrovia and its main economic corridors in small towns and rural areas, representing about 2,5 million people. The majority of households in the towns are engaged in agriculture and trade with Monrovia and other locations, related services (like machinery supply and repair, carpentry, metal-working, etc.) and local commercial activities. Households in surrounding rural areas are mainly subsistence farmers and/or petty traders, with little or no cash income. Lack of basic infrastructure services such as electricity and transport imposes a significant constraint on the local economy and hinders the development of income-generating activities. . In addition, women are still amongst the poorest in rural communities thereby making equal access to affordable energy a key development priority.

B. Sectoral and Institutional Context

5. After the end of the Liberian civil war, the Liberia Electricity Corporation (LEC) resumed operations in 2010, focusing initially on re-establishing service in Monrovia. Donors, including the World Bank, financed a number of electricity sector investments including installation of emergency, 22.6 MW of diesel-based generation plants, and reconstruction of a basic distribution network and connections for low-income customers. These investments were accompanied by a five-year management contract financed by Norway and signed in 2010 between LEC, the Ministry of Lands, Mines, and Energy (MLME), and Manitoba Hydro International (MHI), aiming to improve LEC's performance and to expand the customer base in the capital. LEC's customer base increased from 2,469 customers in July 2010 to 30,485 customers in January 2015.

6. In 2012, the GoL adopted an ambitious strategy aiming to increase electricity coverage to 70 percent of the population in Monrovia and 35 percent nationwide by 2030. To achieve the expansion of electricity services target, the GoL is following a two-pronged strategy: (i) expansion of LEC's grid connected service in Monrovia and priority economic corridors outside of the capital; and (ii) development of decentralized electricity service for towns and rural areas that are not expected to be connected to the national grid in the medium term.

7. Liberia has a renewable energy potential that is beginning to be exploited. Hydropower potential exists in some of the major rivers although it is seasonal. The generally flat topography requires extensive civil works, which increases the costs of the hydro plants. With such works, hydropower can be available eight months of the year. Liberia has good prospects for solar photovoltaic (PV) systems with a global horizontal irradiation similar to Spain. While traditional biomass meets the energy needs for cooking and heating of 90 percent of the population, use of biomass for electricity generation has been limited. Logistical challenges in gathering and transporting biomass fuel, pricing, and competing uses create difficulties in using biomass for power generation. Finally, global and regional wind maps indicate that wind resources are likely to be poor.

8. The Government, with the support of donors, has started to develop electricity and lighting services in rural areas and small towns. In 2010, the Government established the Rural and Renewable Energy Agency (RREA) to promote electrification and use of renewable energy in such areas. The Law on Rural and Renewable Energy, establishing RREA as a permanent public institution and providing the legal framework for developing renewable energy and expanding electricity services to areas outside of Monrovia and its economic corridors, was approved by Parliament on June 18, 2015 and signed into Law by the President on July 6, 2015.

9. RREA aims to facilitate the economic transformation of towns and rural areas by accelerating the commercial deployment of modern and renewable energy services. RREA's primary function is the planning, development and promotion of projects together with public, private, and community developers. RREA has carried out pilot activities to provide decentralized electricity, including: (i) the rehabilitation and expansion of a mini-grid supplied by a micro-hydropower plant of 60 kW in Yandohun, (Lofa County) funded by the World Bank; (ii) a micro-hydro and a biomass-powered mini-grid pilots under implementation with support from the United States Agency for International Development (USAID); and (iii) the Lighting Lives in Liberia

(LLL) Program to foster the development of a national market for solar lanterns supported by the World Bank.

10. The LLL Program, implemented since 2012, is developing the local market for pico-PV products in areas that are not expected to be served by any grid. Pico-PV products use efficient lights (mostly LEDs), sophisticated charge controllers, efficient batteries, and PV panels of only a few watts to provide services such as lighting, phone charging, and powering a radio or other small appliances. Such products target low-income people who rely on kerosene lamps, candles, and battery-powered lights. The LLL Program focuses on the establishment of a local retail network and stimulation of consumer demand through lower retail prices. RREA procures and imports products in bulk on behalf of local retailers, covering the cost of shipment and importation. It has established a revolving fund using payments from retail partners to import additional solar products. The Program has also provided business development support, technical training, market intelligence and consumer education, thereby reducing the costs and hurdles for retailers.

11. RREA's long term goal for the LLL Program is to kickstart a larger, sustainable, private-sector led, commercial market for pico-PV products. To date, about 20,000 products have been sold, demonstrating the existence of a strong demand for pico-PV products.. However, the market it is still in a nascent and fragile stage. The Ebola outbreak in mid-2014 slowed new sales and made it more difficult to recover payments. Other factors constrain market growth, such as the lack of access to finance for importers, retailers, and consumers; the lack of national quality standards for PV products and the resulting competition from low quality products, high in-country transportation costs and lack of accessibility to rural markets during the rainy season.

12. In 2014, RREA prepared the Liberia Investment Plan for Renewable Energy (IPRE) under the guidance of MLME and with the support of the World Bank and the African Development Bank (AfDB). The IPRE provides a roadmap for scaling up renewable energy to increase access, reduce over-reliance on imported fossil fuels, and strike a balance between electricity provision to urban and rural areas. The investment plan defines two priority choices for expanding use of renewable energy: (i) mini-grid systems based on small hydro and biomass, backed up by PV to compensate for seasonal variation; and (ii) stand-alone solar systems, which include solar lanterns, other pico-PV products, and solar home systems (SHS). The Government received a commitment of US$50 million financing from the Scaling Up Renewable Energy Program in Low Income Countries (SREP) to start implementing the IPRE. This will be done with the help of the World Bank and AfDB, with the World Bank supporting the preparation of a project in the North-West and AfDB providing a similar support for a project in the South-East of the country.

C. Higher Level Objectives to which the Project Contributes

13. The proposed Project is fully aligned with the World Bank Group's twin goals of reducing poverty and boosting shared prosperity as well as the Liberia Country Partnership Strategy (CPS) FY2013-17. The CPS places a strong priority on expanding electricity services and making them more affordable to businesses and households in order to spur economic growth, job creation, and poverty reduction.

14. The CPS mentions SREP as one of the financing instruments to support the country to increase access to affordable and reliable electricity for businesses and households in priority areas

outside of Greater Monrovia, using renewable energy that will contribute to the overall sustainability and security of the sector.

15. The proposed Project is also aligned with the Government's development strategy, the *Agenda for Transformation*. Under pillar 2 of the *Agenda*, as well as the *2015 Economic Stabilization and Recovery Plan*, electricity services expansion and the reduction of the cost of electricity are cited as essential conditions for achieving and sustaining economic transformation. Expansion of electricity access would be critical to address both short-term needs of health, education centers, water treatment plant, and other critical facilities, as well as to support the economic and social recovery of the country. The proposed Project would also contribute to the Government's efforts to rebuild the economy in a post-Ebola situation, since the proposed area of major intervention of the Project is Lofa County, where Liberia's Ebola outbreak started.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

16. The Project Development Objective (PDO) is to increase access to electricity and to foster the use of renewable energy sources.

B. Project Beneficiaries

17. The Project is expected to benefit about 50, 000 people in households, small businesses, associations, and public institutions (e.g., local government, elementary and secondary schools, and health centers) in Lofa County that would be connected to the mini-grids. The Project would also contribute to enhancing the capabilities of RREA and MLME. Finally, the Project would benefit about 100,000 people nationwide, who would have access to stand-alone solar systems in the local market.

C. PDO Level Results Indicators

18. Progress toward achieving the PDO would be measured by the following indicators:
- People provided with access to electricity through connections to mini-grid (number);
- People with access to modern energy services (off-grid) through stand-alone solar PV systems (number);
- Number of direct project beneficiaries (number), of which females (percentage).

III. PROJECT DESCRIPTION

19. The proposed Project would support the implementation of mini-grids powered mainly by renewable energy in small towns and rural areas, strengthening of institutions and regulations for decentralized electricity services, and the scale-up of the Government's initiative to foster a market in Liberia for modern solar lanterns and other solar devices. The Project is comprised of three components. The first component would finance the implementation of decentralized electrification through mini-grids in Lofa County, in the North-West of Liberia. The second component would finance the elaboration of regulations for decentralized electricity services to ensure sustainability of the as well as the strengthening of RREA's institutional capacity to deliver

the Project. The third component would continue support to RREA to foster the growth of a market for solar PV lighting devices.

A. Project Components

Component 1. Decentralized electrification in Lofa County (estimated cost US$22 million).

20. This Component would expand access to affordable, reliable, year round electricity services to at least 8,000 new users in North Lofa County, an economic and agricultural hub on the border with Guinea and Sierra Leone. The county was one of the hardest hit during the Ebola outbreak. It is more than 200 km from the national grid. There are no prospects in the medium term to provide service to this area from the national grid that serves Greater Monrovia. The Component would give priority to the towns of Vonjaima, Foya, Kolahun and Massambolahun/Bolahun as well as peripheral areas. Households and businesses in this area do not have any public electricity services; instead, some have expensive and unreliable electricity from small diesel generators. Identified large customers range from 20 kW to 100 kW, including hospitals and large educational centers. Several productive uses such us stores, sugar crushers, palm oil processors in the range of 5-10 kW have been also identified. Four percent of the potential connections will be for commercial or institutional uses which represent almost 50 percent of the electricity demand. Large businesses such as agricultural processors operate their own diesel generators. Since the mini-grid would aim to supply productive and commercial uses as well as household needs, it would be important to provide a reliable and continuous supply of electricity. Financing would be provided for installation of facilities, implementation of safeguards measures, and operation and maintenance (O&M) services.

- ***Subcomponent 1A.*** *Investment in decentralized renewable energy generation and hybrid mini-grids in Lofa County (estimated cost US$18.9 million – SREP financing).* This subcomponent would finance generation facilities based on renewable energies as well as distribution lines and connections for households, businesses, and public entities. Generation would be based on hydropower during the wet season (approximately eight months). The option of using PV generation was examined but not adopted due to the high capital cost which reduced the funding for connections and the technical complexity of a MW sized PV plant in this isolated location (see Annex 2). Two potential hydroelectric generation sites have been identified near Kolahun in the Kaiha River. The selection of the hydropower site, generation mix and the design of the mini-grids would be finalized once the results of the ongoing prefeasibility study of mini-grids are available.

- ***Subcomponent 1B.*** *Investment in diesel generation for the hybrid mini-grids in Lofa County (estimated cost US$2.00 million –IDA financing).* This subcomponent would finance the diesel generation facilities of the mini-grids. Diesel generation would be needed during the dry season, in order to provide reliable service for productive activities. A technical study is ongoing to minimize the use of diesel during the dry season thorough the optimization of the hydropower plant design.

- ***Subcomponent 1C.*** *Technical Assistance for decentralized electrification in Lofa County (estimated cost US$1.10 million –SREP financing).* This subcomponent would finance two key activities.

a) *Owner's Engineer* to assist RREA with: (i) overall component management and supervision of the procurement, design, construction, management and operation and maintenance arrangements of the hybrid mini-grids; and (ii) coordination of the implementation of the Environmental and Social Management Plans (ESMPs) and Resettlement Action Plans (RAPs).

O&M operators for mini-grids in Lofa County. Technical assistance would be provided to define the best O&M contract arrangements and propose efficient tariffs, to assure sustainability of the mini-grids established under subcomponent 1A. The business model, including the ownership of the assets, would be based on the menu of options outlined in the IPRE, a sound business plan and the legal framework of the sector. RREA, with the help of international consultants financed by USAID, is already working on business models for decentralized mini-grid systems (e.g., public decentralized utility, cooperative, private operator, and hybrid business models). Technical assistance under this component would build on this work.

Component 2. Technical assistance to strengthen rural electrification institutions and regulations (estimated cost US$2 million-SREP Financing).

21. This Component would provide technical assistance to support the implementation of the Government's program to expand decentralized electrification and foster the use of renewable energy. It would finance assistance to develop the regulations and technical standards for isolated mini-grids. It would also finance capacity building of RREA, the documentation of the experience in establishing decentralized hybrid renewable energy mini-grids, as well as support needed to implement the Project.

- ***Subcomponent 2A.*** *Regulations for isolated mini-grids (estimated cost US$0.3 million-SREP financing).* The subcomponent would support the development of regulations and standards for isolated mini-grids, to complement the new Law for the Electricity Sector and the Rural and Renewable Energy Act. . The work would include development of technical and financial standards as well as mechanisms to establish and operate the mini-grids and monitor their performance. It would also include definition of arrangements to ensure a smooth transition in the longer term, when the national grid will reach these communities.

- ***Sub-Component 2B.*** *Project implementation support and capacity building (estimated cost US$1.7 million-SREP financing).* This subcomponent would support project implementation, including the development of safeguard documents, other preparatory studies and Project audits. It would finance the hiring of consultants with fiduciary or safeguards expertise to strengthen the Project management team in RREA. It would support RREA's institutional capacity in areas related to decentralized electrification and renewable energy. The subcomponent would also finance consultants to document the experience gained so far in establishing hybrid mini-grids in Liberia, to inform RREA's larger program. Other stakeholders like MLME, LEC, local authorities, community members, and private companies would also benefit from these capacity building activities.

22. ***Component 3. Market development of stand-alone solar systems (estimated cost US$3 million-SREP financing).*** This Component would finance the development and strengthening of the local market for pico-PV products and the provision of access to modern energy services for over 100,000 people. The Component would be based on the experience and achievements of the LLL Program. It would aim to increase the sustainability of the retail network.

- ***Sub-Component 3A.*** *Provision of financing for import of stand-alone solar systems (estimated cost US$2.3 million-SREP financing).* This sub-component would finance the bulk import of high quality pico-PV systems by RREA on behalf of the local retailers. In parallel, it would aim to facilitate the transfer of procurement and import responsibilities from the RREA to the private sector.[1] The sub-component would also partially subsidize the cost of shipment and imports carried out by RREA and by private importers. To foster long term sustainability, this subsidy would be phased out gradually during the life of the Project. .

- ***Subcomponent 3B.*** *Creation of an enabling environment for commercialization of stand-alone solar systems (estimated cost US$0.7 million-SREP financing).* This sub-component would finance: (i) strengthening the national policy and quality assurance framework for pico-PV systems to foster the competiveness of these products in the market; (ii) carrying out public awareness campaigns to inform consumers of the benefits of pico-PV products and the characteristics of good quality products; (iii) strengthening importers' and retailers' technical knowledge as well as their business and financial management skills; and (iv) strengthening RREA's technical and financial capacity in this area.

Exploring carbon results-based finance opportunities to support rural electrification

23. The funding needed to support access to electricity in Liberia is huge as as the country has one of the lowest electrification rate in the world, at less than two percent currently. Also, RREA is newly created agency that will need financial resources to accomplish the management and the coordination of rural electrification projects in Liberia. Therefore, the project will explore additional sources of financing that could support the implementation of future rural electrification project through the country base on RE. Carbon results-based finance is one of such sources of additional funding that could be considered. The potential for tapping additional funding from carbon-finance will be explored early in project implementation and the exact role that carbon finance could play to support the project objectives will be determined. Assistance, as needed, will be provided to RREA to explore available options to create a carbon asset out of the project interventions, particularly Component 1 and Component 3 which will generate emission reductions from renewable energy mini-grids and stand-alone solar systems.

24. The assistance would include: (i) assessing the eligibility for carbon finance for the mini-grids using various renewables technologies and for the pico-PV and solar home systems; (ii) developing a carbon crediting framework such as a Clean Development Mechanism (CDM) Program of Activities (PoA) that other similar initiatives that provide access to electricity to unserved population can join; and (iii) analyzing the potential purchase of carbon credits generated from this program through climate and carbon finance initiatives such as the World Bank's Carbon Initiative for Development (Ci-Dev) which targets energy access activities in Least Developed Countries or any other similar instruments that could rewards mitigation outcomes. Given transaction costs, this option would likely be viable by bundling this project with other renewable energy projects financed either by the Bank and/or other MDB and donors in Liberia, and using the specific methodology for access to measure emission reductions.

[1] Constraints include import duties on private importers, unfavorable payment terms from the manufacturer to new importers, limited access to finance etc.

B. Project Financing

Lending Instrument

25. The lending instruments for the proposed Project would be an Investment Project Financing (IPF) and a Single Investment Loan (SIL). The Government would receive a SREP grant of US$25 million for the Project and a US$2 million Single Investment Loan from IDA.

Project Cost and Financing

26. The total Project cost is estimated at US$27 million. Cost estimates by component are detailed in the following table.

Table 1: Breakdown of Project Cost and Financing by Component (US$ million)

Project Components	Project Cost	SCF-SREP Financing	IDA[2]	% of total Cost Project
Component 1. Decentralized electrification in Lofa County	22.00	20.00	2.00	81.5
Component 2: Technical assistance for rural electrification regulations and Project implementation	2.00	2.00		7.4
Component 3. Market development of stand-alone solar systems	3.00	3.00		11.1
Total Project Costs including contingencies[3]	**27.00**	**25.00**	**2.00**	**100**

C. Lessons Learned and Reflected in the Project Design

27. This Project has been designed taking into account lessons learned from experiences of the World Bank and other stakeholders in decentralized electrification and the use of mini-grids in Sub-Saharan Africa and other regions. Experiences from specific projects in Bangladesh, Mali, Senegal, Nicaragua, Peru, Lao PDR, Guinea, and Haiti have been considered, as well as lessons learned from hybrid mini-grids for decentralized electrification around the world. It is also taken into consideration the experience coming from Lighting Africa and countries that are commuting efforts to expand the pico-PV solar market such as Ethiopia, Uganda and of Liberia itself.

28. Particular attention was paid to incorporating lessons learned regarding technical and financial sustainability.[4] First, cost estimates for decentralized electrification need to have significant contingencies to anticipate uncontrollable factors such as exchange rate changes and

[2] IDA resources will be used to finance diesel generation that is not eligible for SREP financing.
[3] There is limited experience with construction of isolated rural electrification projects in Liberia. Capital and operating cost estimates have high uncertainty, especially at prefeasibility stage. In addition, there is no experience with the operation and maintenance of such mini-grids on which to base cost estimates. These significant uncertainties are mitigated by using contingency factors of 30 percent in capital cost estimates.
[4] See *The Welfare Impact of Rural Electrification: a Reassessment of the Costs and Benefits, an IEG Impact Evaluation (2008*) and Project documents.

inflation in construction costs due to infrastructure programs in areas with limited capacity. Second, cost reflective tariffs are essential to measure and encourage operator efficiency. Third, rolling connection charges into tariffs rather than requiring upfront payment is an effective way to encourage access by the poor. Fourth, the option of a fee-for-service for low-income customers, where the consumer pays for a service (e.g., lighting, watching TV, etc.) can be used rather than metering to increase access and reduce costs. Finally, opportunities need to be maximized for productive, institutional, and community applications that complement household electricity service and improve quality of life as well as provide livelihood opportunities and generate revenue.

29. The Project builds on dramatic improvements in Pico PV technologies, in recent years. Improvements include cost reductions and improvements in reliability, widespread distribution of efficient and effective lighting and other appliances powered by solar PV in developing countries, and the emergence of innovative and effective private business models for commercial distribution in developing countries

30. The Project design takes into account lessons learned on the sustainability of off-grid decentralized electrification projects.[5] First, the project must be consistent with the overall national electrification plan. Second, project design must utilize least cost design and not be technology driven. Third, early efforts must be made to maximize community awareness, involvement, and support. Fourth, the design must reflect the capabilities of the service providers and ensure adequate financing. Fifth, users must have access to quality equipment and products and qualified maintenance and repair service, and also spare parts over the long term. Finally, training should be provided to participating government staff, service providers, and consumers.

31. Recent experience with innovative renewable energy electrification projects in Senegal and Mali provides additional lessons. First, implementation of innovative projects takes time. Given the lack of experience of government and stakeholders with decentralized grids and the lack of an established business model, particularly with respect to regulation, contracting and procurement, a longer implementation timeframe than the usual four years could be needed. Second, flexibility and pragmatism are needed to achieve results; for example, project procurement and construction may need to proceed in advance of full definition of the business and regulatory models. Third, there is a need to balance the advantage of using state-of the art technology for electricity generation, and the importance of using approaches adapted to the local conditions that are often quite challenging. Fourth, the possibility of leveraging private sector investments for decentralized renewable electrification may require legal, regulatory, and fiscal incentives, in addition to a stable legal and regulatory framework including a strong independent regulator.

32. During the implementation of the LLL Program, lessons have emerged with regard to the promotion of individual solar systems in Liberia. First, procurement of pico-PV products must be properly planned, considering the fluctuations in product sales across seasons. The peak of sales is during the dry season, October to May, when access to rural areas is least restricted by poor roads. Second, it is preferable to have several importers operating in parallel. While bulk procurement by one importer reduces cost, issues with import delays can significantly affect retailers when no options are present. Third, awareness campaigns are essential, particularly in

[5] See *Operational Guidance for World Bank Group Staff: Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices (2008).*

rural areas. Road shows carried out by RREA have been effective in raising awareness of the products and increasing sales. Advertising the road shows by radio ahead of time allows consumers to secure the necessary funds to purchase the products. Fourth, it is important to respond to market needs. While the project initially only encompassed lanterns, larger systems, such as SHS, were later introduced in response to market demand and have achieved good sales. Finally, retailers must engage with established rural distribution networks as weak road infrastructure poses challenges with delivering products to rural customers.

