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Report No: PAD1618

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT

IN THE AMOUNT OF SDR 1.5 MILLION
(US\$2 MILLION EQUIVALENT)

AND A

PROPOSED GRANT FROM THE STRATEGIC CLIMATE FUND SCALING UP
RENEWABLE ENERGY PROGRAM

IN THE AMOUNT OF US\$25 MILLION

TO THE

REPUBLIC OF LIBERIA

FOR A

RENEWABLE ENERGY ACCESS PROJECT

December 15, 2015

ENERGY AND EXTRACTIVES GLOBAL PRACTICE
AFRICA REGION

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CURRENCY EQUIVALENTS

(Exchange Rate Effective October 31, 2015)

Currency Unit = Liberian Dollars
LRD = US\$1
US\$1 = SDR 0.71588623

FISCAL YEAR

July 1 – June 30

ABBREVIATIONS AND ACRONYMS

AFD	Agence Française de Développement
AfDB	African Development Bank
AFREA	Africa Renewable Energy and Access Program
ARAP	Abbreviated Resettlement Action Plan
AWPB	Annual Work Plan and Budget
CESMP	Contractor Environmental and Social Management Plan
CoA	Chart of Accounts
CPS	Country Partnership Strategy
CIF	Cost, insurance and freight
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
FD	Financial Director
FIRR	Financial Internal Rate of Return
FM	Financial Management
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIMPA	Ghana Institute of Management and Public Administration
GRS	Grievance Redress Service
IAA	Internal Audit Agency
IC	Individual Consultants
ICB	International Competitive Bidding
IDA	International Development Association
IFRs	Interim Financial Reports
IPF	Investment Project Financing
IPRE	Investment Plan for Renewable Energy
IPSAS	International Public Sector Accounting Standards
ISA	International Standards on Auditing

LCPDP	Least Cost Power Development Plan
LCS	Least Cost Selection
LEC	Liberia Electricity Corporation
LIB	Limited International Biding
LIRENAP	Liberia Renewable Energy Access 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
WB	World Bank

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LIBERIA
LIBERIA RENEWABLE ENERGY ACCESS PROJECT (LIRENAP)

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PAD DATA SHEET

Liberia

Liberia Renewable Energy Access Project (P149683)

PROJECT APPRAISAL DOCUMENT

AFRICA

GEEDR

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-Jan-2016	Project Implementation End Date 30-Jun-2021		
Expected Effectiveness Date 30-Apr-2016	Expected Closing Date 30-Jun-2021		
Joint IFC No			
Practice Manager/Manager Meike van Ginneken	Senior Global Practice Director Anita Marangoly George	Country Director Henry G. R. Kerali	Regional Vice President Makhtar Diop
Approval Authority			
Approval Authority: Board/Absence of Objection Decision Please explain: According to the Board Report on Climate Investment Funds (CIFs, World Bank 2008), including the Strategic Climate Fund (SCF, which supports the Scaling Up Renewable Energy Program), all CIF projects need to be approved by the Board regardless of whether there is associated IBRD/IDA funding.			
Borrower: Republic of Liberia			
Responsible Agency: Rural and Renewable Energy Agency			
Contact:	Augustus Gouanue	Title: Executive Director	

Telephone No.: 231886559266

Email: gusgoanue@yahoo.com**Project Financing Data(in USD Million)**

<input type="checkbox"/> Loan	<input type="checkbox"/> IDA Grant	<input type="checkbox"/> Guarantee
<input checked="" type="checkbox"/> Credit	<input checked="" type="checkbox"/> Grant	<input type="checkbox"/> Other
Total Project Cost:	27.00	Total Bank Financing: 27.00
Financing Gap:	0.00	

Financing Source	Amount
Borrower	
IDA	2.00
Strategic Climate Fund Grant	25.00
Total	27.00

Expected Disbursements (in USD Million)

Fiscal Year	2016	2017	2018	2019	2020	2021
Annual	0.10	0.70	1.00	10.50	12.70	2.00
Cumulative	0.10	0.80	1.80	12.30	25.00	27.00

Institutional Data**Practice Area (Lead)**

Energy & Extractives

Contributing Practice Areas**Cross Cutting Topics**

- Climate Change
 Fragile, Conflict & Violence
 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		
Energy and mining	Other Renewable Energy	10		

Energy and mining	Transmission and Distribution of Electricity	20		
Total		100		
<input type="checkbox"/> 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 infrastructure and service delivery	50		
Rural development	Rural services and infrastructure	10		
Total		100		
Proposed Development Objective(s)				
The Project Development Objectives (PDOs) are to increase access to electricity and to foster the use of renewable energy sources.				
Components				
Component Name		Cost (USD Millions)		
Component 1: Decentralized electrification in Lofa County		22.00		
Component 2: Technical assistance to strengthen rural electrification institutions and regulations		2.00		
Component 3: Market development of stand-alone solar systems		3.00		
TOTAL		27.00		
Systematic Operations Risk- Rating Tool (SORT)				
Risk Category			Rating	
1. Political and Governance			Moderate	
2. Macroeconomic			Moderate	
3. Sector Strategies and Policies			Substantial	
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		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	
Legal Covenants			
Name	Recurrent	Due Date	Frequency
Hiring of external auditor for the project		Four months after effectiveness	
Description of Covenant			
The Project Implementing Entity shall, no later than four (4) months after the Effective Date, hire an external auditor with terms of reference and qualifications satisfactory to the World Bank/Association (Section I.A.3 of the Schedule to each of the SCF Project Agreement and the IDA Project Agreement).			
Name	Recurrent	Due Date	Frequency