D. Partnership Arrangement

33. The proposed Project will complement projects financed by other donors under the umbrella of IPRE, an important roadmap for the implementation of the Government's national strategy for rural electrification.

34.

35. In addition to the LLL program and the proposed projects proposed project, other ongoing or planned activities related to rural electrification include: (i) AfDB'sUS$28 million biomass and hydropower project in the south of the country through SREP and AfDB financing,; (ii) USAID's "Beyond the Grid" initiative is providing technical assistance and capacity building to strengthen RREA's capacity to plan, design, and implement decentralized electrification projects; (iii) the Government of Norway, through NVE is providing training and technical assistance to MLME, RREA and to the Liberia Hydrologic Institute to build up technical knowledge and planning capacity in hydroelectric systems; and through the Energy+ initiative, it is also providing US$1.5 million for technical assistance to conduct pre-feasibility studies for three small hydro sites in Lofa County and a feasibility study of the best site; it has also committed US$18 million investment project using a Payment-for-Results approach; (v) the European Union (EU) plans to invest EUR 30 million to support rural electrification projects still to be defined; and (v) the Agence Française de Développement has expressed strong interest in cofinancing projects fostering access to electricity in Liberia.

36. RREA, as the agency in charge of rural and renewable energy in Liberia under the guidance of MLME, is the implementation agency and main interlocutor of the donors financing all the projects listed above. Having the same focal point has greatly facilitated coordination among the donors, and this coordination has been further strengthened through a systematic sharing of information and periodical working sessions led by RREA with these donors and their consultants, to ensure that the various activities are complementary and that there is no duplication of effort, to share results of studies or discuss work in progress, and to liaise both on the strategic and technical level. Building on this shared knowledge and active dialogue with all the donors working with RREA, the proposed project has been designed to maximize synergies with the projects of the other donors, and avoid unnecessary duplication.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

37. **Institutional Arrangements.** The Act establishing RREA as a permanent and autonomous agency was approved and entered into effect in July 2015. Until now, RREA has been operating

under the guidance of MLME, the highest authority in the sector, with RREA's Executive Director appointed and reporting to the MLME Minister. This arrangement will continue until the Board of Directors of the institution, in charge of providing strategic guidance and general oversight, is appointed. Members of the BD will include representatives of MLME, LEC, Ministry of Justice, the Executive Director of RREA, three persons selected to ensure equitable geographic, demographic, and gender representation of the country, three persons selected on the basis of their qualifications and experience, and one representative of civil society. As part of its functions, the BD would facilitate inter-ministerial cooperation, which would be particularly useful for the project during implementation. The appointment of the BD is expected to take place in the coming months, and is a dated covenant in the Grant and Financing Agreement to be met by December 15, 2016.

38. **Implementing Agency.** RREA would be the sole implementing agency of the project. It would liaise with MLME to ensure consistency between the activities financed under this Project and the sector policies for decentralized electrification.

39. A dedicated Project Management Team (PMT) in RREA would be responsible for the implementation of the Project. RREA would contract a Project Coordinator who will report to the Executive Director of RREA and would work with the RREA's Technical Director and other technical and fiduciary staff already in place to implement the Project. , including Four junior technical staff have been hired and trained by NRECA, with USAID financing, and are being integrated into RREA's staff to build its institutional capacity. Several of these technical staff would be assigned to the Project as technical members of the PMT. A pico-PV specialist will be hired to support the implementation of Component 3. Fiduciary staff (financial management and procurement) would be dedicated to the Project, but report to the respective directors of RREA.

40. Project implementation arrangements– including fiduciary responsibilities – are described in detail in Annex 3. The role and responsibilities of the Project's management team would be described in detail in the Project Implementation Manual (PIM), to be prepared by RREA prior to effectiveness.

B. Results Monitoring and Evaluation

41. In addition to the Project indicators, other activities to be reported on and monitored would include the timeliness, efficiency, and transparency of procurement and contract management; construction and commissioning of the mini-grid generating facilities, transmission and distribution lines and substations; the effective implementation of the Environmental and Social Management Plan and Resettlement Action Plan; and the successful completion of studies and training activities. In addition, attention will be paid to generating sex-disaggregated data through RREA's data system to adequately monitor and report on the outcome and impact of improved energy services for female and male beneficiaries.

42. Annex 1 presents the Project's results framework, which defines specific outcomes and results to be monitored. RREA would be responsible for monitoring progress on indicators and submitting periodic monitoring and evaluation (M&E) reports to the Bank.

C. Sustainability

43. The Project has been designed to support the sustainability of the results, as follows.

44. *Financial and technical viability of the decentralized electrification program.* Sustainability of the mini-grid systems would be supported by a smart tariff scheme, affordable for the population that ensures full recovery of costs of operation, maintenance, and expansion to attend future customers.[6] Moreover, the Project would provide technical assistance to RREA to define and procure O&M contracts. Equally important, the Project would finance the elaboration of regulations and technical standards that guarantee the enabling environmental for efficient and sustainable operation of the mini-grids.

45. *Strong technical and capacity building support for RREA.* RREA benefits from technical assistance from a number of sources in addition to the technical assistance proposed under the Project, Such support includes assistance from the U.S.-based nonprofit NRECA, one of the most experienced entities in decentralized electrification efforts worldwide. NRECA will provide expertise and best practices related to electrification with mini-grids and business models for decentralized electrification. NRECA will also provide on-the-job capacity building during three years to the technical staff of RREA in the different areas of rural electrification projects (identification, design, supervision, monitoring and sustainable operation and maintenance models).

46. *Sustainability of the market for stand-alone solar systems*. To increase the sustainability of the supply chain and market for stand-alone solar systems, Component 3 will support the strengthening of the retail network and removal of constraints to the transfer of procurement and import responsibilities from RREA to the private sector. The current subsidy, supporting the cost of shipment and imports, would be phased out during the life of the Project, with a faster scale-down for products imported by RREA. These measures would make it easier for the for-profit private sector to take over once RREA is no longer an intermediary in the market. RREA's revolving fund, with incoming payments from retailers, also aims at increasing sustainability of the market after the close of the project[7].

47. *RREA's clear legal mandate to foster decentralized electrification and use of renewable energy*. The success of the decentralized electrification effort in general and the Project in particular relies on RREA's continued efforts. While RREA is a relatively new organization, it has a clear legal and policy mandate to carry out decentralized electrification and development of renewable energy in Liberia, recently reaffirmed through the passing of the Rural and Renewable Energy Act.

48. *Elaboration of regulations for decentralized electrification systems and of replicable business models for renewable-energy based hybrid mini-grids and off-grid household SHS.* The

[6] To ensure affordability and sustainability, tariffs would cover recurring expenditures and the expansion of the mini-grid beyond the Project to serve future customers. The costs for expansion include those of the grid, as well as the diesel generation capacity. No increase would be needed in hydropower since there would be significant excess capacity in the wet season during the initial years of the project.

[7] The funds may be used to support the private sector with working capital loans or other financial instruments aimed at helping them take over the import responsibilities. Alternatively, in case of low interest from private actors in taking over this role, the funds may be used to support the continued bulk import of products either by RREA, or an RREA-contracted entity.

preparation of these regulations and business models would help RREA to achieve its broader mandate of fostering decentralized electrification and use of renewable energy.

D. Gender

49. The Government has committed to achieving gender equality and women's rights as a means of maintaining peace, reducing poverty, enhancing justice, and promoting sustainable development. It approved a National Gender Policy in 2009. Following this, a gender focal point has been hired by RREA, and particular emphasis was placed on gender in the IPRE. Therefore, there is a strong basis for incorporating gender sensitivity in the Project. Specifically, in Components 1 and 3, attention would be paid to relevant gender dimensions in consultation and information campaigns, market outreach and surveys, payment and application procedures, and income generating opportunities. Care would be taken to ensure that women have access to and benefit from gaining energy access.

50. Specifically, and in line with these national priorities, the following gender mainstreaming actions, financed under the Bank-executed AFREA Gender and Energy Program, will be taken forward to complement the various components of the project: a) conducting a gender assessment[8] for the decentralized electrification in Lofa; b) developing a gender sensitive stakeholder consultation strategy for the project activities; c) contributing to the market research and consumer surveys undertaken by RREA to ensure that the research is gender informed and that the survey results are gender disaggregated; d) delivering training and capacity building on gender and energy to RREA and e) generating sex-disaggregated data to adequately monitor and report on the outcome and impact of improved energy services on female and male beneficiaries. Initial discussions have occurred with RREA and their gender focal point to assess the relevant ongoing and planned actions on gender and energy at the national level.

V. KEY RISKS AND MITIGATION MEASURES

A. Risk Rating Summary Table

Risk Category	Rating
1. Political and Governance	Substantial
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	High
5. Institutional Capacity for Implementation and Sustainability	High
6. Fiduciary	Substantial
7. Environment and Social	Moderate
8. Stakeholders	Moderate
9. Other	Moderate
OVERALL	**High**

[8] The aim of a project level gender assessment is to identify key gender issues, risks, constraints and opportunities associated with a proposed energy project activity in order to identify concrete actions that can help improve the delivery of and access to energy services for both men and women. This is particularly relevant given the 8000 new potential users including households, businesses, and public entities under Component 1.

B. Overall Risk Rating Explanation

51. The overall risk of the proposed Project is rated as "High". The main risks identified are summarized below.

52. *Lack of experience with decentralized hybrid mini-grids in Africa*. The proposed Project faces a high implementation risk due to its pioneering nature. It would result in the first megawatt-size decentralized hybrid electrification Project for public service in Liberia, as part of the Government's strategy to scale up the use of renewable energy.[9] Technical, financial, and regulatory experience with respect to decentralized electricity services is thus limited. Mitigation measures include: (i) the contracting of an "Owner's Engineer" to supervise Project activities with respect to the decentralized grids; and (ii) the funding of capacity building, workshops, and technical assistance for the final beneficiaries, public institutions, and the operator.

53. *Uncertainties about costs*. There is limited experience with construction of small-scale hydropower projects facilities in Liberia. Capital and operating cost estimates for these facilities have high uncertainty, especially at prefeasibility stage. In addition, there is no experience with the operation and maintenance of such mini-grids on which to base cost estimates. These large uncertainties in cost estimates are mitigated by using contingency factors of 30 percent in capital cost estimates.

54. *Possible delay in construction due to the rainy season.* Experience in Yandohun showed that difficulties in accessing the site during the rainy season resulted in a delay of the construction times. The same situation may occur in this Project, which is located in a remote part of Liberia. The Project design has taken into consideration such potential delays that could increase the construction time of the mini-grid.

55. *Overestimation of electricity demand from mini-grids*. Given that there is little experience with public decentralized electricity service and that most of the potential beneficiaries have low incomes, there is a risk that demand would be lower than forecast, reducing the financial viability of the mini-grids. To mitigate the risk, a socioeconomic assessment is underway of the potential demand in towns in Lofa County. In addition, estimates of household demand have been set at a low level by international standards, at 20 kWh per month per household, and innovative tariff setting would be sought (such as fee-for-service, lifeline tariff, or deferred payment schedule). Finally, a conservative approach has also been adopted, with the decision of not including the demand of large users, such as plantations, in the base case for the economic and financial analysis of the component.[10]

56. *Lack of sustainability of the decentralized mini-grid operators and RREA's inability to backstop them*. In Liberia there is a lack of experience and competence in the provision of decentralized electrification services and the operation of renewable energy technologies. There are risks that the mini-grid operators would fail. This would be mitigated through a project design that will prioritize simplicity and adaptation to the local characteristics, and by RREA's

[9] As explained earlier in the text, RREA has undertaken three pilot projects for kilowatt size decentralized hydroelectric mini-grids, including the Yandohun project of 60 kW, commissioned in 2013, and two other small projects currently in construction.

[10] However, sensitivity analysis shows that the inclusion of such customers would make the project financially more attractive. It is likely that some large users would connect to the mini-grid during the wet season when excess generation is available, as a fuel cost saving measure, and revert to self-generation during the dry season.

supervision and technical support of the operators. The Project would ensure that the capacity of RREA and potential operators as well as the new decentralized customers, would be strengthened with respect to technical, financial, organizational, and social aspects of decentralized electrification.

57. *Lack of specific regulations for decentralized electrification*. A new electricity Law has been approved in September 2015, but the specific regulations, including those for decentralized electrification, have yet to be written. One of the aims of the Project is to support establishment of these regulations. There is a risk in proceeding with investments in the absence of regulations. On the other hand, the establishment of the mini-grids in the Project provides an opportunity to inform the formulation of this regulatory regime. The technical assistance support to be provided in coordination with Norway, together with parallel assistance on the business model provided by USAID through NRECA, mitigates to some extent the risk of proceeding in advance of regulations.

58. *Risk of sustainability of the Pico-PV sector*. The pico-PV market in Liberia is at a nascent stage and is mainly public sector driven. There are substantial risks with respect to this innovative component, including the risks that retailers would not be sufficiently interested in selling systems, that importers would not step forward to scale up imports, and that the retail chain would not be sufficiently well developed at the end of the Project to be sustainable without the subsidy and support provided. This risk is mitigated by the use of RREA's revolving fund, financed with incoming payments from retailers, which, if necessary, can be used to support the market at the end of the Project. The funds may be used to support the private sector with working capital loans, subsidies or other financial instruments aimed at incentivizing their participation in the pico-PV market. In case of low interest from private actors in taking over import responsibilities, the funds may be used to support the continued bulk import of products either by RREA, or a RREA-contracted entity.

59. *Delays in the establishment of the Board of Directors of RREA (BD)*. The BD would play an useful role for the project, mainly during the implementation phase, because since it gathers representative of various ministries and government agencies, as well as representatives of the community, it could foster the cooperation of different stakeholders that will play a role in this implementation (for instance the granting of right of ways, etc.). As RREA has been recently established, the GoL has not yet appointed the BD members. If the BD is not functional when the Project is under implementation, there is a risk of delays in actions to overcome any eventual difficulties.

60. *Delays and effects of Ebola Crisis*. The Project faces the risk of delays in implementation and/or increase in costs due to the impact of the Ebola crisis. This impact includes difficulties in getting contractors on the ground. It also includes the possibility of increases in the cost of the offers submitted by bidders. The Project would address these risks by: (i) adopting a simple design; (ii) launching the procurement process for works as soon as possible; (iii) financing the recruitment of experts to assist RREA in design and implementation of activities; and (iv) adopting a conservative budget and including contingencies to cover higher than normal costs.

61. The Climate and Disaster Risk Screening has been completed for the proposed project. The screening identified current and future key drivers of risks as extreme temperature and extreme precipitation flooding. The team has confirmed that the technical specifications for equipment will

take into consideration these risks, especially the future temperature increase. For the expected civil works and substations, technical specifications of drainage systems will account for potential increased flooding. Finally, there will be focused training on extreme events and preventive maintenance (e.g., cleaning of drainage infrastructure before rainy season).

VI. APPRAISAL SUMMARY

A. Economic and Financial Analyses

Economic analysis

62. **Economic Analysis of Component 1.** The economic analysis shows that mini-grid service in Voinjama-Foya-Kolahun-Massambolahun-Bolahun would be economically viable with an EIRR of 18 percent and a net present value (NPV) of US$11.5 million at a ten percent discount rate. Economic benefits were conservatively estimated based on avoided costs of electricity substitutes currently used by households, businesses, and public entities. Currently, there is no electricity service to the Project area, thus the population uses diesel generators, lamps using dry cell batteries, kerosene lamps, candles, and communication devices powered by dry cell batteries. Taking into consideration a preliminary electricity demand study prepared for the towns as well as preliminary estimates of capital and operating costs, a number of supply options were analyzed to meet the demand. Details, including a sensitivity analysis are provided in Annex 5.

63. **Economic Analysis of Component 3.** The approach used to assess the economic benefits of the Market development of stand-alone solar systems program was to calculate the avoided costs of the services that would be replaced by the pico-PV products and compare them to the costs of the systems (see Annex 5). While the exact number and types of PV systems to be sold are difficult to predict, the analysis made the simplifying assumption that PV LED lamps would replace dry cell lamps (see Annex 6 for details). With these assumptions, the NPV of the Component at a 10 percent discount rate would be US$4.2 million. Since the net economic benefit would be greater than the cost in each year, it is not possible to calculate the EIRR. This analysis does not take into account the environmental and health benefits in comparison with the alternatives based on fossil fuel or disposal batteries. These benefits include reduced greenhouse gas emissions, reduced risk for indoor pollution and fire hazards, and reduced amounts of hazardous wastes.

Financial analysis

64. **Financial analysis of Component 1**. Since the capital costs of the mini-grid would be grant financed, its financial viability was determined by: (i) estimating the average electricity tariff in current US$ that would need to be charged to the customers in order to recoup costs for operation and maintenance (including generation costs, commercial, operation and maintenance activities as well as non-technical losses), to finance the connection of new users to the mini-grid, and to yield a financial rate of return on equity equal to 14 percent (pre-tax values); and (ii) ensuring that the resulting tariff was well below the current average tariff in Liberia. The financial analysis shows that the mini-grid in Voinjama-Foya-Kolahun-Massambolahun-Bolahun is financially viable with a tariff of US$0.26 per kWh, which is sufficient to ensure sustainability of the system and at the

same time some 50% below the current electricity tariff in Monrovia. The analysis will be further developed as results become available from the prefeasibility study now underway.

65. **Financial analysis of Component 3**. The financial analysis of this component shows a financial internal rate of return (FIRR) of 14 percent (based on weighted average cost of capital including an 11 per cent return on equity) and an NPV of zero at a 14 percent discount rate. It also shows that the financial ratios are adequate for this type of business (competitive environment with low operational margin).

B. Technical Analysis

66. The Project involves the installation of a MW-sized hybrid mini-grid in Lofa County, including electricity generation based on hydro power complemented by diesel as well as transmission lines from the generation sites to the main load centers, distribution lines within the towns and customer connections. Two possibly hydropower sites are being considered in ongoing feasibility studies. Based on current information, the hydropower plant of Kaiha 2 is likely to be selected as the most reliable and cost-effective source of electricity. During the wet season, hydropower production would be sufficient to cover the demand in the benefited towns. Given the seasonal variability of hydropower, with eight months of availability during the wet season, diesel generation to supply electricity during the dry season (see Annex 2). The ongoing prefeasibility study includes definition of the design of the mini-grid considering investment costs and operation costs for the first 20 years of service. The technologies considered are commercially available and already used in other countries in Sub-Saharan Africa.

67. The proposed Project would also promote sale of high quality pico-PV systems on a national scale by local importers and retailers. All pico-PV products under the Project would meet the Lighting Africa Minimum Quality Assurance Standards which ensure high performance with respect to lighting output, and run time as well as high quality and durability such as physical ingress, water and battery protection. Under the LLL Program, RREA and local retailers have worked with these technologies and products since 2012 and 20,000 products have been sold. Consumer surveys conducted by RREA show that the solar products are considered high quality by consumers and are preferred over traditional lighting sources (candles, kerosene, battery, powered lights) as they are perceived to be safer, more economical and higher quality.

C. Financial Management

68. The Project would build on existing FM arrangements for the LLL Program, implemented by RREA, which have been assessed as adequate. The overall residual FM risk for the Project has been assessed as 'Substantial'. Mitigation measures include an external annual audit of the Project, the rendition of quarterly IFRs, segregation of duties of the core Project staff, and a customized chart of accounts (CoAs) for the Project. The Project accountant would submit withdrawal applications on at least a monthly basis.

69. RREA would prepare an annual work plan and budget to be approved by the Task Team Leader (TTL). Existing internal control procedures for transaction authorization by the appropriate officials of the RREA would apply for the Project. The detailed description and segregation of duties for the core staff of the Project would also be included in the Project Implementation

Manual. Accounting reports on the use of Project funds would be prepared by the project management team using the International Public Sector Accounting Standards (IPSAS) cash basis of accounting. RREA would prepare quarterly unaudited interim financial reports (IFRs) and submit them to the Bank 45 days after the end of each quarter. The Project would prepare annual financial statements at the end of each fiscal year in accordance with IPSAS and submit annual audited financial statements 6 months after the end of the Borrower's fiscal year. Details on the FM assessment are included in Annex 3.

D. Procurement

70. Procurement related responsibilities of the Project Management Team (PMT) in RREA would include: (i) managing procurement activities, and ensuring compliance with the procurement process described in the relevant manuals; (ii) preparing and updating annually the procurement plan; (iii) preparing bidding documents, draft Requests for Proposals (RFPs), evaluation reports, and contracts in compliance with World Bank procedures; and (iv) seeking and obtaining approval of IDA on procurement documents as required.

71. Procurement for the proposed Project would be carried out in accordance with the World Bank's *"Guidelines: Procurement under IBRD Loans and IDA Credits*" dated January 2011 and revised July 2014; and *"Guidelines: Selection and Employment of Consultants by World Bank Borrowers"* dated January 2011 and revised in July 2014, and the provisions stipulated in the Legal Agreement. For each contract to be financed by the Grant, the different procurement methods or consultant selection methods, the need for pre-qualification, estimated costs, prior review requirements, and time frame would be agreed between the Borrower and the Bank in a Procurement Plan. A Procurement Plan for the first 18 months of the project would be agreed during appraisal. The Procurement Plan would be updated at least annually or as required to reflect the actual Project implementation needs.

E. Social and Environmental Safeguards

72. The Project is safeguards category B as the proposed activities are small-scale, site-specific, and manageable. No adverse long-term impacts are anticipated. The Project triggers three safeguards policies: Environmental Assessment (OP 4.01), Involuntary Resettlement (OP 4.12.), and Physical Cultural Resources (OP 4.11). The triggering of the Natural Habitats (OP 4.04) is to be determined (TBD) since the exact location of the mini-hydropowere plant is not yet known. The Safety of Dams policy (OP 3.37) is not trigered. The design of the 5 meter high dam will be done taking sound engineering practices into account to address dam saftey issues as reflected in the ESMF. The safeguards policy of Projects on International Waterways (OP 7.50) is triggered since the Kaiha river is a tributary of Mano River, which is an international river waterway since it runs along the boundary between Sierra Leone and Liberia. However, the team will seek an exception from the requirement of notification through a memorandum to the Regional Vice President on the basis of paragraph 7(c) of OP 7.50 because: (i) the Kaiha River is a tributary of the Mano River; (ii) the Kaiha River runs exclusively within Liberia; (iii) Liberia is the lowest downstream riparian of the Mano River; and (iv) the project would not cause appreciable harm to other riparian states.

73. RREA is preparing a Resettlement Policy Framework (RPF) to address the social impacts related to potential land acquisition and/or resettlement and losses of assets or access to resources,

given that the physical footprint of the civil works is not known. The RPF includes the guidelines and procedures for compensation and/or resettlement in the event that future activities should require land acquisition, involuntary resettlement, or cause restriction of access to livelihoods or assets and resources. It contains (i) an assessment of the country regulatory and institutional framework for land acquisition and compensation; (ii) likely categories of affected assets and parties as well as the scope of impacts on women and men; (iii) a gap analysis and a compensation framework consistent with OP 4.12 and the national legislation; (iv) measures to assist vulnerable groups, including women; (v) a consultation framework to enable the participation of affected populations in the preparation of specific resettlement plans; (vi) an institutional framework to implement the resettlement policy framework; (vii) a grievance redress mechanism; and (viii) a monitoring and evaluation framework and budget. In case any land acquisition or compensation becomes necessary, the Government would cover the cost. The RPF would be consulted upon and disclosed in country and in the Bank's Infoshop after approval by the Bank prior to appraisal. The RPF is being prepared and the report is expected to be submitted for Bank review by October 21.

74. The RPF would guide the elaboration of a Resettlement Action Plan (RAP), if needed, which would be carried out during Project implementation when the feasibility studies have been finalized and the location of the hybrid mini-grid facilities and their social and gender impacts are known.

75. An Environmental and Social Management Framework (ESMF) is also being prepared to identify the potential impacts of Project-financed activities, especially the impacts of the mini-hydropower plant. The ESMF is being elaborated and the draft will be submitted for Bank review by October 21. It is expected that the environmental, health, and safety impacts would be low and concern mainly health and safety issues during construction. The World Bank Group General Environmental, Health and Safety Guidelines (EHSGs) would be applied, as well as other applicable EHSGs. The ESMF contains a screening mechanism to identify if an Environmental and Social Impact Assessment (ESIA) would need to be prepared during Project implementation. The screening mechanism includes the screening for the presence of Physical Cultural Resources, which could be graves or sacred forests.

76. The preparation of the safeguard documents (i.e., ESMF, RPF) follows a broad-based and in-depth consultation approach that include interviews with relevant Project stakeholder groups, in particular: local communities and mayors, potential Project affected people (PAPs), including vulnerable groups such as women and local NGOs, and other interested parties. This consultation approach would be carried on throughout Project implementation and supervision. Main concerns raised would be listed, based on the conclusions of the ESMF and RPF.

77. Climate and Disaster Risk Screening has been completed for the proposed Project and is discussed under risks above (see paragraph 57).

F. World Bank Grievance Redress

78. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection

Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

G. Beneficiary Feedback

79. Beneficiary feedback will be recorded and monitored for Component 1 through the grievance redress mechanism, which is further described in the RAP. The PIU would gather information about Component 1 activities where complaints have been brought forward, including information on how they were resolved or relevant follow-up. This information would be included in an annual progress report and taken into account under the project, as relevant, during project implementation.

Annex 1: Results Framework and Monitoring

Country: Liberia
Project Name: Liberia Renewable Energy Access Project (P149683)
Results Framework

Project Development Objectives

PDO Statement: The Project Development Objective (PDO) is to increase access to electricity and to foster the use of renewable energy sources.

Project Development Objective Indicators							
		Cumulative Target Values					
Indicator Name	**Baseline**	**YR1**	**YR2**	**YR3**	**YR4**	**YR5**	**End Target**
People provided with access to electricity by household connections - Off-grid/ mini-grid (Number) - (Core)	0.00	0	0	0	25,000	50,000	50,000
People with access to modern energy services (off-grid) (Number)	0.00	10,000	25,000	45,000	70,000	100,000	100,000
Direct project beneficiaries (Number) - (Core)	0.00	10,000	25,000	45,000	95,000	150,000	150,000
Female beneficiaries (Percentage - Sub-Type: Supplemental) - (Core)	50	50	50	50	50	50	50
Intermediate Results Indicators							
Indicator Name	**Baseline**	**Cumulative Target Value**					
		YR1	**YR2**	**YR3**	**YR4**	**YR5**	**End Target**
Annual electricity output from RE as a result of SREP interventions (GWh/year)	0	0	0	0	2.9	5.8	5.8

Generation Capacity of Hydropower constructed or rehabilitated (MW) - (Core)	0	0	0	0	2	2	2
Distribution lines constructed or rehabilitated under the project (km) – (Core)	0	0	0	0	58	58	58
Business plan of Lofa county electricity service elaborated (Yes/No)	No	No	Yes	Yes	Yes	Yes	Yes
Project-related grievances registered under the project GRM and addressed (percentage)	0	100	100	100	100	100	100

Indicator Description				
Project Development Objective Indicators				
Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
People provided with access to electricity by household connections - Off-grid/ mini-grid (Number) - (Core)	This indicator measures the number of people that have received a new electricity household connection to the mini-grid financed by the Project. The baseline value is zero.	Semi-annual	Client database of mini-grids.	RREA
People with access to modern energy services (off-grid) (Number)	This indicator measures the number of people provided with access to modern energy services under the Project via a pico-PV or solar home system.	Semi-annual	List of imported products, retailer's list of buyers of systems, and conversion methodology of LA.	RREA
Direct project beneficiaries (Number) - (Core)	This indicator measures the direct beneficiaries who are people or groups who directly derive benefits from the interventions. Supplemental Value: Female beneficiaries (percentage).	Semi-annual	Project progress report. Client database of mini-grids. List of imported products, retailer's list of buyers of systems, and conversion methodology of LA. Census data from LISGIS of electrified towns	RREA
Female beneficiaries(Percentage - Sub-Type: Supplemental) - (Core)	Based on the assessment and definition of direct project beneficiaries, this indicator specify what percentage of the direct project beneficiaries are female.	Semi-annual	Census data from LISGIS.	RREA
Intermediate Results Indicators				
Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Annual electricity output from RE as a result of SREP interventions (GWh/year)	This indicator measures the annual electricity generation (in GWh/year) coming from renewable energy sources	Semi-annual	Project progress report	RREA

Generation Capacity of Hydropower constructed or rehabilitated (MW) - (Core)	This indicator measures the capacity (in MW) of hydropower constructed or rehabilitated under the project.	Semi-annual	Project progress report	RREA
Distribution lines constructed or rehabilitated under the project (km) – (Core)	This indicator measures the length of the distribution lines (in km) constructed or rehabilitated/upgraded under the project.	Semi-annual	Project progress report	RREA
Business plan of Lofa county electricity service approved (Yes/No)	This indicator checks whether the business plan for the electricity service in Lofa county has been elaborated and approved by RREA (Yes/No).	Semi-annual	Business Plan approved by RREA	RREA
Project-related grievances registered under the project GRM and addressed (percentage)	This indicator measures, the number of addressed grievances over the number of registered grievances (in percentage)	Annual	Project progress report	RREA

Annex 2: Detailed Project Description
Liberia Renewable Energy Access Project (P149683)

1. The proposed Project would support the implementation of the Liberia Investment Plan for Renewable Energy (IPRE) prepared by the Government in October 2013. The total financing plan of the IPRE amounts to US$178.5 million. In addition to the proposed Project, other financing sources for the IPRE include AfDB, Government of Norway, USAID, the EU, and the Government of Liberia. The Agence Française pour le Développement (AFD) has expressed strong interest in partnering with the donors already involved to contribute to financing IPRE. The Project would also support the scale-up of the Government's initiative to foster the creation of a market for modern solar lanterns and home systems that would provide sustainable lighting solutions to improve living conditions of the population living in areas that are unlikely to receive electricity from the grid.

2. RREA has carried out pilot activities to provide decentralized electricity, including: (i) the rehabilitation and expansion of a mini-grid supplied by a micro-hydropower plant of 60 kW in Yandohun, in Lofa County near the border with Sierra Leone funded by the World Bank; (ii) a micro-hydro and a biomass-powered mini-grid pilot under implementation with support from the United States Agency for International Development (USAID); and (iii) a program to foster the development of a national market for solar lanterns to benefit those unable to access grid electricity supported by the World Bank through Africa Renewable Energy and Access Program (AFREA) and the Global Environment Facility (GEF).

3. In Yandohun, villagers had been without electricity since their micro hydropower plant was destroyed during the civil war. The old 30 kW plant supplied enough electricity for lighting, the school, local businesses, and a rice mill. In May 2009, an assessment made with Energy Sector Management Assistance Program (ESMAP) funds identified Yandohun as a pilot case for decentralized electrification. The studies found that the pre-war capacity of the hydropower plant could be doubled to 60 kW, and many productive uses of electricity were possible. The population contributed in-kind to the rehabilitation of the plant. Work started in 2011; the plant was commissioned in March 2013. The project benefits about 200 families. It is run by a cooperative formally constituted to this end. Users pay a fee for the service that has been calculated to cover the operation and maintenance of the plant and mini-grid and to ensure the sustainability of this first pilot project in RREA's program of decentralized electrification.

4. The Lighting Lives in Liberia (LLL) Program funded by the World Bank, the AFREA program, and the GEF since 2012, aims at developing the local market for pico-PV products. RREA's long term goal for the LLL Program is to transition to a large, sustainable, private-sector led, commercially viable market for pico-PV products that meets the lighting needs of those who cannot obtain grid electricity. To date, about 20,000 products have been sold, demonstrating strong potential demand. However, even though the pico-PV market is growing, it is still at a nascent and fragile stage. The Ebola outbreak in mid-2014 slowed new sales and made it more difficult to recover payments. Several retailers are facing financial difficulties, and some have left the program. Other factors constrain market growth,[11] such as the lack of access to finance for

[11] Constraints identified in *Market Opportunities for Solar Portable Lights Study* (October 2012) and Local Retail Partners Business Capacity Assessment Report (August 2015).

importers, retailers, and consumers; the lack of national quality standards for PV products and the resulting competition from low quality products; high in-country transportation costs; and, lack of accessibility to rural markets during the rainy season.

5. The proposed Project would finance three main activities. First, the Project would finance the implementation of decentralized electrification through mini-grids in Lofa County, in the North of Liberia. Second, the project would finance the strengthening of institutions and regulations for decentralized electricity services. Third, it would support the development of a market nationwide for scaling-up of stand-alone solar systems.

Component 1. Decentralized electrification in Lofa County (estimated cost US$22 million)

6. This Component would finance investments in renewable and diesel generation as well as mini-grids to distribute this electricity to the local population. Financing would be provided for construction of facilities, implementation of safeguards measures, and operation and maintenance (O&M) services. The Component would mainly serve towns in the North of Lofa County, including Vonjaima, Foya, Kolahun and Massambolahun/Bolahun as well as peripheral areas. This is an important economic and agricultural region, located on the border of Guinea and Sierra Leone. This county is more than 200 km from the national grid; there are no prospects in the medium term to provide service to this area from the national grid that serves Greater Monrovia, nor to connect it to the regional transmission line under construction in the CLSG regional interconnector Project. Currently, some large businesses in the area such as agricultural processing plants have their own diesel generators. Households and small businesses do not have any electricity services or have limited, unreliable and expensive electricity supply from informal diesel generators. Since electricity demand of the mini-grid would include agricultural processing and other productive and commercial uses as well as household needs, it would be important to provide a reliable and continuous supply of electricity. Identified large customers range from 20 kW to 100 kW, including hospitals and large educational centers. Several productive uses such us stores, sugar crushers, palm oil processors in the range of 5-10 kW have been also identified. Four percent of the potential connections will be for commercial or institutional uses which represent almost 50 percent of the electricity demand.

7. *Subcomponent 1A. Investment in decentralized generation and hybrid mini-grids in Lofa County (estimated cost US$18.9 million–SREP financing).* This subcomponent would finance installation of a MW-sized hybrid mini-grid, with generation based on hydropower during the wet season complemented by diesel generation during the dry season.

8. Based on the results of IPRE and previous analysis of hydropower potential in Liberia, several prefeasibility studies were launched for the best hydropower sites identified in the North, with financing from the World Bank, the Government of Norway, and MLME.[12] The studies are ongoing; the preliminary results have shown that the best sites for development are three sites in Lofa County. However, electricity supply cannot be based solely on hydropower because of the seasonal nature of hydro resources. Diesel and/or solar PV generation are required during the dry season to provide the continuous and reliable electricity service needed by productive users in the area. While maximizing the use of renewables is an explicit objective of the Government's energy

[12] The following prefeasibility studies of hydropower plants were carried out: the World Bank financed two in Bomi County and two in Lofa county (near Voinjama); MLME conducted four in different counties, of which one in Lofa County (near Zorzor); and Norway financed three in Lofa county (near Kolahun).

policy and of the Project, even under a scenario that would use 100 percent PV during the dry season, diesel generation would be required in case of failure of the PV system.

9. The definition of an investment program to provide access to electricity to these communities in Lofa County depends on: (i) the investment cost based on the technology configuration which would determine the electricity generation to come from hydropower and diesel; (ii) the achievement of an affordable and sustainable tariff that covers the operation, maintenance, and replacement costs of the system on a sustainable basis while not exceeding the average cost of grid electricity in Liberia of US$0.52/kWh; and (iii) the amount of financing available to cover the investment costs of generation and distribution facilities in different locations in the county.

10. A prefeasibility study of renewable hybrid mini-grids in Lofa County is ongoing, utilizing the results of the hydropower studies and taking into account the above factors. The final decision on sites and technology configurations will be made after the results of the consultancy will become available. Priority will be given to the main economic corridor of the county composed by the biggest towns, including Voinjama, the county capital, Foya, Kolahun, Massambolahun/Bolahun and other small populations to be defined based on the final results of the studies. Table 1 below shows the range of possible generation technology configurations to provide electricity in these main towns with one mini-grid. Prefeasibility studies for various hydro generation sites in the county are ongoing. The preliminary results show that the most suitable site to supply this mini grid is likely to be the small hydro power site of Kaiha 2.

Table 1: Summary results of preliminary analysis of possible generation technology mix of the mini-grid to supply Voinjama-Kolahun-Foya-Massambolahun/Bolahun

Scenarios	Hydro (kW)	PV (kW)	Diesel (kW)	CAPEX generation (million US$)	OPEX generation (million US$/yr)	LCOE generation (US$/kWh)	LCOE generation without CAPEX (US$/kWh)	Liters of diesel (m3/yr)	Total CAPEX (with grid and connections) (million US$)
Hydro + only diesel	2,000	0	1,800	11.5	1.626	0.446	0.237	1,372	19
Hydro + diesel/PV	2,000	1,100	1,500	16.5	0.906	0.412	0.125	704	24
Hydro + only PV	2,000	5,700	0	29.9	0.612	0.62	0.086	0	37

11. The analysis showed that hydropower would be the main source of electricity during the wet season and that a mix of PV and diesel generation could be used during the dry season. Different options to meet the electricity demand during the dry season were analyzed, from a diesel only generation system (no PV) to a system powered 100 percent by PV and an intermediate hybrid PV-diesel option. In all cases a diesel generator would be required as backup in case of failure of the PV, to ensure reliable service. The back-up system using only PV presented the highest capital and lowest operating costs. This supply option would require the lowest tariff to end users if the tariff were set to recover only O&M costs. However, it would be the most expensive option from an economic point of view for Liberia as it would have the highest Levelized Cost of Electricity (LCOE). Also, it would reduce the electricity access provided under the Project because there would be less funding available to finance connections.

12. The system using only diesel generation during the dry season would have the lowest capital costs for generation and the highest operating costs due to the fuel costs. While it would require users to pay a higher tariff than the other options analyzed to cover operation and maintenance costs, the required tariff would still be well below the current 0.52 cents/kwh paid by LEC customers, or the revealed willingness to pay of 65 cents/kwh for electricity substitutes indicated in recent studies for Lofa County and other similar areas in the country. This supply option would also allow the project to maximize the number of connections made to increase access to electricity.

13. The hybrid PV-diesel option with a small share of PV would have only a slightly lower LCOE than the diesel-only option, since the lower operating costs would be almost offset by the increase in capital cost of about 50 percent. Furthermore, installing a MW-sized PV power plant to supply the isolated mini grid in Lofa County would increase the Project risks, as it would be a first in Africa. While PV power systems to supply mini-grids in rural areas have been installed recently in Mali and Guinea Bissau, these are smaller, at 50 to 300 kW. A MW size PV generation plant has technical operating requirements (engineer on-site or sophisticated remote control systems) that would represent a major challenge in such an isolated area and could endanger the sustainability of the Project.

14. Based on this preliminary analysis, the best option appears to be a mini-grid serving the main towns in the Northwest, which would include Voinjama, the capital of the county, Foya, a commercial hub in the border with Sierra Leone and Guinea, Kolahun, Massambolahun/Bolahun and other smaller populations along the line. Among the generation sites for hydroelectricity under study, Kaiha 2 appears to be the most likely site to be selected to supply electricity to the mini-grid based on preliminary information. This site consists of small rapids and a waterfall over approximately 100 meters. The proposed layout consists of a small dam and intake structure upstream of the waterfall, a short penstock and a power station downstream. It has an approximate total head of 13 meters (5 m high dam and 8 m head difference); the design discharge of the power plant would be 7.5 m3/s. This layout for the plant would optimize the use of the hydro resources, allowing the plant to generate some electricity even during the dry season, complemented by diesel generation (see subcomponent 1B). The other sites under study have similar characteristics.

15. A transmission network (33 kV line) would connect the towns of Voinjama, Kolahun, Foya and Bolahun and would have a length of 90 km (30 km from Kaiha 2 to Bolahun and another 60 km to connect Voinjama, Foya and Kolahun).

16. *Subcomponent 1B. Investment in diesel generation for the hybrid mini-grids in Lofa County (estimated cost US$2.00 million – IDA financing).* This subcomponent would finance the diesel generation facilities described above. As already noted, diesel generation would be needed during the dry season to provide reliable, continuous power for productive uses.

17. *Subcomponent 1C: Operation and maintenance contracts to ensure the sustainability of the decentralized electricity mini-grids established in Component 1 (estimated cost US$1.10 million–SREP financing).* This subcomponent would finance the Owner's Engineer to assist RREA with: (i) overall Project management and supervision of the procurement, design, construction, interface management and preparation for operation and maintenance of the hybrid mini-grid; and (ii) coordination of the implementation of the ESMPs and RAPs. It would also

finance technical assistance to define the business model for the ownership and operation and maintenance of the hybrid mini-grids. The business model would be based on a sound business plan and the new legal and regulatory framework (see Component 2). TA would also be used to define the tariff to be charged to users that would ensure the sustainability of the services. RREA, with the help of international consultants financed by USAID, has already begun work on the ownership and business models for the mini-grid systems based on a menu of options (e.g. public decentralized utility, cooperative, private operator and hybrid business models). Technical assistance provided under this Component would build upon this work.

18. Regarding the business models to operate and maintain the mini-grid, the Project will build on the potential delivery models and ownership options described in the IPRE. Depending on site specific and project needs, several arrangements were considered: (i) Cooperatives and/or private non-profit entities—for small, isolated mini-grids that self-generate and supply electricity to the cooperative's members or local populations; (ii) Commercial/public enterprises (anchor consumers) operating existing businesses—they would establish a renewable energy generation project to serve their own requirements and extend services to other consumers in the area; (iii) LEC ownership of projects—for the areas near to, and likely to be served by, LEC's grid; and (iv) Independent power producers—for larger projects specifically set up as private companies or joint ownership under public–private partnership arrangements, to sell electricity to mini-grids. Drawing from local capacity, it is expected that local entrepreneurs will provide operation and maintenance and commercial services for several delivery models. Similar experiences from other countries will be looked at also, such as Mali, which showed the difficulty to attract foreign private sector investors to run rural electrification concessions but the high participation from local private operators.

Component 2. Technical assistance to strengthen rural electrification institutions and regulations (estimated cost US$2 million)

19. This Component would provide technical assistance to support the implementation of the GoL's program to expand decentralized electrification and foster the use of renewable energy. Among other activities, it would finance assistance to develop the regulations and technical standards for isolated mini-grids. It would also finance capacity building of RREA and documentation of the experience with establishing this first decentralized hybrid renewable energy mini-grid, as well as providing support needed to implement the Project.