Board of Directors of the Implementing Agency (Rural and Renewable Energy Agency)		15-Dec-2016		
Description of Covenant				
The Recipient shall ensure that all members of the Project Implementing Entity's board of directors are appointed no later than December 15, 2016; such board of directors shall be responsible for strategic guidance, general oversight and facilitating coordination of the Project.				
Conditions				
Source Of Fund	Name	Type		
IDA	Subsidiary Agreement	Effectiveness		
Description of Condition				
The Subsidiary Agreement referred to in Section I.B of Schedule 2 to the Credit Agreement has been executed on behalf of the Recipient and the Project Implementing Entity.				
Source Of Fund	Name	Type		
IDA	Co-financing Agreement	Effectiveness		
Description of Condition				
The Co-financing Agreement has been executed and delivered and all conditions precedent to its effectiveness or to the right of the Recipient to make withdrawals under it (other than the effectiveness of this Agreement) have been fulfilled.				
Source Of Fund	Name	Type		
IDA, Strategic Climate Fund	Project Implementation Manual	Effectiveness		
The Project Implementation Manual, in form and substance satisfactory to the Association, has been adopted by the Project Implementing Entity. Article V to each of the SCF Grant Agreement and the IDA Financing Agreement				
Source Of Fund	Name	Type		
Strategic Climate Fund	Execution of Grant Agreement	Effectiveness		
The execution and delivery of this Agreement on behalf of the Recipient and the Project Agreement on behalf of the Project Implementing Entity have been duly authorized or ratified by all necessary governmental and corporate action.				
Source Of Fund	Name	Type		
Strategic Climate Fund	Subsidiary Agreement	Effectiveness		
The Subsidiary Agreement referred to in Section I.B of Schedule 2 to the Grant Agreement has been executed on behalf of the Recipient and the Project Implementing Entity.				
Team Composition				
Bank Staff				
Name	Role	Title	Specialization	Unit
Clemencia Torres De Mästle	Team Leader (ADM Responsible)	Senior Energy Economist	Co-TTL	GEEDR

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Joseph Tawiah Quayson	Team Member	Energy Specialist	Electricity Engineering	GEEDR	
Luis M. Schwarz	Team Member	Senior Finance Officer	Financial Management	WFALA	
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Julie Rieger	Counsel	Senior Counsel	Legal	LEGAM	
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Yeyea Gloria Kehleay Nasser	Team Member	Team Assistant	Administration	AFMLR	
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Name	Title	Office Phone	Location		
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Arsh Sharma	Energy Finance Specialist		World Bank, Wash DC		
Inka Schomer	Gender Specialist		World Bank, Wash DC		
Maria Luisa Esteban Meer	Team Member		World Bank, Wash DC		
Susan V. Bogach	Senior Energy Economist		Ottawa, Canada		
Locations					
Country	First Administrative Division	Location	Planned	Actual	Comments

Liberia	Lofa	Lofa County		X	
Consultants (Will be disclosed in the Monthly Operational Summary)					
Consultants Required? Consultants will be required					

LIBERIA

LIBERIA RENEWABLE ENERGY ACCESS PROJECT (LIRENAP)

I. STRATEGIC CONTEXT

A. Country Context

1. Liberia is a low-income country with a population of 4.4 million and a Gross Domestic Product (GDP) estimated at US\$2 billion in 2014. 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. Liberia made notable progress in the reduction of poverty between 2007 and 2010, but poverty remains high. In 2010 approximately 56.3 percent of the population was estimated to live below the poverty line (56.9 percent in rural areas and 55.5 percent in urban areas).¹ In 2014, Liberia ranked 175 out of 187 countries on the Human Development Index (HDI) and 145 out of 152 countries on the Gender Inequality Index (GII), highlighting the immense poverty and social development needs of the country.

2. Liberia still faces many challenges in laying the foundation to transition from post-conflict recovery to long-term development. The economy remains vulnerable to external shocks given its dependence on primary commodities, imported foods and fuel, 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, which are mainly focused on Monrovia where a quarter of the population lives.

3. The Ebola crisis that struck Liberia, Sierra Leone, and Guinea in mid-2014 increased these vulnerabilities. The country was able to manage the crisis with the assistance of the international community, and the number of cases have abated drastically since early 2015. With the health situation now improved, the Government's attention has gradually returned to its broader development agenda

4. The Government's economic and social development programs aim to benefit both urban and rural populations, reducing 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. The majority of households in the towns are engaged in agriculture and trade with Monrovia and other locations, related services (such as 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 local economies and hinders the development of income-generating activities. Women are still amongst the poorest in rural communities.