- *Subcomponent 2A. Regulation for isolated mini-grids (estimated cost US$0.3 million-SREP financing).* The current legal framework focuses mainly on the national grid. Building on the work done for the mini-grid in Component 1, in coordination with USAID and Norway who also provide technical assistance to RREA, this subcomponent would support the development of regulations and standards for isolated mini-grids, in agreement with the Law for Rural and Renewable Energy and the legal framework of the sector. These would include technical and financial standards, mechanisms to establish and operate the mini-grids and monitor their performance. They would also include arrangements to ensure a smooth transition in the longer term, when the national grid would reach these communities.

- *Sub-Component 2B. Project implementation support and capacity-building (estimated cost US$1.7 million-SREP financing).* This subcomponent would include the cost of preparing and managing the Project, including the elaboration of the safeguard documents, other preparatory

consultancies, and the realization of Project audits. It would finance the hiring of consultants with fiduciary or safeguards expertise, as needed, to strengthen the Project management team in RREA, and beyond the Project, RREA's institutional capacity in decentralized electrification and renewable energy. It would also finance consultants to document the experience gained with establishing this first hybrid mini-grid so that it can be used to inform RREA's larger program. Other stakeholders like MLME, LEC, local authorities and community members, and private companies would also benefit from these capacity building activities.

Component 3. Market development of stand-alone solar systems (estimated cost US$3 million)

20. This Component would finance the development and strengthening of the local market for pico-PV products and the provision of access to modern energy services for over 100,000 people. The Component would be based on the experience and achievements of the AFREA/GEF-financed and World Bank-administered LLL Program, underway to supply pico-PV products in Liberia since 2012. It would aim to increase the sustainability of the supply chain and market by growing and strengthening the retail network and by facilitating the transfer of procurement and import responsibilities from RREA to the private sector.

21. Pico-PV products play an important role in the Government's efforts to promote access to modern energy services in rural areas. They are: (i) the lowest-cost alternative to the kerosene and candles traditionally used; and, (ii) often the first modern energy services used by rural households. The first large order of pico-PV products was brought into Liberia under the LLL Program in 2012. As no market for pico-PV products existed, the focus of the program has been to develop the market by building in-country distribution capacity through the establishment of a local retail network and the stimulation of consumer demand through lower retail prices.

22. To support this approach, RREA has been procuring and importing products in bulk on behalf of local retailers, as well as covering the cost of shipment and importation. It has further established a revolving fund utilizing incoming payments from retail partners to import additional solar products and further expand the market. Bulk import by RREA has reduced the costs and hurdles that importers/retailers bear when engaging in product procurement, streamlined their purchase, importation and customs clearance, and lowered their costs. In addition, the program has provided business development support, such as matching grants to retailers,[13] trade shows linking up local retailers with international manufacturers, and technical training for local retailers, as well as market intelligence[14] and consumer education.

23. The rate of sales of pico-PV products has steadily increased. To date, 20,000 pico-PV products have been sold, demonstrating strong demand. Even though the market is growing, it is still at a very nascent and fragile stage. The outbreak of the Ebola epidemic in mid-2014 significantly slowed down economic activity and caused financial difficulties for many households and small and medium enterprises, resulting in a slowdown of new sales of pico-PV products as well as difficulties in recovering payments for existing sales. As a result, several retailers are experiencing financial difficulties while others have decided to leave the program.

[13] Matching grants have been used by retailers for activities such as awareness creation, road shows, consumer surveys, staff training and the establishment of retail outlets in rural area.

[14] *Willingness to Pay Analysis* (July 2012) and *Market Opportunities for Solar Portable Lights Study* (October 2012).

24. The LLL Program's retail network currently consists of 11 organizations selling high quality products (meeting the Lighting Africa Minimum Quality Assurance Standards) in peri-urban and rural Liberia. Additional market activity outside the project has started in the past few years, with a few specialized electronic and solar energy shops selling small numbers of pico-PV systems in downtown Monrovia, as well as several small convenience shops selling cheap, low-quality pico-PV products in public markets.

25. RREA's ultimate goal is to transition from a small public sector initiative to a large, sustainable, private-sector led, commercially viable market for high quality pico-PV products that meet the lighting needs of those who cannot obtain grid electricity. To reach this goal, a gradual transition is needed, where constraints are removed and private actors are given incentives to increase their responsibilities while bulk import by the RREA is scaled down.[15]

26. Several factors constrain importation by private actors and the growth of the market,[16] including: (i) lack of access to finance for importers, retailers, and consumers; (ii) lack of an enabling policy and regulatory framework; (iii) lack of national quality standards for PV products and the resulting risk of competition from low quality products; (iv) low levels of awareness of solar products and their advantages as well as ways to distinguish good quality products, especially in rural areas; (v) technical and business skills constraints; and (vi) high in-country transportation costs and lack of accessibility to rural markets during the rainy season due to poor road conditions and lack of distribution networks in rural areas.

27. The proposed Component would tackle these barriers through the following activities.

28. *Sub-Component 3A. Provision of financing for import of stand-alone solar systems (estimated cost US$2.3 million).* This sub-component would finance the continuation of bulk import of systems by RREA on behalf of the local retailers. In parallel, it aims to remove constraints[17] to the transfer of procurement and import responsibilities from RREA to the private sector.[18] The Component would cover the cost of shipment and importation, both when the importation is carried out by the RREA and by the private importers. In order to support long-term sustainability, this subsidy would be phased out during the life of the Project.

Subcomponent 3B. Creation of an enabling environment for commercialization of stand-alone solar systems (estimated cost US$0.7 million). This sub-component aims to promote an enabling environment for stand-alone solar systems by: (i) strengthening the national policy and quality assurance framework for stand-alone solar systems and fostering the competiveness of these products; (ii) carrying out public awareness campaigns to inform consumers of the benefits of solar lighting products and to educate consumers about good quality products; (iii) providing technical

[15] This transition needs to take place gradually. Actors interested in importing often do not qualify for loans due to the lack of business planning, creditworthiness and credit-capacity, limited cash flow history and lack of bookkeeping. Technical assistance will be provided to these actors to build their capacity in these areas.

[16] Constraints were identified in *Market Opportunities for Solar Portable Lights Study* (October 2012) and Local Retail Partners Business Capacity Assessment Report (August 2015)

17 Constrains include import duties imposed on private importers, unfavorable payment terms from the manufacturer to new importers, limited access to finance etc.

[18] In addition to Project support, RREA's own resources in the revolving fund based on incoming payments from retail sales could be made available to provide working capital to importers as sales volumes grow, allowing them to build a credit history that should facilitate obtaining commercial loans at a later stage.

assistance to importers and retailers to strengthen their technical knowledge and business and financial management skills. Special attention would be given to recruiting and training additional rural retailers to strengthen the distribution networks in rural areas; and (iv) providing technical assistance to RREA to strengthen its technical and financial capacity.

Exploring carbon results-based finance opportunities to support rural electrification

80. The funding needed to support access to electricity in Liberia is huge as as the country has one of the lowest electrification rate in the world, at less than two percent currently. Also, RREA is newly created agency that will need financial resources to accomplish the management and the coordination of rural electrification projects in Liberia. Therefore, the project will explore additional sources of financing that could support the implementation and ensure the sustainability of the business models, particularly when it involves private players. Carbon results-based finance is one of such sources of additional funding that could be considered. The potential for tapping additional funding from carbon-finance will be explored early in project implementation and the exact role that carbon finance could play to support the project objectives will be determined. Assistance, as needed, will be provided to RREA to explore available options to create a carbon asset out of the project interventions, particularly Component 1 and Component 3 which will generate emission reductions from renewable energy mini-grids and stand-alone solar systems.

81. The assistance would include: (i) assessing the eligibility for carbon finance for the mini-grids using various renewables technologies and for the pico-PV and solar home systems; (ii) developing a carbon crediting framework such as a Clean Development Mechanism (CDM) Program of Activities (PoA) that other similar initiatives that provide access to electricity to unserved population can join; and (iii) analyzing the potential purchase of carbon credits generated from this program through climate and carbon finance initiatives such as the World Bank's Carbon Initiative for Development (Ci-Dev) which targets energy access activities in Least Developed Countries or any other similar instruments that could rewards mitigation outcomes. Given transaction costs, this option would likely be viable by bundling this project with other renewable energy projects financed either by the Bank and/or other MDB and donors in Liberia, and using the specific methodology for access to measure emission reductions.

Annex 3: Implementation Arrangements
Liberia Renewable Energy Access Project (P149683)

Project Institutional and Implementation Arrangements

1. **Institutional Arrangements.** The Act establishing RREA as a permanent and autonomous agency wholly owned by the Government of Liberia was approved in July 2015. This act stipulates that a Board of Directors (BD) would be the governing body of RREA, with MLME as a member. Other members of the BD are: a representative of LEC, a representative of the Ministry of Justice, the Executive Director of RREA, three persons selected to ensure equitable geographic, demographic and gender representation of the country, three persons selected on the basis of their qualifications and experience, and one representative of civil society. Among other functions, the BD would oversee the Project, provide advice on strategic questions related to the Project's implementation, and facilitate strong inter-ministerial cooperation when necessary. The BD is expected to be appointed by the GoL in the coming months.

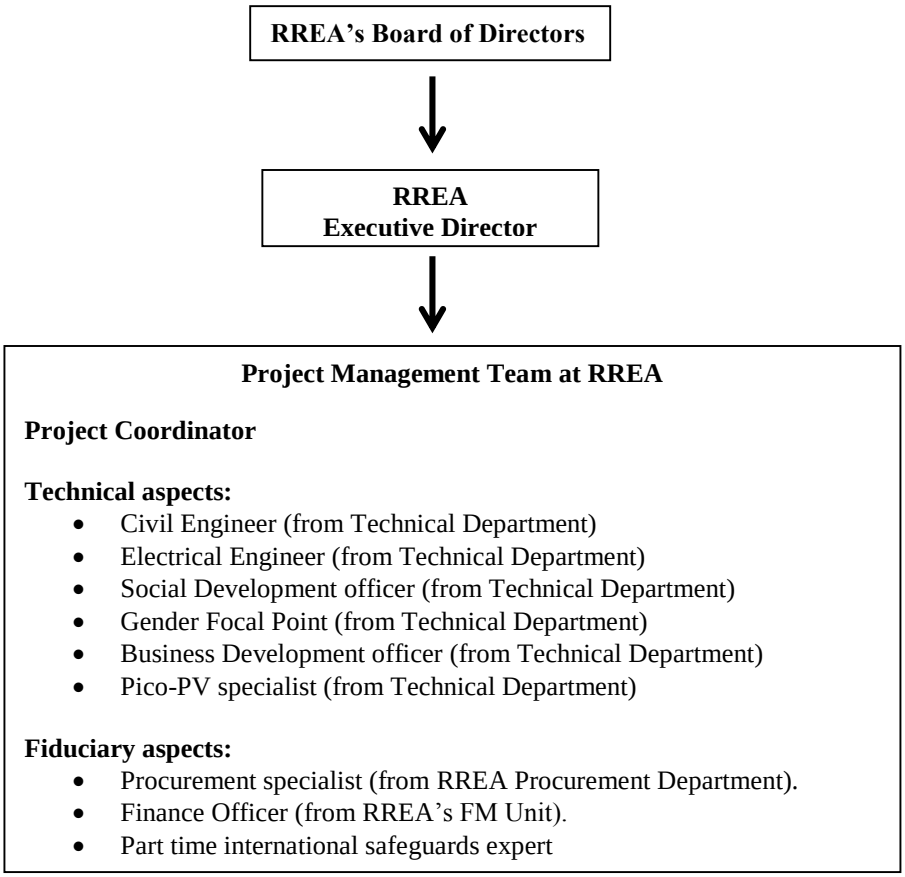
2. **Implementing Agency.** RREA is the entity responsible for the SREP in Liberia under the strategic leadership of MLME. In this context, RREA would be the Project implementing agency, assuming all fiduciary responsibilities and responsibilities for reporting to the Bank. It would liaise with MLME to ensure consistency between the activities financed under this Project and the sector policies for decentralized electrification. RREA would also coordinate with other donors supporting decentralized electrification, such as AfDB, USAID, Norway, and the EU, to maximize the synergies among the projects and avoid duplication in the use of resources. The role and responsibilities of the Project's implementing agency would be described in detail in the Project Implementation Manual (PIM) to be prepared by RREA prior to effectiveness.

3. A dedicated Project Management Team (PMT) in RREA would be responsible for the implementation of the Project. RREA would contract a Project Coordinator, who would work with the Agency's Technical Director and other technical and fiduciary staff already in place to implement the Project, including a pico-PV specialist hired to support the implementation of component 3. Four engineers have been hired and trained by NRECA with USAID financing; they are to be integrated into RREA's staff to build its institutional capacity. RREA would dedicate some of these engineers to be the technical experts in the PMT. Fiduciary analysts (FM and procurement) would be dedicated to the Project, but would report to the respective directors of RREA. Project implementation arrangements are represented in Figure 1 below.

4. RREA would be supported by an Owner's Engineer contracted under the Project. The Owner's Engineer would be responsible for reviewing bidding documents and would actively participate in the bidding evaluation, supervision of construction, as well as the supervision of implementation of the environmental and social mitigation measures. The Owner's Engineer will be funded by the Project.

5. **Project Implementation Manual.** The Project would be implemented in accordance with the Project Implementation Manual to be prepared by RREA prior to effectiveness.

Figure 1: **Project Implementation Arrangements**



Financial Management and Disbursements, and Procurement

Financial Management

6. The FM arrangement under the Liberia Lighting Lives Program being implemented by RREA would apply for the Project. The FM arrangements would ensure that: (1) the funds are used only for the intended purposes in an efficient and economical way; (2) accurate, reliable and timely periodic financial reports are prepared; (3) the entity's assets are safeguarded; and (4) adequate fiduciary assurances are provided through an independent audit of the Project.

Budgeting

7. The Project team, together with the accountant, would be responsible for preparing the annual work plan and budget based upon the agreed program to be financed. The key components are already known and these would be included in the Project annual work plan and budget to be cleared by the Task Team Leader (TTL).

Internal Controls and Audit

8. The already specified internal control procedures for transaction authorization by the appropriate officials of the RREA would apply for the Project. There should be clear segregation of duties for expenditure initiation, approval, and authorization. The centralized Internal Audit Agency of Liberia deploys internal auditors to the Project for periodic internal control activities and the internal auditor would prepare quarterly internal reports and furnish these to the Bank 45 days after the end of each quarter. As mentioned, a Project Implementation Manual would be developed prior to effectiveness; Project management would be expected to provide the detailed description of the internal control procedures in the Manual. The detailed description and segregation of duties for the core staff of the Project would also be included in the Manual.

Accounting and maintenance of accounting records

9. Accounting reports on the use of Project funds would be prepared by the Project team using the International Public Sector Accounting Standards (IPSAS) cash basis of accounting. This would be carried out using the Quick Books accounting system. The system would be capable of recording all accounting transactions for the Project and also capable of producing accurate periodic financial reports including interim un-audited financial reports (IFRs) and annual Project financial statements. The RREA would utilize its Chart of Accounts (CoA) in order to classify the Project expenses. A Project Fixed Assets register would be maintained at all times to correctly reflect assets acquired or created under the Project.

Periodic Financial Reporting

10. The RREA would prepare quarterly unaudited interim financial reports (IFRs) and submit them to the Bank 45 days after the end of each quarter in the IFR format currently used by the LLL Program. The Project would also prepare annual financial statements at the end of each fiscal year in accordance with IPSAS – cash basis. Project management would submit financial statements to the auditor no later than four months after the end of each fiscal year. These would comprise, at a minimum: (a) sources and uses of funds (summary of Expenditures shown under the main program headings and by main categories of expenditures for the period); (b) notes to the financial statements, including background information on the Project, the accounting policies, detailed analysis and relevant explanation of the main accounts/major balances, etc. In addition, the Project shall provide, as an annex to the financial statements, an inventory of fixed assets acquired according to asset classes, dates of purchase, location, and cost.

External Audit Arrangements

11. Annual audits would be conducted at the end of each fiscal year by independent and qualified auditors, acceptable to the Bank. The auditor would be selected to carry out the audit of the Project on a competitive basis and in accordance with the Bank's procurement guidelines. The auditor would be selected within four months of Project effectiveness. The ToR of the auditors would be cleared by the Bank. The Project financial statements including movements in the designated accounts would be audited in accordance with International Standards on Auditing (ISA) and a single opinion would be issued to cover the Project financial statements in accordance with the Bank’s audit policy. The auditors’ report and opinion in respect on the financial

statements, including the management letter, would be furnished to the World Bank within six months after the end of each fiscal year.

Disbursement

12. Funds would be disbursed directly into a Designated Account set up and managed by RREA. This account would be established in US Dollars at the Central Bank of Liberia or a commercial Bank acceptable to the Bank. The Accountant would submit withdrawal applications for the initial deposit and subsequent replenishment as per the Disbursement Letter. The Statement of Expenditure (SOE) disbursement method would be used as a basis for the withdrawal of Project funds. The Project provides for the use of advances, reimbursements, special commitments and direct payments as applicable disbursement methods, and these would be specified in the disbursement letter. An initial advance as per Disbursement Letter would be provided to the Project. Replenishments, through fresh withdrawal applications to the Bank, into the designated account would be made subsequently, at minimum of monthly intervals, but such withdrawals would equally be based upon documentation of prior funds received in the DA through an SOE. Supporting documentation would be retained by the RREA for review by the IDA missions and external auditors. Any advances made for contracts would be secured by a bank guarantee or performance-based bonds and a retention amount withheld.

Financial Management Project Risk Assessment and Mitigation

13. The table below shows the risks that may hinder the achievement of Project objectives, together with mitigating measures on how these risks would be addressed.

Table 1: Project Financial Management Risks and Risk Mitigation Measures

Element	Risk Mitigating Measures/Remarks	Residual Risk Rating
Funds not used for the purposes intended	The Project would be audited on annual basis and the auditor would express an opinion on whether the funds have been used for the intended purpose. Bank supervision would also test whether funds have used for intended purposes only.	Moderate
Delay in submitting quarterly IFRs.	The financing agreement would include the rendition of quarterly IFRs by the Project 45 days after end of each quarter.	Moderate
Internal controls would not be followed.	Segregation of duties for the core Project staff would be described in the Project implementation manual. The IAA would review the compliance by the Project on monthly basis and; issue quarterly internal audit reports.	Moderate
Wrong classification of Project expenses.	The RREA has a well-defined chart of accounts (CoAs) and a customized CoAs would be developed for the Project consistent with the RREA' CoAs.	Moderate
Slow disbursement rate	The Project accountant would be expected to submit withdrawal applications on at least a monthly basis.	Moderate

Procurement

A. General

14. Procurement for the proposed Liberia Renewable Energy Access Project (LIRENAP), which would be implemented by RREA, would be carried out in accordance with the World Bank's *"Guidelines: Procurement under IBRD Loans and IDA Credits*" dated January 2011 and revised July 2014; and *"Guidelines: Selection and Employment of Consultants by World Bank Borrowers"* dated January 2011 and revised in July 2014, and the provisions stipulated in the Legal Agreement. For each contract to be financed by the Grant, the different procurement methods or consultant selection methods, the need for pre-qualification, estimated costs, prior review requirements, and time frame are agreed between the Borrower and the Bank in a Procurement Plan. The Procurement Plans would be updated at least annually or as required to reflect the actual Project implementation needs and improvements in institutional capacity.

15. **Procurement of Works**. Works procurement valued at about US$21 million would be procured under this Project, including the construction of mini-grids in Lofa County.

16. **Procurement of Goods.** A total of about US$1.8 million of goods would be procured under this Project. This would include off-grid solar lighting systems which would be procured in batches.

17. **Procurement of Non-Consulting Services.** There would be no Non-Consulting Services.

Selection of Consultants. Consultancy services valued at about US$2.6 million is provided for the recruitment of various consultants such as of an Owner's Engineer and other Project staff. Consultancy firms will be selected using the following methods: (a) Quality-and Cost-based Selection (QCBS); (b) Quality Based Selection (QBS); (c) Fixed Budget Selection (FBS); (d) Least Cost Selection (LCS) and (e) Selection based on Consultants' Qualifications (CQS) for services estimated to cost less than US$300,000 per contract. .Selection of Individual Consultants (ICS) would be followed for assignments which meet the requirements of paragraphs 5.1 to 5.5 of the Consultant Guidelines. Single Source Selection (SSS) of Consultants would be followed for assignments which meet the requirements of paragraphs 3.8 to 3.11 of the Consultant Guidelines for firms, paragraph 5.6 of the Guidelines for individuals and will always require the World Bank's prior review regardless of the amount. Short lists of consultants for services estimated to cost less than US$100,000 equivalent per contract may be composed entirely of national consultants in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines if a sufficient number of qualified firms are available. However, if foreign firms have expressed interest, they would not be excluded from consideration.

18. **Training and Workshops.** All training programs, seminars, workshops, etc., would be procured based on the annual training plans, part of the annual work plan and budget (AWPB), subject to the Bank's review. The AWPB would identify the general framework of training and similar activities for the year, including the nature and objectives of training and study tours,

conferences, workshops, the number of participants, cost estimates, and the translation of the knowledge gained in the actual implementation of Project components.

19. **Operating Costs.** Incremental recurrent expenditures during Project implementation, including maintenance of vehicles, fuel, equipment, office supplies, utilities, consumables, banking charges, advertising expenses, internet service, car insurance, travel, per diems, and accommodations, but excluding salaries of civil and public servants, would be procured using the implementing agency's administrative procedures reviewed and found acceptable by the Bank.

B. Assessment of RREA's capacity to implement procurement

20. An assessment of the capacity of the Rural and Renewable Energy Agency (RREA) to implement procurement actions under the LIRENAP was carried out in August 2015 by the World Bank. Its procurement rules respond to the Public Procurement and Concessions Act (PPCA) of Liberia, which was enacted in 2005, and amended and restated in September 2010 and herein called 'The Amendment and Restatement of the Public Procurement and Concession Act, 2010. It provides a good legal framework for the conduct of transparent and comprehensive procurement. In response to the PPCA, RREA as a procurement entity has the required structures, i.e. a procurement unit and a procurement committee. Further, ad hoc evaluation panels are set up to evaluate bids and make recommendations to the Procurement Committee, as required by law, whenever there is a process that involves competition. The procurement and supply management functions are clearly distinguished, and RREA has auditing arrangements in-house. In addition, it has clear technical and administrative controls for reviews, approvals and decision making.

21. The Procurement Unit is headed by a Director who has gained some experience in World Bank procurement procedure from previous Bank projects such as Lighting Lives in Liberia (P124014) and Catalyzing New Renewable Energy in Rural Liberia (P118439). He is assisted by a procurement officer. It is envisaged that the Project would sponsor the Director of Procurement and the Procurement Officer to participate in the GIMPA workshop on World Bank procurement procedures in 2016 to sharpen their skills.

22. The overall procurement risk is **Moderate** for RREA procurement capacity.

Procurement Risk and Mitigation Measures

23. The key risk identified for procurement management and over signature powers is the uncertainty of retention of experienced procurement staff in World Bank Procurement procedures within the RREA Procurement Unit to carry out procurement activities of the Project. This risk can cause, possible delays in evaluation of bids and technical proposals leading to implementation delays, poor quality of contract deliverables and ineligible expenses. To mitigate this risk, RREA's management would sponsor the participation of its procurement staff in the Ghana Institute of Management and Public Administration (GIMPA) Workshop on World Bank procurement guidelines, in June 2016.

C. Procurement Plan

24. The Agency developed a procurement plan for Project implementation that provides the basis for the procurement methods. The plans have been agreed between the Borrower and the

World Bank and are available at RREA office. It would also be available in the Project's database and in the Bank's external website. The Procurement Plans would be updated in agreement with the Project Team annually or as required to reflect the actual Project implementation needs and improvements in institutional capacity.

Table 1: Thresholds, Procurement Methods, and Prior Review**

No	Expenditure Category	Contract Value Threshold**	Procurement Method	Contracts Subject to Prior Review /(US$)
1	Works	C>=3,000,000	ICB	All contracts
		100,000=<C<3,000,000	NCB	Specified contracts as would be identified in the approved Procurement Plans
		C<100,000	Shopping	Prior reviews of first 2 contracts
		All Values	Direct Contracting	All Contracts
2	Goods and services other than Consulting Services	C>=500,000	ICB / LIB	All contracts
		50,000=<C<500,000	NCB	Specified contracts as would be identified in the approved Procurement Plans
		C<50,000	Shopping	Prior reviews of first 2 contracts
		All Values	Direct Contracting	All Contracts
3	Consulting Services	C>=300,000 (firms)	QCBS	All contracts
		100,000=<C<300,000 (firms)	LCS, FBS, CQS and QBS	TORs and first three contracts
		C>=50,000 (individuals)	IC	All contracts
		C<50,000 (individuals)	IC	Only TOR (Except for the hiring of Lawyers and Procurement Specialists, TTLs have all clearance responsibilities
		All values	SSS	All contracts

4	Training, Workshops, Study Tours	All Values	Based on approved Annual Work Plan & Budgets (AWPB)	Approved by TTL when due

**These thresholds are for the purposes of the initial procurement plan for the first 18 months. The thresholds would be revised periodically based on re-assessment of risks.

25. *Contracts Disbursement Status Reports*. As part of the Project reports, the agency would submit contract management and expenditure information in quarterly reports to IDA. The procurement management report would consist of information on procurement of goods, works and consultants' services and compliance with agreed procurement methods. The report would compare procurement performance against the plan agreed at negotiations and, as appropriate, update at the end of each quarter. The report would also provide any information on complaints by bidders, unsatisfactory performance by contractors and any information on contractual disputes.

26. *Publication of Awards and Debriefing*. The results of the bidding process for all ICB/LIB, Direct contracts and also for consultant contracts estimated at US$200,000 and above, shall be published in the UNDB online in line with relevant paragraphs of the World Bank's Guidelines: Procurement under IBRD Loans and IDA Credits dated January 2011 and revised in July 2014; and Selection and Employment of Consultants by World Bank Borrowers# dated January, 2011 and revised in July 2014. In addition, all NCB contracts shall be published in the national Press. Publication of all other procurement activities, including debriefing and review shall be subject to the relevant stipulates in the Liberian Public Procurement and Concessions Law of 2005
27.

28. *Fraud and Corruption*. All procuring entities as well as bidders and service providers, i.e. suppliers, contractors and consultants, shall observe the highest standard of ethics during the procurement and execution of contracts financed under the Project in accordance with paragraphs 1.16 of the Procurement Guidelines and paragraphs 1.23 of the Consultants Guidelines.

Draft Procurement Plan (World Bank financed works only)
Details of the Procurement Arrangements Involving International Competition

Table 3: Goods and Works and non-consulting services

(i) List of contract packages to be procured:

Prior Review Threshold:

	Procurement Method	**Levels**	**Comments**
1.	Goods	= or > US$300,000.00	Prior review
2.	Works (if any)	= or > US$3,000,000.00	Prior review
3	Direct Contracting	All contracts	Prior review

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Ref. No.	**Contract (Description)**	**Estimated Cost US$**	**Procurement Method**	**Prequalification (yes/no)**	**Domestic Preference (yes/no)**	**Review by Bank (Prior / Post)**	**Expected Bid-Opening Date**	**Comments**
Component 1:								
01	Mini-grids in Lofa county (Voinjama-Foya-Kolahun and Massambolahun/Bolahun), including generation, distribution and connections	19,800,000	ICB	Yes	No	Prior	Jan 2017	
Component 3:								
02	Lighting Africa-approved off-grid solar lights (batch 1)	350,000	Direct Contracting	No	No	Prior	Aug 2016	

03	Lighting Africa-approved off-grid solar lights (batch 2)	350,000	Direct Contracting	No	No	Prior	Feb 2017	
04	Lighting Africa-approved off-grid solar lights (batch 3)	350,000	Direct Contracting	No	No	Prior	Aug 2017	
05	Lighting Africa-approved off-grid solar lights (batch 4)	350,000	Direct Contracting	No	No	Prior	Feb 2018	
06	Lighting Africa-approved off-grid solar lights (batch 5)	350,000	Direct Contracting	No	No	Prior	Aug 2018	
07	Lighting Africa-approved off-grid solar lights (batch 6)	350,000	Direct Contracting	No	No	Prior	Feb 2019	

(ii) ICB contracts estimated to cost above US$ 3,000,000 per contract for works, US$ 300,000 per contract for goods and non-consulting services, the first contract irrespective of the cost estimate and all direct contracting would be subject to prior review.

Table 4: Consulting services

Prior Review Threshold:

	Selection Method	**Prior Review Threshold**	**Comment**
1.	Selection of firms	US$ 200,000.00	Prior review
2.	Selection of individual consultants	US$100,000.00	Prior review
3	Single source for firms and individual consultants	All contracts	Prior review

1	2	3	4	5	6	7
Ref. No.	**Description of Assignment**	**Estimated Cost (US$)**	**Selection Method**	**Review by Bank (Prior / Post)**	**Expected Proposals Submission Date**	**Comments**
Component 1						
01	Owner's Engineer	1,000,000	QCBS	Prior	June 2016	
02	Elaboration of Business Plan and operation contract of Lofa County Electricity Service	100,000	QCBS	Prior	June 2017	
Component 2						
03	Development of regulation for rural electrification	100,000	QCBS	Post	June 2017	
04	External audit /Others	75,000	QCBS	Prior	Yearly	1st, 2nd and 3rd year of project
05	External audit /Others	50,000	QCBS	Prior	Yearly	4th and 5th year of Project
05	Project Coordinator	250,000	QCBS	Prior	Jan 2017	Salary funded through LESEP until December 2016
06	FM officer	50,000	QCBS	Prior	June 2016	
07	Procurement officer	60,000	QCBS	Prior	June 2016	
08	Safeguards specialist	200,000	QCBS	Prior	June 2016	
09	Mid-term review evaluator	150,000	QCBS	Prior	Dec 2018	
10	Pico-PV program specialist	250,000	QCBS	Prior	July 2016	Currently an expert is recruited by RREA, salary funded through LLL-GEF project until June 2016

11	RREA's support staff	45,000	QCBS	Post	July 2016	Severall positions in RREA
Component 3						
11	Fund manager	300,000	QCBS	Prior	June 2018	
12	Awareness and communication campaign	100,000	QCBS	Post	June 2017	
13	Training consultant	100,000	QCBS	Post	December 2016	

(iii) Consultancy services estimated to cost above US$200,000 per contract for firms and US$100,000 per contract for individual consultants, the first contract irrespective of the cost estimate and every single source selection of consultants (firms) for assignments would be subject to prior review by the Bank.

(iv) Short lists composed entirely of national consultants: Short lists of consultants for services estimated to cost less than US$ 200,000 equivalent per contract may be composed entirely of national consultants in accordance with the provisions of paragraph 2.7 of the Consultant Guidelines.

Monitoring and Evaluation

29. Overall monitoring and coordination of Project activities would be performed by RREA. This would be a key responsibility of the Project Coordinator in the Project management team. Activities to be monitored and reported on regularly include: the timely, efficient and transparent supervision of procurement and contract management; the construction and commissioning of the distribution lines and substations; effective implementation of the ESMP and RAP; successful completion of studies and training activities; and Project implementation including the agreed Project indicators. In addition, attention will be paid to generating sex-disaggregated data through RREA's data system to adequately monitor and report on the outcome and impact of improved energy services for female and male beneficiaries. Annex 1 presents the Project's Results Framework, which defines specific outcomes and results to be monitored under this Project.

Environment and Social Safeguards

30. The Project is safeguards category B as the proposed activities are small-scale, site-specific, and manageable. No adverse long-term impacts are anticipated.

31. The net social effect of the Project is expected to be highly positive, as greater access to electricity would significantly improve the beneficiaries' living conditions in these areas. New households would be connected through a mini-grid providing 24 hour daily electricity as would businesses and institutional users (local government, schools, health centers, etc.).

32. Expected environmental, health and safety impacts would be small. Main concerns raised would be listed, based on the conclusions of the ESMF and RPF, and would be addressed through the preparation of an ESIA, which includes an ESMP and the applicable EHSGs.

33. The Project triggers three safeguards policies: Environmental Assessment (OP 4.01), Involuntary Resettlement (OP 4.12.), and Physical Cultural Resources (OP 4.11).

Safeguard policies triggered

Safeguard Policies	Yes	No	TBD
Environmental Assessment (OP/BP 4.01)	x		
Natural Habitats (OP/BP 4.04)			x
Forests (OP/BP 4.36)		X	
Pest Management (OP 4.09)		X	
Physical Cultural Resources (OP/BP 4.11)	x		
Indigenous Peoples (OP/BP 4.10)		X	
Involuntary Resettlement (OP/BP 4.12)	x		
Safety of Dams (OP/BP 4.37)		X	
Projects on International Waterways (OP/BP 7.50)		X	
Projects in Disputed Areas (OP/BP 7.60)		X	

34. RREA is preparing a Resettlement Policy Framework (RPF) to address the social impacts related to potential land acquisition and/or resettlement and losses of assets or access to resources and given that the physical footprint of the civil works is not known. The RPF includes the

guidelines and procedures for compensation and/or resettlement in the event that future activities should require land acquisition, involuntary resettlement, or cause restriction of access to livelihoods or assets and resources. It contains (i) an assessment of the country regulatory and institutional framework for land acquisition and compensation; (ii) likely categories of affected assets and parties as well as the scope of impacts on women and men; (iii) a gap analysis and a compensation framework consistent with OP 4.12 and the national legislation; (iv) measures to assist vulnerable groups, including women; (v) a consultation framework to enable the participation of affected populations in the preparation of specific resettlement plans; (vi) an institutional framework to implement the resettlement policy framework; (vii) a grievance redress mechanism; and (viii) a monitoring and evaluation framework and budget. In case any land acquisition or compensation becomes necessary, the cost would be covered by the Government. The RPF would be consulted upon and disclosed in country and in the Bank's Infoshop after approval by the Bank prior to appraisal. The RPF is being prepared and the report is expected to be submitted for Bank review by October 21.

35. The RPF would guide the elaboration of a Resettlement Action Plan (RAP), if needed, which would be carried out during Project implementation when the feasibility studies have been finalized and the location of the hybrid mini-grid facilities and their social and gender impacts are known.

36. An Environmental and Social Management Framework (ESMF) is also being prepared to identify the potential impacts of Project activities, especially the impacts of the mini-hydropower plant. The ESMF is being elaborated and the draft will be submitted for Bank review by the 21 of October. It is expected that the environmental, health, and safety impacts would be low and concern mainly health and safety issues during construction. The World Bank Group General Environmental, Health and Safety Guidelines (EHSGs) would be applied, as well as other applicable EHSGs. The ESMF contains a screening mechanism to identify if an Environmental and Social Impact Assessment (ESIA) would need to be prepared during Project implementation. The screening mechanism includes the screening for the presence of Physical Cultural Resources, which could be graves or sacred forests.

37. The preparation of the safeguard documents (i.e., ESMF, RPF) follows a broad-based and in-depth consultation approach that include interviews with relevant Project stakeholder groups, in particular: local communities and mayors, potential Project affected people (PAPs), including vulnerable groups such as women and local NGOs, and other interested parties. This consultation approach would be carried on throughout Project implementation and supervision and will be the beneficiary feedback mechanism. Main concerns raised would be listed, based on the conclusions of the ESMF and RPF.

38. Climate and Disaster Risk Screening has been completed for the proposed Project. The screening identified current and future identified key drivers of risks as extreme temperatures and extreme flooding caused by precipitation. The team has ensured that the technical specifications for equipment would take into consideration these risks, especially the future temperature increase. For the expected civil works and substations, technical specifications of drainage systems would account for expected increased flooding. Finally, there would be strengthening of the capacity to maintain the system with focused training on extreme events and how to do preventive maintenance (e.g., cleaning of drainage infrastructure before rainy season).

Disclosure

39. The ESMF and RPF will be disclosed in-country and at the World Bank InfoShop prior to appraisal. The subsequent ESIAs and RAPs would be reviewed and cleared by the Liberian Environmental Protection Agency and the World Bank, and then disclosed in-country and in the Bank's Infoshop before any construction can start.

Arrangements for safeguards monitoring

40. Coordination and implementation of the Project's environmental and social safeguards related to component 1 of the Project would be carried out by RREA, which would recruit environmental and social specialists to be responsible for overseeing Project compliance with the environmental and social guidelines established under the ESMF and RPF related to component 1 in accordance with national and Bank policies and procedures. These new staff would be trained on World Bank safeguards requirements. RREA would ensure adherence to the safeguard documents of all entities involved in the implementation of the Project, including contractors. All contractor bidding documents would include specific environmental and social clauses to be strictly followed during the implementation phase. The contractors would need to prepare and implement their own Contractor Environmental and Social Management Plan (CESMP). In all cases, the Supervising Engineer would need to be contractually made responsible for the adequate implementation of the Environmental and Social Clauses and for the CESMPs. World Bank supervision teams would also include environmental and social safeguard experts.

Annex 4: Implementation Support Plan
Liberia Renewable Energy Access Project (P149683)

1. **Strategy and Approach for Implementation Support.** The strategy for implementation support has been developed on the basis of the nature of the Project and responds to its complexities given a low capacity for implementation and a challenging environment due to the fragile situation in the country. The implementation support's objective is to ensure that government agencies involved properly implement the Project. It also ensures that the World Bank's resources and staff are sufficient to supervise and support this implementation.

Implementation Support Plan

2. Most of the procurement activities and contracting would be carried out in the early period of Project implementation. Therefore the first two years of the Project implementation would require efforts to review technical, procurement, and safeguard documents as well as to ensure NRECA's technical assistance is aligned with the Project and the safeguards measures are correctly applied. It would also ensure proper application of the Project Implementation Manual. The detailed support from the Bank team during Project supervision is outlined below. The Bank team would include headquarters (HQ) and country office-based staff and consultants.

3. The Bank would carry out a mid-term review after about 30 months from effectiveness and prepare an Implementation Completion and Results Report at the end of the Project.

Main Areas of Supervision

Procurement and technical aspects

4. World Bank procurement specialists would regularly participate in implementation support missions to assist in monitoring procurement procedures and plans. The procurement plan would indicate those contracts which are subject to prior review. All other contracts would be subject to post-review. During the early phase of the Project implementation, more frequent supervision is envisaged in order to ensure that the Project management team at RREA follows procurement guidelines. The Bank team would include a Bank staff engineer, in order to review technical specifications and proposals. It is expected to do field supervision of the construction sites. During th regular implementation support missions, the procurement plans would be updated at least once each year (or more often as required to reflect the actual Project implementation needs) and post-procurement reviews would be carried out at a minimum once annually.

5. The Bank team would provide implementation support for: (a) reviewing procurement documents including technical specifications and providing timely feedback and no objection; and (b) monitoring procurement progress against the Procurement Plan developed by RREA. During Project implementation, World Bank supervision would be required in order to ensure that procurement is conducted in accordance with the Bank's procurement procedures. Post procurement review would be conducted at the end of the first year and annually thereafter on all contracts below the prior review threshold. Bank supervision should be done every six months.

Financial management aspects

6. Consistent with the risk rating an annual FM implementation support mission would be carried at RREA for the Project. The FM supervision missions' objectives would include reviewing the financial management systems maintained for the Project.

Environmental and social aspects

7. Environmental and social safeguards staff would supervise subproject preparation and implementation during one to two implementation support missions during the pre-construction and construction phases per year. Missions would include visits to Project areas and the monitoring of mitigation measures. During construction, supervision will continue to ensure compliance with environmental and social safeguards related to the infrastructure projects.

Overall Support Implementation Needs

8. The Bank team will be composed of a mix of skills and experience for successful Project implementation. The table below outlines the expected staff weeks and travel required to make sure the actions and schedule are appropriately resourced.

Table 1: Supervision Needs

Time	**Focus**	**Skills Needed**	**Resource estimate (US $ 000)_**	**Partner Role**
First twelve months	Establishment of the Project management team at RREA.	Task Management	120	
	Review procurement of main construction contracts	Technical (hydropower and electrical)		
	Definition of Business Plan of mini-grids	Economic analysis		
	Implementation of environmental and social safeguard studies – EIA, and RAP as required.	Safeguards		
	Development and improvement of FM/Procurement systems	Financial Management and Procurement		
	Gender mainstreaming actions	Gender and Energy	40	
12-60 months	Technical implementation support	Energy Specialist and Hydropower Engineer	550	

	Social and environmental safeguard implementation support Development of regulation for rural electrification M&E implementation support Financial management & procurement implementation support	Social Safeguard Specialist & Environmental Specialist Rural electrification specialist M&E Specialist FM Specialist & Procurement Specialist		

Table 2: Estimated Staff Required During Supervision

Skills Needed	Number of Staff Weeks	Number of Trips per year	Comments
Team Leader	55	2	HQ based
Hydropower Engineer	16	1	HQ based
Electrical Engineer	20	0	Country office based
Procurement Specialist	20	2	Based in region
Financial Management Specialist	20	0	Country office based
Environmental Specialist	15	1	
Social Specialist	20	2	
Gender Specialist	15	2	

Annex 5: Economic and Financial Analysis
Liberia Renewable Energy Access Project (P149683)

1. This annex provides an economic and financial analysis for the decentralized electrification activities (Component 1) as well as for the market development of stand-alone systems (Component 3).

Methodology and Assumptions

2. Economic cost benefit analysis was used for Components 1 and 3. Costs were adjusted to remove financing costs, duties and taxes while economic benefits were based on a conservative approach using an avoided cost methodology derived mainly from survey results. With respect to financial analysis, a standard project financial model was applied to the mini-grid options to determine the tariff necessary to cover the operating and maintenance cost on a sustainable basis and deliver an adequate rate of return after the capital costs had been fully subsidized by the grant. In the case of pico-PV and solar home systems, a financial analysis was conducted from the point of view of the retailers of SHS.

3. The following table presents a summary of the macroeconomic assumptions used in the economic and financial models:

Table 1: Main macroeconomic (first 10 yrs only)

		1	2	3	4	5	6	7	8	9	10
Macroeconomic											
Liberia Inflation (CPI)	%	9.7%	7.3%	6.5%	6.5%	6.3%	6.0%	6.0%	6.0%	6.0%	6.0%
Liberia Inflation (Index)		100	107	114	122	129	137	145	154	163	173
US Inflation (CPI)	%	2.1%	2.1%	2.2%	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
US Inflation (Index)		100	102	104	107	109	111	113	115	118	120
Forex Nominal	LRD/USD	85	89	93	97	101	105	109	113	118	123
Nominal devaluation rate	%		5.1%	4.2%	4.3%	4.2%	3.9%	3.9%	3.9%	3.9%	3.9%
Forex Real	LRD/USD	85	85	85	85	85	85	85	85	85	85
Real devaluation rate	%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Crude Oil Scenario (real)	USD/bbl	57.5	61.2	63.7	66.3	69.1	71.9	74.9	78.1	81.3	84.7
Diesel (nominal - pre-tax)	USD/lt	0.60	0.66	0.71	0.77	0.83	0.89	0.96	1.03	1.11	1.20
Carbon price (real)	USD/tCO2	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Tax on fuel	%	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0

Economic and Financial Analysis of Component 1

4. *Economic analysis*. The economic analysis for this component measures the costs and benefits of providing electricity access to selected areas of Lofa County in northern Liberia. Currently, there is no electricity service to this area, thus the population satisfies their energy needs by using diesel generators, kerosene lamps, candles, and dry cell batteries for lightning or communication.

5. The economic analysis was performed for various mini-grid options on the basis of discounted cash flow in real 2015 US$ over a 20 year period. The main economic costs of the

Project include the capital investments and operation and maintenance activities, both excluding the impact of any tax or subsidy for the purposes of the economic analysis.

6. Based on data from a preliminary survey of demand in Lofa County and data from other areas, it is estimated that 96 percent of the customers of the mini-grids in Lofa County would be households, 3.6 percent would be businesses, and 0.4 percent would be institutional customers.

7. The approach followed to estimate the economic benefits of the beneficiaries of the Project is to estimate these benefits conservatively on the basis of avoided costs. With this methodology, the estimated economic benefits for households are defined by the amount that they actually pay today for energy services that can be substituted by electricity from the mini-grid including dry cell battery powered lanterns, kerosene lamps, wood, charcoal, and/or candles. For businesses and institutions that now use diesel generators, the benefit would be estimated as the avoided economic cost of generating electricity using diesel or gasoline generators, based on economic capital and fixed operating costs of generation equipment, and using the border price of diesel plus economic cost of diesel transport to site.

8. For households, the estimated benefits are based on current information on energy expenditures in Liberia plus some conservative assumptions. According to information provided by the electricity utility in Monrovia, the monthly average bill of low-income customers is around US$11, with an average demand of 20 kWh/month. It should be noted however, that Monrovia consumers pay a tariff that is considerably higher than the tariff expected in the Project's mini-grid, where the capital costs would be covered by a grant. However, the Monrovia information on monthly expenditures is in line with survey information[19] where the average current energy expenditure per month for electricity substitutes by households in Liberia is estimated at US$12 (see Table 2 below).

Table 2: Energy Consumption, Expenditure and WTP, USUS$—Rural Survey

	HH Using	% of Sample	Avge kWh/Month - Users	Avge kWh/Month - Sample	Avge Cost/kWh	Avge Spent per Month - Users	Avge Spent per Month - Sample	% and Average WTP/kWh
Electric Bulbs	45	2.9%	10.28	0.30	$1.39	$14.23	$0.42	3.5%
DC Battery Lamps	974	63.5%	4.26	3.24	$1.60	$6.83	$4.86	40.8%
Kerosene Lamp	148	9.6%	0.30	0.03	$18.00	$5.37	$0.65	5.5%
Palm Oil Lamp	108	7.0%	0.10	0.01	$20.67	$2.11	$0.25	2.1%
Candles	137	8.9%	0.07	0.01	$137.21	$9.33	$0.83	7.0%
Other Electric	73	4.8%	36.76	1.75	$1.58	$57.93	$2.76	23.2%
Other Battery	710	46.3%	0.35	0.16	$10.43	$3.62	$2.13	17.9%
				5.49			$11.90	$2.17

Source: World Bank (2012) – Liberia and energy access: a willingness to pay analysis

9. The survey showed that households outside of Monrovia were consuming, on average, the equivalent of 6kW/h per month of poor quality lighting and other energy services and were paying US$12 per month for these services. With the mini-grids, households would have access to more and better quality energy services from grid connected electricity and would be willing to pay at least as much as they paid for poor quality service. The economic analysis assumes that decentralized household demand in the target areas would reach an average demand of 20 kWh/month in the fifth year of Project implementation, as families gradually buy more electrical

[19] World Bank (2012) – Liberia and energy access: a willingness to pay analysis.

equipment. We assume that the economic benefit from these services would be US$11 per month for these services, the same amount that poor households in Monrovia pay and slightly less than households pay today for inferior energy services. After the fifth year, it is assumed that residential demand keeps growing for three more years at 1.5 percent per year.

10. According to the preliminary electricity demand survey in Lofa region and other areas, business customers were assumed to consume an average of 144 kWh/month and institutional customers 3148 kWh/month on average. These demands were assumed to grow at 1.5 percent per year for the first eight years after Project implementation.

11. The economic analysis has considered, when relevant, the negative environmental impact of CO_2 derived from the need to use diesel generation as a back-up. Following a conservative approach, it has not considered the positive environmental impact of the displaced self-generation or other positive externalities directly or indirectly derived from this Project due to the limits of the information available to perform an estimation on a reasonable basis.

12. The table below contains a sample spreadsheet for the economic analysis of one of the most promising mini-grid options, the Voinjama-Foya Kolahun-Massambolahun/Bolahun mini-grid.

Table 2 – Economic Analysis of Voinjama-Foya Kolahun-Massambolahun/Bolahun mini-grid

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Economic Flows (real USD)																					
Benefits																					
Willingness to Pay																					
Residential	000 USD	0	0	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521	1,521
Commercial	000 USD	0	0	2,742	2,865	2,997	3,132	3,278	3,431	3,540	3,654	3,772	3,895	4,023	4,157	4,296	4,442	4,593	4,750	4,915	5,086
Plantations	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**000 USD**	**0**	**0**	**4,263**	**4,385**	**4,517**	**4,653**	**4,798**	**4,952**	**5,061**	**5,174**	**5,293**	**5,416**	**5,544**	**5,678**	**5,817**	**5,962**	**6,113**	**6,271**	**6,435**	**6,606**
Costs																					
CAPEX																					
Hydro	000 USD	-6,488	-4,552	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,072
Solar	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	000 USD	-433	-859	0	0	0	0	-1,310	0	0	0	0	-1,310	0	0	0	0	-1,310	0	0	0
Transmission line	000 USD	-1,098	-1,075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,195
Connections	000 USD	-1,946	-1,906	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,119
Subtotal	*000 USD*	*-9,964*	*-8,391*	*0*	*0*	*0*	*0*	*-1,310*	*0*	*0*	*0*	*0*	*-1,310*	*0*	*0*	*0*	*0*	*-1,310*	*0*	*0*	*9,385*
OPEX																					
Generation																					
Hydro	000 USD	0	0	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150	-150
Solar	000 USD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	000 USD	0	0	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57	-57
Fuel Cost	000 USD	0	0	-347	-432	-527	-564	-604	-648	-685	-724	-766	-810	-857	-907	-961	-1,018	-1,079	-1,144	-1,213	-1,287
Subtotal	*000 USD*	*0*	*0*	*-554*	*-639*	*-734*	*-771*	*-812*	*-855*	*-892*	*-931*	*-973*	*-1,017*	*-1,064*	*-1,115*	*-1,168*	*-1,225*	*-1,286*	*-1,351*	*-1,421*	*-1,495*
Distribution																					
Fixed O&M Costs	000 USD	0	-86	-115	-114	-113	-112	-111	-110	-109	-108	-107	-106	-105	-104	-103	-103	-102	-101	-100	-99
Subtotal	*000 USD*	*0*	*-86*	*-115*	*-114*	*-113*	*-112*	*-111*	*-110*	*-109*	*-108*	*-107*	*-106*	*-105*	*-104*	*-103*	*-103*	*-102*	*-101*	*-100*	*-99*
Total	**000 USD**	**-9,964**	**-8,477**	**-669**	**-753**	**-847**	**-883**	**-2,232**	**-965**	**-1,001**	**-1,039**	**-1,080**	**-2,433**	**-1,170**	**-1,219**	**-1,272**	**-1,328**	**-2,698**	**-1,452**	**-1,521**	**7,791**
Annual Benefit / Co	**000 USD**	**-9,964**	**-8,477**	**3,594**	**3,632**	**3,671**	**3,770**	**2,567**	**3,987**	**4,060**	**4,135**	**4,213**	**2,983**	**4,375**	**4,459**	**4,545**	**4,634**	**3,416**	**4,819**	**4,914**	**14,398**

NPV (@DR)	**000 USD**	**11,469**
EIRR	%	18.0%

13. *Sensitivity analysis of economic analysis*. A sensitivity analysis was undertaken to test the robustness of the results of the economic and financial analysis to changes in the key parameters The analysis was performed following a "break-even" methodology under which for every scenario, the sensitivity value chosen is stressed until the expected NPV (at a 10 percent discount rate) of the mini-grid is equal to zero. Alternatively explained, the analysis tries to answer the following question: how much can this input variable change while maintaining the economic viability of the Project?

14. Variations in the following parameters for the economic analysis of the Voinjama-Foya-Kolahun-Massambolahun/Bolahun mini-grid case shown in Table 3 were considered in the sensitivity analysis:

- Delay of construction of the mini-grid
- Investment cost increase
- Decrease of number of connections
- Plantations owners buy 25 percent of the hydropower generation surplus during the wet season to replace more expensive diesel-based generation
- Reduction of monthly budget to buy electricity available for households
- A combination of the last two parameters

15. The results of the sensitivity analysis are presented in Table 3 below.

Table 3: Results of the sensitivity analysis of mini-grid Voinjama-Foya-Kolahun-Massambolahun/Bolahun Hydro with diesel

Sensitivity	Description	Result	Comment
Commissioning delay	The mini grid is constructed on time but commissioning is delayed	4 yrs	The mini-grid would be economically viable if the commissioning is delayed up to 4 years.
Investment cost increase	A general cost overrun occurs during construction process	+72%	The mini-grid could absorb a 72% increase in CAPEX and maintain economic viability. This is a low risk since base case already includes 30% contingencies.
Decrease in number of connections	Reduction in number of customers	-35%	The mini-grid could absorb a 35% reduction in connections (including commercial) and maintain economic viability.
Plantations	Plantations buy 25% of the hydropower surplus during wet season	+138%	Additional demand from the plantations during the wet season, would result in a 138% increase in the economic NPV of the Project.
HH electricity demand	A reduction in household electricity demand	-100%	The residential demand could decrease 100% and the economic viability of the mini-grid would be maintained (solely with commercial demand).
HH electricity demand w/plantations	Same as the previous but assumes plantations are part of the demand scenario	-75%	If plantation demand is included, then the mini-grid could absorb a 75% reduction in residential demand and be economically viable.

16. *Financial analysis.* The financial analysis uses a standard project financial model to determine the discounted cash flow to the mini-grid in nominal US Dollars. Such an analysis has been performed for each of the mini-grid technology options to determine the average electricity tariff that must be charged be charged to the customers in order to ensure its long-term sustainability. This tariff was calculated to generate the revenue required to recoup generation costs, cover commercial and maintenance activities including replacement of batteries and equipment, non-technical losses, allow the operator to expand the system (an amount of 3 percent of non-hydro capital costs, including diesel generation, distribution lines and connection costs, is included in the required revenues each year to finance this expansion), and ensure a financial rate of return equal to 14 percent (pre-tax current USD) after the grant has been applied to the full capital costs of the mini-grid.

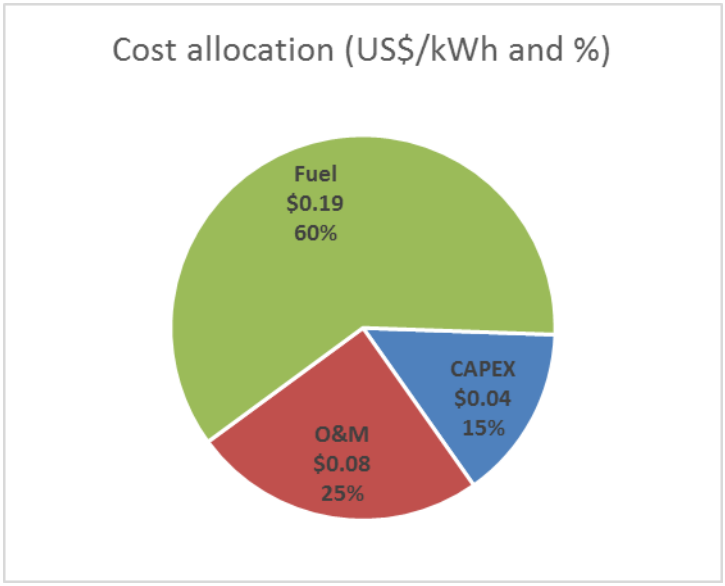
17. The financial analysis was carried out assuming (further to the assumptions already presented in the economic analysis section):

- 20 percent tax for diesel used for generation;
- Full initial capital expenditures subsidized by grants (subsequent capital expenditures for diesel based generation required to expand access to new users are included in the tariff component);
- No other subsidy.

18. Based on current information, the best option for investment in this Component would be the Voinjama-Foya-Kolahun-Massambolahun/Bolahun mini-grid with hydropower and diesel (highlighted in the Table) with an EIRR of 18 percent, a NPV of US$11.5 million at 10 percent discount rate and an affordable tariff at 26 US cents/kWh. While the tariff may appear high compared to some other larger electricity systems in other countries, it is low in relation to the US$0.52/kWh tariff average tariff in Liberia.

19. The tariff reflects the conservative approach taken to ensure sustainability, including full coverage of fuel costs for diesel in the dry season (US$0.19/kWh), commercial, operating and maintenance costs (US$0.08/kWh) and an allowance to finance expansion of the system by the operator (US$0.04/kWh) as presented in the figure below. Based on the analysis of this case, the average household served by this mini-grid would pay an affordable US$5.20 per month for 20 kWh of electricity compared to the US$11.90 currently paid monthly for poor quality energy services. This tariff is expected to provide new grounds for productive uses of electricity, not captured in this model due to conservative assumptions.

Figure 1 – Cost allocation of the tariff in the financial model[20]



20. *Summary of economic and financial analysis component 1*. As noted in Annex 2, various options for mini-grid sites and technology configurations are being studied in an ongoing pre-feasibility study. The final selection will be made when the results of the study are made available.

[20] Calculated as the NPV of costs divided the NPV of electricity collected

21. *Sensitivity Analysis*. For the financial analysis a sensitivity on the impact of the tax on diesel used for generation was implemented. For the sensitivity analysis it is assumed that the tax on diesel is reduced from 20% (base case) to 0%.

22. The results shows that eliminating the tax on diesel, a 10% decrease in the average electricity tariff could be achieved – from 0.26 USD/kWh to 0.23 USD/kWh.

Economic Analysis of Component 3

23. This section presents the economic analysis of component 3: market development of stand-alone solar systems.

24. The simplest approach is to assess economic benefits as the avoided costs of the energy services purchased today by consumers without electricity that would be replaced by the pico-PV products. Meeting the existing lighting needs of consumers was analyzed, including current use of dry cell battery powered lanterns, kerosene lamps, and candles. Such an analysis provides a lower bound for the economic benefits, because it does not account for the fact that the pico-PV systems provide a greater level of service by providing more lumens of better quality light compared to the energy sources that they replace as well as allowing charging of mobile phones (however, no productive uses of electricity can be envisaged from these products). The expenditure information for estimating avoided costs is taken from a study on lighting market development commissioned by the World Bank in 2012.[21]

25. Since the lighting quality of alternative light sources is different, the cost-effectiveness analysis compares the cost of equal lighting output measured in dollar per thousand kilo-Lumen hours ($/kLh). The estimated cost per kLh light output of the alternative lighting sources and the analytical process for obtaining these cost estimates is presented in the Table 5 below. The estimated cost per unit light output of the using solar lighting sources was found to be the lowest (0.04 – 0.08 $/kLh) compared to equivalent lighting provided by alternative sources (see Table 6). There is a clear cost advantage for pico-PV products on the basis of equivalent lighting provided.

Table 5: Economic analysis of lighting alternatives

	PV Led lamp 1*3W Led	**PV Led lamp** 4*3W Led	**Lantern powered by dry cell batteries** (3 * type D)	**Kerosene Lamp**	**Candles**
Consumption / replacement	1 pack every 5 yrs	1 pack every 5 yrs	1 lamp per year 6 batt per month	1 lamp every year 3.45 l per month	49 units per month
Light output (lumens)	110	200	61	45	8
Daily usage	4	7	7	5	4

[21] Renewable Off-Grid Power & Lighting Market Development in Liberia (2012)

Annual service provided	160,600	511,000	155,855	82,125	11,680
First and recurrent costs	$30 every 5 yrs	$175 every 5 yrs	$5 for lamp $1 each batt	$1 for lamp $1.45/ltr	$0.19 per unit
Annualized cost (10% Disc. rate)	$7.91	$46.16	$77.00	$57.38	$111.72
Unit cost ($/kLh)	$0.045	$0.09	$0.49	$0.70	$9.57

26. In addition to the estimated economic benefits of pico-PV products, there are significant environmental and health benefits in comparison with the alternatives based on fossil fuel or disposal batteries that are difficult to quantify. These benefits include reduced greenhouse gas emissions, reduce risk for indoor pollution and fire hazards as well as reduced amount of hazardous waste.

27. Previous experience shows that there is a strong market potential for pico-PV products, with an estimated demand of at least 15,000 units per year for the following five years. Assuming an individual replaces one lantern powered by dry cell batteries with two pico-PV lamps – which provide approximately the same level of service over the same amount of hours per day – then the economic benefit can be estimated in approximately US$61 per year.

28. For simplicity, the economic analysis of this Component assumed that the 75,000 pico-PV systems[22] expected to be sold under the Project would replace 37,500 battery powered lanterns (two PV LED lanterns of the type in column one of the table above are assumed to replace one battery powered lantern of the type in column 3) [23]. An economic cashflow analysis was done in real 2015 US$ for the component, with the costs measured by the costs of the PV systems net of duties and taxes. The benefits were measured as the avoided economic costs of the battery powered lanterns replaced by pico-PV lamps. The NPV over the five year life of the PV LED systems sold under the Project totals US$4.2 million, discounted at 10 percent. It is not possible to calculate an EIRR for this component as the net benefit stream is positive in all years. The economic cost of the PV LED lamps is recovered within the first year, making this a highly attractive investment for lighting services.

Financial Analysis of Component 3

29. The financial analysis assumes that the project's retail network will consist of 11 organizations selling high quality products in peri-urban and rural Liberia, mostly during the dry season, consistent with current situation. Also, it assumes the lifetime of the project will be five years, at the end of which it is expected that the market participants would have accumulated enough capital to phase a gradual transition where private actors are incentivized to increase their responsibilities while the support by RREA is scaled down.

[22] The economic and financial analysis use the conversion of 1.8 person given access per solar PV system. The conversion factor is based on current distribution of systems and the SE4ALL and Lighting Global access framework.
[23] Pico-PV lamps are expected to have a substantial life at lab tests (95 percent of the lamps are expected to last 5 years. However, in real life the mortality rate of pico-PV products is expected to be much higher. For the economic analysis a 25 percent mortality rate per year was assumed.

30. The Project will promote the sale of pico-PV systems through the financing of bulk import of systems by RREA on behalf of the local retailers. This means that the local developers are expected to count with an initial – small– amount of capital to finance: (i) an initial purchase of pico-PV products to RREA; (ii) purchase some necessary equipment to perform sales (laptops, mobile phones, etc.); and (iii) retain some money for working capital needs.

31. The financial analysis also assumes:

a. Local retailers buy and sell pico-PV products in cash, no further credit is available.
b. The annual estimated sales of pico-PV products is 15.000 units at a selling price of 32.5 USD/unit and a purchase price of 24.4 USD/unit[24]
c. The project provides a subsidy for the transport costs (difference between FOB and CIF prices) estimated at 4.88 USD/unit. However, this subsidy is faced off in two years at 50% rate per year. A full pass-through of the transport cost to the selling price is further assumed.
d. Each local retailer starts the business with an equity injection of US$6,000;
e. Once the program has started, operational expenses are estimated at US$9,000/year per retailer.

32. The financial analysis of this component will be developed by preparing consolidated financial statements – assuming all 11 retailers comprise a single company – and including, further to the calculation of NPV and internal rate of return, typical financial ratios like return on assets, return on equity, and net margin. The table below presents the results for the base case scenario:

Table 6: Projected financial statements (in nominal USD)

P&L Statement	0	1	2	3	4	5
Revenues	-	539,948	600,752	622,413	645,281	669,451
Costs						
Cost of sales	-	(415,410)	(473,101)	(491,571)	(511,168)	(531,985)
Operating Expenses		(101,475)	(104,012)	(106,612)	(109,277)	(112,009)
Total	-	(516,885)	(577,113)	(598,183)	(620,445)	(643,994)
EBITDA	-	23,062	23,639	24,230	24,836	25,457
Depreciation		(1,000)	(1,000)	(1,000)	(1,000)	(1,000)
Financial expenditures	-	-	-	-	-	-
EBT	-	22,062	22,639	23,230	23,836	24,457
Taxes	-	(4,633)	(4,754)	(4,878)	(5,006)	(5,136)
Profits	-	17,429	17,885	18,352	18,830	19,321
Balance Sheet						
Assets						
Cash	61,000	67,196	72,879	78,702	84,669	2,461
Acc Receivable	-	-	-	-	-	-

[24] For simplicity the financial model assumes the retailers only sell the D. Light Solar S250 that has a buying price of US$24.4/unit (CIF) and an average selling price of US$32.5/unit in Liberia.

Net fix assets	5,000	4,000	3,000	2,000	1,000	-
Total Assets	66,000	71,196	75,879	80,702	85,669	2,461
Liabilities						
Financial Debts	-	-	-	-	-	-
Taxes to pay	-	2,225	2,282	2,340	2,399	2,460
Other payable	-	-	-	-	-	-
Total Liabilities	-	2,225	2,282	2,340	2,399	2,460
Equity						
Capital	66,000	66,000	66,000	66,000	66,000	66,000
Acc Income		2,971	7,597	12,362	17,270	(66,000)
Total Equity	66,000	68,971	73,597	78,362	83,270	0
Cash Flow Statement						
EBITDA	-	23,062	23,639	24,230	24,836	25,457
Investment	(66,000)	-	-	-	-	-
WC Change	-	2,225	57	58	59	61
Taxes	-	(4,633)	(4,754)	(4,878)	(5,006)	(5,136)
FCF project	(66,000)	20,654	18,941	19,410	19,890	20,382
Interest	-	-	-	-	-	-
Debt repayment	-	-	-	-	-	-
New debt	-	-	-	-	-	-
CF to equity	(66,000)	20,654	18,941	19,410	19,890	20,382
Equity injection	66,000					
Div Distr		(14,458)	(13,259)	(13,587)	(13,923)	(102,590)
Ratios						
Net Margin	N/A	3.2%	3.0%	2.9%	2.9%	2.9%
ROA	N/A	24%	24%	23%	22%	785%
ROE	N/A	25%	24%	23%	23%	N/A
NPV (@14%DR)	**27,581**	Based on the cash flow generated by the equity injections and the dividend distribution[25]				
FIRR	**25.2%**					

33. The results of the analysis show a financial internal rate of return (FIRR) of 25.2 percent and a NPV of US$27,581 (at 14 percent discount rate). It also shows that the financial ratios are adequate for this type of business (competitive environment with low operational margin).

[25] Assumed dividend distribution policy equal to 70% of cash flow to equity

Sensitivity Analysis

34. For the sensitivity analysis, the following switching values were analyzed:
- Decrease in annual sales;
- Increase in operational expenditures

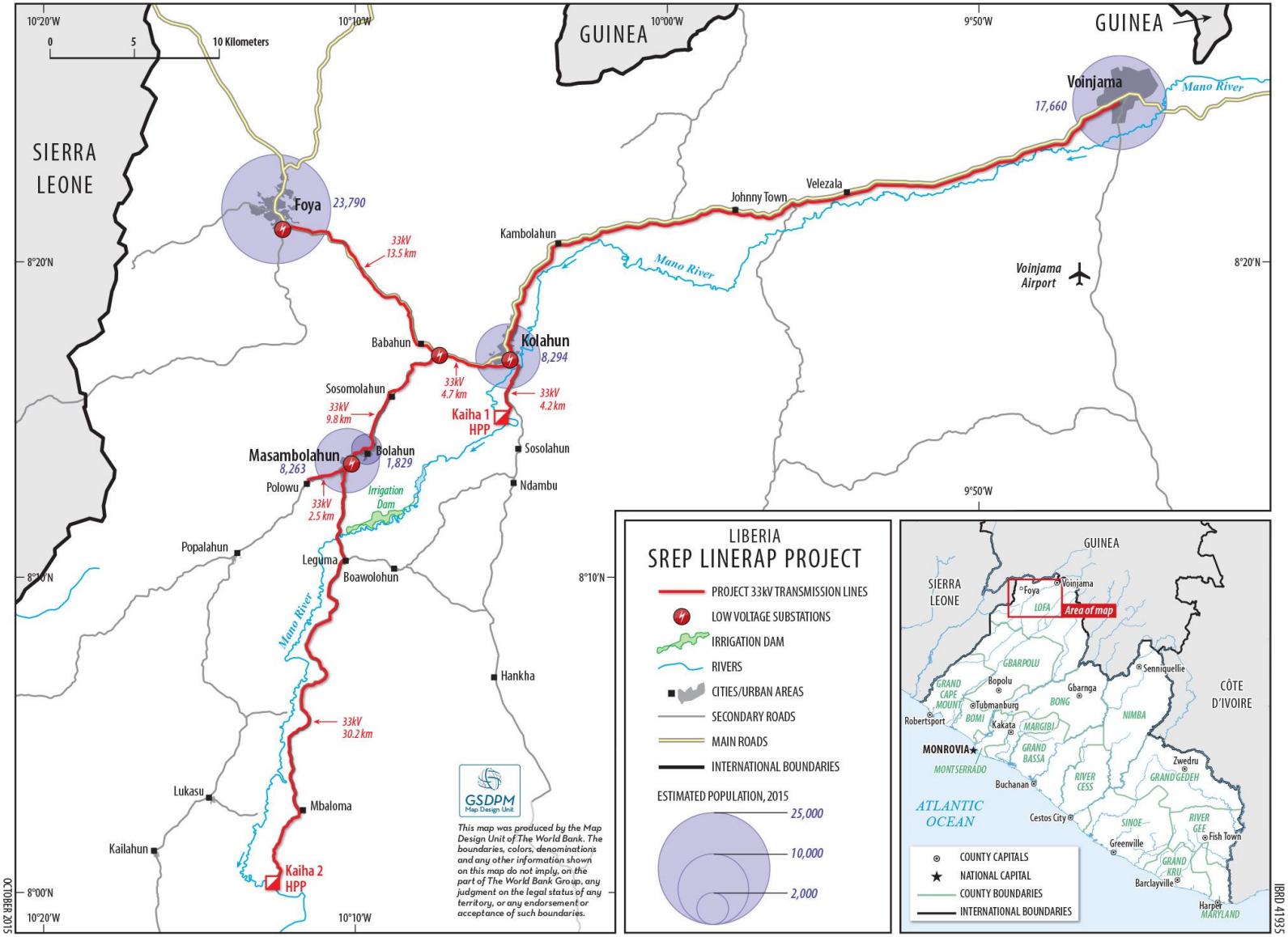
35. The results of the sensitivity analysis are presented in the table below:

Table 7: Results of the sensitivity analysis of Component 3

Sensitivity	Description	Result
Increase in operational costs (switch value)	How much needs to increase the expenses to make FIRR = 14%?	+10.3%
Decrease in sales (switch value)	% reduction in pico-PV products sold to make FIRR = 14%?	-8.3%

36. As it can be observed, the sensitivity analysis shows how sensitive the results are to small changes in operations, for instance, a 10.3 percent increase in expenses is enough to decrease the FIRR from 25.2 percent to 14 percent; and this is derived from the small operational margin ratios already observed in the financial model. This results stress the need to inform the local retailors on the importance of maintaining a tight control on expenditures.

Annex 6: Maps
Liberia Renewable Energy Access Project



Annex 7: Scaling-Up Renewable Energy Program (SREP) in Low Income Countries
Liberia Renewable Energy Access Project

Indicator	SREP/IDA Project	Transformational Scaled-up Phase (IPRE[26] Targets by 2020)
Annual electricity output from RE as a result of SREP interventions (GWh)	4-6 GWh/year	28.07 GWh/year
Number of women and men, businesses and community services benefiting from improved access to electricity and fuels as a result of SREP interventions	150,000 people, of which: • 50,000 people (mini-grids) • 100,000 people (pico-PV)	360,000 people (mini-grids, pico-PV), representing 9% of Liberia's population
Financing leveraged through SREP funding [US$ million]	US$4.5 million, of which: • WB (IDA) US$2.5 million • Norway US$1.5 million • AFREA/SE4ALL US$0.5 million	US$128.5 million, of which: • MDB (WB, AfDB): US$23 million • Government US$2.5 million • Private (debt/equity) US$18.9 million • Customer connections US$10.8 million • Others (Norway Energy +, other results-based financing, donors) US$73.2 million
SREP leverage ratio	1 : 0.2	1 : 5.1
Tons of GHG emissions reduced or avoided • Tons per year [tCO_{2eq}/yr] • Tons over lifetime of the investment [tCO_{2eq}]	• 3,174 – 4,762 tCO_{2eq} /yr • 63,496 – 95,244 tCO_{2eq} over 20 year lifetime	• 22,279 tCO_{2eq} /yr • n/a
Other co-benefits • Enhanced energy security and reduced dependence on imported fossil fuels and traditional sources of lighting • Reduction of local pollution from diesel generators, kerosene lamps, candles, and dry cell batteries that would have otherwise been kept for lightning or communication • Income raised and decentralization through building and sustaining management and technical skills within rural communities • Increased income generating activities in the evening and enhanced communication and access to information • Employment opportunities generated, mainly from construction, operation, and maintenance of mini-grids and standalone solar systems		

[26] The SREP Liberia Investment Plan for Renewable Energy (IPRE) was endorsed by the SREP Sub-Committee in October 2013.

- Effective and wide deliver of education through the provision of electricity and lighting to schools and households
- Enhanced public safety through street lighting
- Improved gender equality and women's socioeconomic status by the provision of access to increased economic opportunities to female

A. Introduction

Country and sector context

1. **Problem Statement.** Since 2006 when President Ellen Johnson Sirleaf took office for the first time, Liberia has made substantial progress in recovering from the 15-year civil war. Between 2009 and 2013, the economy grew steadily at an average rate of 7.3 percent per year. This performance showed the country's potential for sustainable economic growth and development. However, the economy remains vulnerable to external shocks given its dependence on primary commodities, imported foods and fuel, its limited diversification, and the volatility of commodity prices. Inequality remains high and is exacerbated by the dearth of infrastructure and social services nationwide and by the asymmetry of the reconstruction efforts, mainly focused on Monrovia where a fourth of the population lives.

2. The Ebola crisis that struck Liberia, Sierra Leone and Guinea in mid-2014 increased these vulnerabilities. It caused a substantial loss of lives, dampened economic activity, and weakened social cohesion and safety nets. The announcement on May 9, 2015 by the World Health Organization that Liberia is Ebola free means that the Government's attention can gradually return to its development agenda.

3. With the renewed focus on development, increased electricity services are urgently needed to support the country's economic transformation and to improve the lives of the population. Liberia has one of the world's lowest rates of electrification, at less than two percent, combined with one of the highest electricity tariffs, at US$0.52/kWh. Expanding access to reliable and affordable electricity supply is a high priority of Liberia's Agenda for Transformation 2012-2017. The Agenda includes a US$3.3 billion infrastructure investment program to overcome the constraints imposed by the lack of access to basic services. Expansion of the electricity sector, a key driver of transformation, is a major component of this program.

4. The Government's economic and social development programs aim to benefit both urban and rural populations and to reduce disparities in services. About 58 percent of Liberia's population is considered rural, representing about 2.5 million people. The majority of rural households are engaged in subsistence farming and/or petty trading as their main source of livelihood, with little or no cash income. Lack of basic infrastructure services such as electricity and transport imposes a significant constraint on the local economy and hinder the development of income-generating activities.

5. After the end of the Liberian civil war, the Liberia Electricity Corporation (LEC) resumed operations in 2010, focusing initially on re-establishing service in Monrovia. Donors, including the World Bank, financed a number of electricity sector investments including installation of emergency, 22.6 MW of diesel-based generation plants, and reconstruction of a basic distribution network and connections for low-income customers. These investments were accompanied by a five-year management contract financed by Norway and signed in 2010 between LEC, the Ministry of Lands, Mines, and Energy (MLME), and Manitoba Hydro International (MHI), aiming to improve LEC's performance and to expand the customer base in the capital. LEC's customer base increased from 2,469 customers in July 2010 to 30,485 customers in January 2015.

6. In 2012, the Government adopted an ambitious strategy aiming to increase electricity coverage to 70 percent of the population in Monrovia and 35 percent nationwide by 2030. To achieve the expansion of electricity services target, the Government is following a two-pronged strategy: (i) expansion of grid connected service in Monrovia and priority economic corridors outside of the capital; and (ii) development of decentralized electricity service for areas that are not expected to be connected to the national grid in the medium term.

7. Liberia has a renewable energy potential that is beginning to be exploited. Hydropower potential exists in some of the major rivers although it is highly seasonal. The generally flat topography requires extensive civil works, which increases the costs of the hydro plants. Liberia has good prospects for solar photovoltaic (PV) systems with a global horizontal irradiation similar to Spain. While traditional biomass meets the energy needs for cooking and heating of 90 percent of the population, use of biomass for electricity generation has been limited. Logistical challenges in gathering and transporting biomass fuel, pricing, and competing uses create difficulties in using biomass for power generation. Finally, global and regional wind maps indicate that wind resources are likely to be poor.

8. The Government, with the support of donors, has started to develop the provision of electricity and lighting services in rural areas and small towns. In 2010, the Government established the Rural and Renewable Energy Agency (RREA) to promote rural electrification and use of renewable energy in Liberia. The Law on Rural and Renewable Energy, establishing RREA as a permanent public institution and providing the legal framework for developing renewable energy and expanding electricity services to rural areas, was approved by Parliament on June 18, 2015 and signed into Law by the President on July 6, 2015.

SREP Liberia Investment Plan for Renewable Energy

9. The SREP Liberia Investment Plan for Renewable Energy (IPRE) was prepared under the guidance of MLME and with the support of the World Bank and the African Development Bank (AfDB). The IPRE was endorsed by the SREP Sub-Committee in October 2013. The IPRE provides a roadmap for scaling up renewable energy to increase access, reduce over-reliance on imported fossil fuels, and strike a balance between electricity provision to urban and rural areas. The IPRE defines two priority choices for expanding use of renewable energy: (i) mini-grid systems based on small hydro and biomass, backed up by PV to compensate for seasonal variation; and (ii) stand-alone solar systems, which include solar lanterns, other pico-PV products, and solar home systems (SHS). The Government has agreed with the African Development Bank to provide electricity to communities in the South-East of Liberia and with the World Bank in the North-West of the country, in particular to Lofa County.

Table 1 - IPRE Tentative Financing Plan (US$ million)

Components	SREP	AfDB	World Bank	NOR Energy + TA	Other Partners TBD	Private Equity TBD	Govt. of Liberia	Customer connections	Investment & TA Total	Energy+ Results-based Payment	Other Results-based Financing	Grand Total
Phase I	**50.0**	**13**	**10**	**1.5**	**6.8**	**12.8**	**2.5**	**6.4**	**103.0**	**18.0**		**121.0**
Project Preparation Grant	**1.0**	-	-	-	-	-	-	-	**1.0**		-	**1.0**
Investment Phase I	**46.5**	**12.5**	**8.5**	-	**6.8**	**12.8**	-	**6.4**	**93.5**	18.0	-	**111.5**
Investments—Phase I Mini-grids	41.7	12.5	8.5	-	6.8	12.8	-	1.6	83.9	-	-	101.9
Investments—Phase I Stand-alone PV	4.8	-	-	-	-	-	-	4.8	9.6	-	-	9.6
Technical Assistance	**2.5**	**0.5**	**1.5**	**1.5**	-	-	**2.5**	-	**8.5**	-	-	**8.5**
Transaction Advisory Services	1.0	-	1.0	-	-	-	-	-	2.0	-	-	2.0
Renewable Resource Assessment	-	-	-	0.5	-	-	-	-	0.5	-	-	0.5
Regulatory/Policy Support	-	-	0.5	0.5	-	-	-	-	1.0	-	-	1.0
Training & Capacity Building	0.5	0.5	-	0.5	-	-	-	-	1.5	-	-	1.5
Knowledge Management—M&E	0.5	-	-	-	-	-	-	-	0.5	-	-	0.5
Program Management	0.5	-	-	-	-	-	2.5	-	3.0	-	-	3.0
Phase II	-	-	-	-	**32.5**	**6.1**	-	**4.4**	**43.1**	-	**14.4**	**57.5**
Investments—Phase II Mini-grids	-	-	-	-	28.9	6.1	-	4.4	35.9	-	14.4	50.3
Investments—Phase II Stand-alone PV	-	-	-	-	3.6	-	-	3.6	7.2	-	-	7.2
Total	**50.0**	**13**	**10**	**1.5**	**39.3**	**18.9**	**2.5**	**10.8**	**146.1**	**18.0**	**14.4**	**178.5**

M&E = monitoring and evaluation; TA = technical assistance; TBD = to be determined. *Source: RREA estimates*

B. Project description

10. The objective of the SREP-funded Liberia Renewable Energy Access Project (LINERAP) (US$25 million SREP, US$2 million IDA) is to increase access to electricity and to foster the use of renewable energy sources. The proposed Project will support the implementation of 1-2MW hybrid mini-grid powered mainly by renewable energy in rural areas and small towns, strengthening of institutions and regulations for decentralized electricity services, and the scale-up of the Government's initiative to foster a market in Liberia for modern solar lanterns and other solar devices. The Project is expected to benefit households, small businesses, associations, and public institutions (e.g., local government, elementary and secondary schools, and health centers) in Lofa County that would be connected to the mini-grids, as well as nationwide through stand-alone solar systems. The Project will also contribute to enhancing the capabilities of RREA and MLME.

11. The Project is comprised of three components. The ***first*** component will finance the implementation of decentralized electrification through 1-2 MW[27] hybrid mini-grid in Lofa County, benefitting approximately 50,000 people. SREP will finance hydro-based power generation facilities, as well as distribution lines and connections for households, businesses, and

[27] Pending confirmation from the feasibility studies (ongoing).

public entities. Based on preliminary analysis, the Project will focus on the Northwest corridor liaising the main towns of the county, which are Voinjama, the county capital, Foya and Kolahun. The mini-grid will supply electricity combining hydropower during the wet season (approximately eight months) and diesel-based power during the dry season. Funding from SREP will be used to finance the renewable energy component of the mini-grid, while IDA will cover the diesel component of the system. The option of integrating solar PV into the generation mix was examined but not adopted for (i) the high capital cost which increased the end-user consumer tariffs and reduced the availability of funding for user connections, and (ii) the technical complexities associated with integrating and operating solar PV technologies in a MW-sized system in this isolated location (see Annex 2). Two potential hydroelectric generation sites have been identified near Kolahun in the Kaiha River. The selection of the hydropower site, generation mix and the design of the mini-grid would be finalized once the results of the ongoing prefeasibility study of mini-grids are available. Preliminary analysis indicate that the total cost for the 2MW mini-grid, including generation assets, distribution grid and connections, would cost approximately US$20 million. Technical assistance will help define an adequate O&M contract arrangements that will assure the sustainability of the mini-grid proposed to be constructed under the Project, as well as serve as a basis for further mini-grid investments in Liberia. The selection of the most appropriate business model, including considerations for ownership of assets, will be based on a sound business plan and legal framework of the sector. The business model selected for the proposed mini-grid can also serve as a model for future rural electrification efforts in the country. The ***second*** component will finance the elaboration of regulations for decentralized electricity services to ensure sustainability of the services as well as the strengthening of RREA's institutional capacity to deliver the Project. The ***third*** component will finance the development and strengthening of the local market for pico-PV products and the provision of access to modern energy services for over 100,000 people. See Annex 2 for detail description of all project components.

12. **Transformation.** The proposed SREP-funded project will contribute to the transformation of rural electrification in Liberia by demonstrating the feasibility of MW-scale hybrid mini-grids in Lofa County and promoting the local market of pico-PV products nationwide. The successful implementation of the Project will not only supplement and enhance ongoing rural electrification efforts in Liberia, especially through the provision of electricity in areas where grid extension becomes too costly, but also provide a road map for increasing access to electricity through renewable energies. The demonstrational effects from the proposed SREP-funded mini-grid, combined with the technical assistance offered under the Project, will support the transformation by improving the enabling environment to attract private investments in the medium to long term. The Project will scale-up the pilot rural electrification projects with the implementation of a MW-size mini-grid and the implementation of sustainable business models to operate and maintain the electricity service. The technical assistance component will help identify and assess the suitability to local conditions of different business models to engage the private sector in rural electrification. Besides, the Project will transform the stand-alone solar system market by kick starting a larger, sustainable, private-sector led, commercial market for pico-PV products that meets the lighting needs of those who are not connected to the grid through access to finance for importers and retailers, building national quality standards for PV products and the resulting competition from low quality products.

13. **Rationale for SREP financing.** The Lofa County has an immense and untapped potential for renewables, especially for hydro and solar. The proposed SREP-funded Project will help demonstrate the viability of mini-grids as the best alternative for electrification of communities in

Lofa County, which is not expected to be reached by the national grid in the next decade or so. The use of SREP grant funding will be crucial to lower the high upfront costs of hydro-based renewable energy generation, therefore making end-user consumer tariffs more affordable. The demonstrational effect of the proposed SREP-funded mini-grid will increase the attractiveness of this type of operation to donors and investors potentially interested in rural electrification. SREP support will also help demonstrate the feasibility of business models to operate rural electrification projects, which might increase the capacity of private sector to participate in these type of projects, either as operators, developers, and/or investors in future projects. SREP support will also help increase the availability of clean energy in rural areas, therefore reducing the dependency on fossil fuel and shifting Liberia into a low carbon development pathway The proposed SREP-funded Project will also help ramp up the local market of solar-PV stand-alone systems, assisting with the electrification of areas with widely dispersed population where neither grid extension nor mini-grids are cost-effective solutions. SREP support will be crucial to strengthen the incipient commercial market for pico-PV in Liberia. The use of SREP funding will support the establishment of a sustainable, private-sector led, commercial market for pico-PV products in Liberia. SREP support in this segment is expected to be phased out during the Project lifecycle. Therefore, the proposed SREP-funded Project will directly contribute to increasing and strengthening renewable energy-based rural electrification efforts in Liberia through mini-grids and stand-alone pico-PV solutions. In the absence of SREP support, both the targeted areas of Lofa County and those covered by stand-alone pico-PV systems would not be electrified in the next decade or so and the provision of diesel-based electricity would prevail and continue to proliferate in Lofa County and elsewhere in the country.

C. Assessment of Proposed Project with SREP Investment Criteria

Increased installed capacity from renewable energy sources

14. Liberia has no grid-connected renewable energy capacity. There are, however, off-grid renewable energy systems outside the Monrovia area such as the 4 MW Small Hydro Power plant (SHP) in Firestone plantation (Margibi county) and the 30 kW SHP in Yandohun (Lofa county). An additional two kW-sized mini-grids are being installed elsewhere in the country. The proposed SREP-funded Liberia Renewable Energy Access Project will build 1-2 MW of hydro-power installed capacity in Lofa County, generating around 4-6 GWh annually of hydro-based power enough to serve around 50,000 inhabitants. The size of the generation plant has been determined based on an electricity demand assessment in the main towns of Lofa County, where the main energy use patterns have been identified for households, public institutions, businesses and other productive uses. The total installed capacity from Pico-PV products will be 127.5 kW (between 0.35 W and 14 W with an average size of 1.7 W per system), generating 325.76 MWh annually of solar-based electricity.

Increased access to energy through renewable energy sources

15. The proposed SREP-funded Project is aligned with the Government's development strategy, the *Agenda for Transformation*. Under pillar 2 of the *Agenda,* as well as the *2015 Economic Stabilization and Recovery Plan*, electricity services expansion and the reduction of the cost of electricity are cited as essential conditions for achieving and sustaining economic transformation. Expansion of electricity access will be critical to address both short-term needs of

health, education centers, water treatment plant, and other critical facilities, as well as to support the economic and social recovery of the country. The proposed Project will also contribute to the Government's efforts to rebuild the economy post-Ebola, as the Ebola outbreak that hit Liberia starting 2014 was originated in the area that is primarily targeted by the Project, namely Lofa County. The proposed SREP-funded mini-grid in Lofa County will benefit approximately 8,000 households (around 50,000 people). The pico-PV component will provide energy access to at least 100,000 people (Tier 2 access according to the SE4ALL multitier framework).

Low Emission Development

16. The proposed SREP-funded project will promote the utilization of sustainable energy in rural areas by providing electricity through hybrid MW-scale mini-grid primarily powered using hydro renewable energy sources, with backup diesel especially during the dry season. The Project will also promote the use of solar energy products nationwide through the development of a commercial market for pico-PV products in Liberia. The CO_{2eq} emission savings capacity of the proposed SREP-funded Project was estimated by using the proxy-based method agreed for the SREP program (793.7 tCO_{2eq} per GWh). Savings were derived primarily from the MW-sized mini-grid, since a much smaller portion of savings can be anticipated from the pico-PV component. Applying the proxy-based method to estimate emissions of CO2eq equivalent based on diesel generated electricity, the proposed SREP-funded Project would help avoid 3,175 - 4,762 tCO_{2eq} on an annual basis based on 1-2 MW installed capacity of hydro-based power. The savings over the lifetime of the investment, hereby estimated at 20 years, would be approximately 63,496 - 95,244 tCO_{2eq}.

Affordability and competitiveness of renewable sources

17. Based on the results of IPRE and previous analysis of hydropower potential in Liberia, several prefeasibility studies were launched for the best hydropower sites identified in the North, situated in Lofa and Bomi Counties, with financing from the World Bank, the Government of Norway, and MLME. Preliminary results have shown that the best sites for development are three sites in Lofa County. However, electricity supply in Liberia cannot solely be based on hydropower because of the highly seasonal nature of hydro resources. Other sources of electricity supply such as thermal or solar generation are required during the dry season to provide continuous and reliable electricity service to users. While maximizing the use of renewables is an explicit objective of the Government of Liberia's energy policy and also of the proposed SREP-funded Project, it should be noted that even under a scenario that would use 100 percent PV during the dry season, diesel-based generation would be required for emergencies in case of failure of the PV system.

18. The definition of an investment program to provide access to electricity to these communities in Lofa County would depend upon several factors, including: (i) the investment cost based on the technology configuration which would determine the proportion of electricity generation to come from hydropower and diesel; (ii) the achievement of an affordable and sustainable tariff that covers the operation, maintenance, and replacement costs of the system on a sustainable basis while not exceeding the current average cost of grid electricity in Liberia of US$0.52/kWh; and (iii) the amount of financing available to cover the investment costs of generation and distribution facilities in different locations in the county.

19. A prefeasibility study of renewable hybrid mini-grids in Lofa County is ongoing, utilizing the aforementioned results of the hydropower studies and taking into account the above factors. The final decision on sites and technology configurations will be made after the results of the consultancy will become available. Priority will be given to the main economic corridor of the county composed by the biggest towns of the county, including Voinjama, the county capital, Foya, Kolahun, and Massambolahun/Bolahun. Table 1 below shows the range of possible generation technology configurations to provide electricity in these main towns with one mini-grid. Prefeasibility studies for various hydro generation sites in the county are ongoing. The preliminary results show that the most suitable site to be selected to supply this mini grid is likely to be the small hydro power site of Kaiha 2.

Table 1: Summary results of preliminary analysis of possible generation technology mix of the mini-grid to supply Voinjama-Kolahun-Foya-Massambolahun-Bolahun

Scenarios	Hydro (kW)	PV (kW)	Diesel (kW)	CAPEX generation (million US$)	OPEX generation (million US$/yr)	LCOE generation (US$/kWh)	LCOE generation without CAPEX (US$/kWh)	Liters of diesel (m3/yr)	Total CAPEX (with grid and connections) (million US$)
Hydro + only diesel	2,000	0	1,800	11.5	1.626	0.446	0.237	1,372	19
Hydro + diesel/PV	2,000	1,100	1,500	16.5	0.906	0.412	0.125	704	24
Hydro + only PV	2,000	5,700	0	29.9	0.612	0.62	0.086	0	37

20. The analysis showed that hydropower would be the main source of electricity during the wet season. Different supply options to meet the electricity demand during the dry season were analyzed, from a diesel generation only system (no PV) to a system powered 100 percent by PV and an intermediate hybrid PV-diesel option. In all cases a diesel generator was required as backup in case of failure of the PV, to ensure reliable service. The system using only PV presented the highest capital and lowest operating costs. This supply option would require the lowest tariff to end users if the tariff were set to recover only O&M costs. However, it would be the most expensive option from an economic point of view for Liberia as it would have the highest Levelized Cost of Electricity (LCOE). Also, it would reduce the electricity access provided under the Project because there would be less funding available to finance connections.

21. The hybrid PV-diesel option with a small share of PV would have only a slightly lower LCOE than the diesel-only option, since the lower operating costs would be almost offset by the increase in capital cost of about 50 percent. Furthermore, installing a MW-sized PV power plant to supply the isolated mini grid in Lofa County would increase the Project risks, as it would be a first in Africa. While PV power systems to supply mini-grids in rural areas have been installed recently in Mali and Guinea Bissau, these are smaller, at 50 to 300 kW. A MW size PV generation plant has technical operating requirements (engineer on-site or sophisticated remote control systems) that would represent a major challenge in such an isolated area and could endanger the sustainability of the Project.

22. The system using only diesel during the dry season would have the lowest capital costs for generation and the highest operating costs due to the fuel costs. While it would require users to

pay a higher tariff than the other options analyzed to cover operation and maintenance costs, the required tariff would still be well below the current 0.52 cents/kwh paid by LEC customers, or the revealed willingness to pay of 65 cents/kwh for electricity substitutes indicated in recent studies for Lofa County and other similar areas in the country. This supply option would also allow the project to maximize the number of connections made to increase access to electricity.

23. Based on this preliminary analysis, the best option appears to be a mini-grid with generation from hydropower and diesel, serving the main towns in the Northwest, which would include Voinjama, the capital of the county, Foya, a commercial hub in the border with Sierra Leone and Guinea, Kolahun, Massambolahun/Bolahun and other smaller populations along the line. Among the generation sites for hydroelectricity under study, Kaiha 2 appears to be the most likely site to supply electricity to the mini-grid based on preliminary information. This site consists of small rapids and a waterfall over approximately 100 meters. The proposed layout consists of a small dam and intake structure upstream of the waterfall, a short penstock and a power station downstream. It has an approximate total head of 13 meters (5 m high dam and 8 m head difference); the design discharge of the power plant would be 7.5 m3/s. This layout for the plant would optimize the use of the hydro resources, allowing the plant to generate some electricity even during the dry season, complemented by diesel generation (see subcomponent 1B). The other sites under study have similar characteristics.

24. A transmission network (33 kV line) would connect the towns of Voinjama, Kolahun, Foya and Bolahun and would have a length of 90 km (30 km from Kaiha 2 to Bolahun and another 60 km to connect Voinjama, Foya and Kolahun).

25. For the case of Component 3, meeting the existing lighting needs of consumers was analyzed, including current use of dry cell battery powered lanterns, kerosene lamps, and candles, even though it does not account for the fact that the pico-PV systems provide a greater level of service by providing more lumens of better quality light compared to the energy sources that they replace as well as allowing charging of mobile phones. The estimated cost per unit light output of the using solar lighting sources was found to be the lowest (0.04 – 0.08 $/kLh) compared to equivalent lighting provided by alternative sources. There is a clear cost advantage for pico-PV products on the basis of equivalent lighting provided. In addition to the estimated economic benefits of pico-PV products, there are significant environmental and health benefits in comparison with the alternatives based on fossil fuel or disposal batteries. These benefits include reduced greenhouse gas emissions, reduce risk for indoor pollution and fire hazards as well as reduced amount of hazardous waste.

Productive use of energy

26. Component 1 of the Project will provide reliable and affordable electricity through mini-grids to the main towns of Lofa County which is a commercial, agricultural and economic hub in the area. Businesses and other productive uses have been already identified as potential customers of the MW-sized mini-grid, such as cold storage, infrastructure machinery, sugar crushers and palm oil processors.

Economic, social and environmental development impact

27. The proposed Project is in line with the vision of the Government for the electricity sector. It will contribute to the expansion of electricity infrastructure for economic and social development using renewable energy (low carbon sources). The proposed SREP-funded Project will help to: (i) increase quantity and quality of electricity services in remote areas for households, public sector facilities, businesses and industrial loads; (ii) accrue educational benefits (e.g., through the provision of electricity to schools and households, lighting allows children to study at night); (iii) reduce GHG emissions from using renewable energy sources (in part) for power generation; (iv) increase income or productivity from promoting productive uses of electricity in agricultural, commercial, and industrial activities; (v) generate employment opportunities, mainly related to construction, operation, and maintenance of hybrid mini-grid systems; and (ix) increased public safety in service areas due to street lighting.

Economic and financial viability

28. The economic analysis shows that mini-grid service in Voinjama-Foya-Kolahun-Massambolahun-Bolahun would be economically viable with an EIRR of 18 percent and a net present value (NPV) of US$11.5 million at a ten percent discount rate. Economic benefits were conservatively estimated based on avoided costs of electricity substitutes currently used by households, businesses, and public entities. Currently, there is no electricity service to the Project area, thus the population uses diesel generators, lamps using dry cell batteries, kerosene lamps, candles, and communication devices powered by dry cell batteries. For component 3, the NPV at a 10 percent discount rate would be US$4.2 million. The approach used to assess the economic benefits of the Market development of stand-alone solar systems program was to calculate the avoided costs of the services that would be replaced by the pico-PV products and compare them to the costs of the systems. With these assumptions, the NPV of the Component at a 10 percent discount rate would be US$4.2 million. Since the net economic benefit would be greater than the cost in each year, it is not possible to calculate the EIRR. More details are provided in Annex 5.

29. Since the capital costs of the mini-grid would be grant financed, the financial viability of component 1 was determined by: (i) estimating the average electricity tariff in current US$ that would need to be charged to the customers in order to recoup costs for operation and maintenance (including generation costs, commercial, operation and maintenance activities as well as non-technical losses), to finance the connection of new users to the mini-grid, and to yield a financial rate of return on equity equal to 14 percent (pre-tax values); and (ii) ensuring that the resulting tariff was well below the current average tariff in Liberia. The financial analysis shows that the mini-grid in Voinjama-Foya-Kolahun-Massambolahun-Bolahun is financially viable with a tariff of US$0.26 per kWh, which is sufficient to ensure sustainability of the system and at the same time some 50% below the current electricity tariff in Monrovia. The analysis will be further developed as results become available from the prefeasibility study now underway. The financial analysis of component 3 shows a financial internal rate of return (FIRR) of 14 percent (based on weighted average cost of capital including an 11 per cent return on equity) and an NPV of zero at a 14 percent discount rate. It also shows that the financial ratios are adequate for this type of business (competitive environment with low operational margin). More details are provided in Annex 5.

Leveraging of additional resources

30. The proposed Project is defined to complement projects financed by other donors under the umbrella of IPRE. RREA will be responsible for coordinating various donor-financed activities in the sector. SREP financing for this project has facilitated to crowd-in other sources of funding to prepare and implement the project, such as IDA to finance the safeguards instruments and bidding documents as well as the SREP Project Coordinator at RREA, some Bank Executed Trust Funds (AFREA and SE4ALL) are being used to finance the identification and pre-feasibility studies and the Government of Norway is providing technical assistance to finance the feasibility studies of the hydropower plant. Other ongoing or planned projects include: (i) AfDB is preparing a US$28 million biomass project and hydropower project in the south of the country using SREP and AfDB financing; (ii) USAID's "Beyond the Grid" initiative is providing technical assistance and capacity building to strengthen RREA's capacity to plan, design, and implement rural electrification projects; (iii) the Government of Norway, through the Energy+ initiative is providing US$1.5 million for technical assistance to conduct pre-feasibility studies for three small hydro sites in Lofa County and a feasibility study of the best site; it has also committed US$18 million investment project using a Payment-for-Results approach; (iv) the European Union (EU) plans to invest EUR 30 million to support rural electrification projects still to be defined; and (v) ii) the Agence Française de Développement has expressed a strong interest in cofinancing projects fostering access to electricity in Liberia. Current IDA portfolio in the energy sector of Liberia is focused to support the ambitious strategy of the Government to increase electricity coverage to 70 percent of the population in Monrovia by 2030 through the expansion of LEC's grid connected service in Monrovia and priority economic corridors outside of the capital.

Gender

31. The Government has committed to achieving gender equality and women's rights as a means of maintaining peace, reducing poverty, enhancing justice, and promoting sustainable development. It approved a National Gender Policy in 2009. Following this, a gender focal point has been hired by RREA. Particular emphasis was placed on gender in the IPRE. Specifically, in Project components 1 and 3, attention would be paid to the relevant gender dimensions in consultation and information campaigns, market outreach and surveys, payment and application procedures, and income generating opportunities. Care would be taken to ensure that women have access to and benefit from the economic opportunities of gaining energy access. In addition, the potential for ad-hoc training and capacity building on gender and energy for RREA might be included under component 2B.

Co-benefits of renewable energy scale up

32. The proposed Project is expected to bring wider environmental, economic and social co-benefits both locally and globally, including:

33. *Environmental co-benefit*: An amount of 92,440 tons of carbon dioxide (CO_2) emissions will be avoided over a 20 year lifetime as rural electrification is being progressed through renewable energy based mini-grids and standalone solar systems. In addition, it will also lead to local pollution reduction from diesel generators, kerosene lamps, candles, and dry cell batteries that would have otherwise been kept for lightning or communication.

34. *Economic co-benefit*: Employment opportunities will be generated, mainly from construction, operation, and maintenance of renewable energy based mini-grid systems as well as maintenance of standalone solar systems. It is expected that this project will help to build and sustain management and technical skills within rural communities, which will support income raise and decentralization. Increased access to electricity will support income generating activities in the evening as well as enhance communication over cell-phones and access to information on such as weather, prices, demand, etc. Enhanced energy security and reduced dependence on imported fossil fuels and traditional sources of lighting in the target areas will be also achieved.

35. *Social co-benefit:* Education will be delivered more widely and effectively as the provision of electricity and lighting to schools and households allows children to study at night. It will also contribute to improving health by avoiding the use of kerosene for lighting which produces indoor air pollution caused by particulate emissions. Public safety will be also enhanced in areas where street lighting is provided. It will also contribute to improving gender equality and women's socioeconomic status through the provision of access to increased economic opportunities to female. Overall the quality of life in rural areas will be enhanced as a result of this proposed Project.

D. Monitoring and Evaluation

36. Overall monitoring and evaluation of LINERAP activities will be performed by RREA. The project's key performance indicators for the hybrid mini-grid component are aligned with the indicators required under the SREP core indicators. The regular monitoring and reporting on the agreed project indicators will be conducted by RREA. RREA will have the responsibility to collect data and report on the performance indicators (see Annex 1: Results Framework) on a semiannual basis for the PDO indicators and for the intermediate outcome indicators at the component level.

E. Implementation Readiness

Country/sector strategies

37. The Liberia Investment Plan for Renewable Energy (IPRE) aims to support the government's objective of increasing access to electricity to accelerate the country's reconstruction and economic revitalization. The IPRE is fully aligned with the government's Agenda for Transformation (AFT), a long-term vision to transform Liberia into a more prosperous, inclusive, middle-income society. To assess the investment required to close the electricity gap and support economic development, the government prepared a Least Cost Power Development Plan (LCPDP) that aims to identify the scale and type of investments required to achieve 70 percent household coverage in greater Monrovia and 35 percent in the rest of the country by 2030. Complementing the LCPDP, the IPRE focuses on off-grid areas where extending the main grid will not be cost-effective in the near future. It provides the road map for scaling up renewable energy interventions to increase access, reduce overreliance on imported fossil fuels and strike a balance between rural and urban areas in electricity provision.

Institutional arrangements

38. Institutional Arrangements. The Act establishing RREA as a permanent and autonomous agency stipulates that a Board of Directors (BD) will be the governing body of RREA. Members

of the BD include representatives of MLME, LEC, Ministry of Justice, the Executive Director of RREA, three persons selected to ensure equitable geographic, demographic, and gender representation of the country, three persons selected on the basis of their qualifications and experience, and one representative of civil society. The BD would oversee the Project and would facilitate strong inter-ministerial cooperation. The appointment of the BD by the GoL is expected in the coming months (this is a dated covenant).

39. Implementing Agency. RREA would be the sole implementing agency. It would liaise with MLME to ensure consistency between the activities financed under this Project and the sector policies for rural electrification.

40. A dedicated Project Management Team (PMT) in RREA would be responsible for the implementation of the Project. RREA would contract a Project Coordinator who will report to the Executive Director of RREA and would work with the Agency's Technical Director and other technical and fiduciary staff already in place to implement the Project. Four engineers have been hired and trained by National Rural Electric Cooperative Association (NRECA), with USAID financing, and are expected to be integrated into RREA's staff to build the institutional capacity of the Agency. Some of these engineers would be assigned to the Project as technical members of the PMT. In addition, a pico-PV specialist would be hired under to support the implementation of Component 3 of the Project. Fiduciary staff (financial management and procurement) would be dedicated to the Project, but report to the respective directors of RREA. Project implementation arrangements– including fiduciary responsibilities – are described in detail in Annex 3. The role and responsibilities of the Project's implementing agency would be described in detail in the Project Implementation Manual (PIM), to be prepared by RREA prior to effectiveness.

Sustainability

41. The Project has been designed to support the sustainability of the results. The following aspects are particularly relevant in this respect:

42. Financial and technical viability of the rural electrification program based on mini-grids. Sustainability of the systems would be supported by a smart tariff scheme, affordable for the rural population that ensures full recovery of costs of operation, maintenance, and expansion of the mini-grids to attend future customers. Moreover, the Project would provide technical assistance to RREA to define and procure O&M contracts. Equally important, the Project would finance the elaboration of regulations and technical standards that guarantee the enabling environmental for efficient and sustainable operation of the mini-grids.

43. Strong technical and capacity building support for RREA. RREA benefits from technical assistance from a number of sources in addition to the technical assistance proposed under the Project, Such support includes assistance from the U.S.-based nonprofit NRECA, one of the most experienced entities in rural electrification efforts worldwide. NRECA will provide expertise and best practices related to rural electrification with mini-grids and business models for decentralized rural electrification.

44. Financial viability of sales of SHS by private importers and retailers. The Project design would support importers to build up: (i) commercial relations with international manufacturers; and (ii) a credit history that would help them secure commercial loans after this Project ends. It is

also planned to phase out import subsidies as the cost of imports is reduced. Finally, the definition of sale prices by RREA would include a margin to be used to increase the rural fund. These measures would make it easier for the for-profit private sector to take over once RREA is no longer an intermediary in the market.

45. RREA's clear legal mandate to foster rural electrification and use of renewable energy. The success of the rural electrification effort in general and the Project in particular relies on RREA's continued efforts. While RREA is a relatively new organization, it has a clear legal and policy mandate to carry out decentralized rural electrification and development of renewable energy in Liberia, recently reaffirmed through the passing of the Law on Rural and Renewable Energy. Elaboration of regulations for decentralized rural electrification systems and of replicable business models for renewable-energy based hybrid mini-grids and off-grid household SHS. The preparation of these regulations and business models would help RREA to achieve its broader mandate of fostering rural electrification and use of renewable energy.