¹ Liberia Poverty Note – Tracking the Dimensions of Poverty (World Bank, 2012)

B. Sectoral and Institutional Context

5. Improved 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. It also has 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.

6. The customer base of the Liberia Electricity Corporation (LEC) has increased more than tenfold in five years, from 2,469 customers in July 2010 to 30,485 customers in January 2015. After the end of the Liberian civil war, 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 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 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.

7. In 2012, the Government of Liberia (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 electricity service targets, 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.

8. Liberia is beginning to exploit its renewable energy potential. Hydropower potential on some major rivers is seasonal. The generally flat topography requires extensive civil works, which increases the costs of the hydropower plants. Liberia has good prospects for solar photovoltaic (PV) systems with global horizontal irradiation similar to Spain. While traditional biomass meets the energy needs for cooking and heating of 90 percent of the population, its use 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.

9. GoL, with the support of donors, has started to develop electricity and lighting services in rural areas and small towns. In 2010, GoL 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 signed into Law by the President on July 6, 2015.

10. RREA aims to facilitate the economic transformation of towns and rural areas by accelerating the commercial deployment of modern and renewable energy services. The Agency's primary function is the planning, development, and promotion of projects together with public,

private, and community developers. It 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) micro-hydro and 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.

11. The LLL Program, which started in 2012, is developing the local market for stand-alone solar systems (hereafter solar systems), including pico-PV products and solar home systems, in areas that are not expected to be served by any grid. Solar systems use efficient lights (mostly light emitting diodes, LEDs), sophisticated charge controllers, efficient batteries, and PV panels to provide services such as lighting, mobile 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.

12. LLL's long term goal is to kick start a larger, sustainable, private-sector led, commercial market for solar products. To date, about 20,000 products have been sold, demonstrating the demand for solar products. However, the market 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.

13. In 2013, 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). GoL received a commitment of US\$50 million in 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 (i.e., the proposed Project) and AfDB providing support for a project in the South-East of the country. The possibility of tapping into additional carbon finance resources to support further deployment of renewable energy resources in Liberia will also be explored.

C. Higher Level Objectives to which the Project Contributes

14. The proposed Project is aligned with the World Bank Group's (WBG) twin goals of reducing poverty and boosting shared prosperity as well as the WBG's 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.

15. The CPS mentions SREP as one of the financing instruments that would 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 would contribute to the overall sustainability and security of the sector.

16. The proposed Project is also aligned with the GoL's development strategy, the *Agenda for Transformation*. Under pillar 2 of the *Agenda*, as well as the *2015 Economic Stabilization and Recovery Plan*, electricity service 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 and education centers, water treatment plants, 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 GoL's efforts to rebuild the economy after the Ebola outbreak since the Project's area of major intervention will be in Lofa County where the outbreak started.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

17. The Project Development Objectives (PDOs) are to increase access to electricity and to foster the use of renewable energy sources.

B. Project Beneficiaries

18. The Project is expected to benefit about 50,000 people as well as small businesses, associations, and public institutions (e.g., local government, elementary and secondary schools, and health centers) in Lofa County through connections to a mini-grid. The Project would also contribute to enhancing the capabilities of RREA and MLME. Finally, the Project would also benefit about 100,000 people nationwide who would gain access to stand-alone solar systems.

C. PDO Level Results Indicators

19. Progress toward achieving the PDOs would be measured by the following indicators:
- People provided with access to electricity by household connections - Off-grid/ mini-grid (number) (core);
 - 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) (core).

III. PROJECT DESCRIPTION

20. The proposed Project would support a mini-grid powered mainly by renewable energy in small towns and rural areas, strengthen institutions and regulations for decentralized electricity services, and support the scale-up of the GoL's initiative to foster a market in Liberia for off-grid solar energy devices. The Project includes three components. The first component would finance decentralized electrification through a mini-grid in Lofa County, an economic and agricultural hub on the border with Guinea and Sierra Leone. The second component would finance the development of regulations for decentralized electricity services and institutional strengthening of RREA. The third component would support RREA to continue fostering the growth of a market for solar energy lighting devices.

A. Project Components

Component 1. Decentralized electrification in Lofa County (estimated cost US\$22 million, of which SREP US\$20 million and IDA US\$2 million equivalent).

21. This component would support expansion of access to affordable, reliable, year-round electricity services to at about 50,000 people in North Lofa County, an economic and agricultural hub in North-West Liberia close to 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, and there are no prospects in the medium term to provide service from the national grid. The component would focus on the towns of Vonjaima, Foya, Kolahun, and Massambolahun/Bolahun and surrounding areas. It would support service provision to households, business and public institutions. Financing would be provided for installation of facilities, and technical assistance to define the most suitable arrangements for operation and maintenance services, and selection of the operator. Since the mini-grid would supply productive and commercial users as well as households, it would be important to provide a reliable and continuous supply of electricity. Electricity generation would include hydropower and back up thermal generation based on diesel. A study is ongoing to optimize the hydropower plant design and thus reduce the use of diesel during the dry season.

- ***Subcomponent 1A. Hydropower generation and hybrid mini-grid (estimated cost US\$18.9 million – SREP financing).*** This subcomponent would finance the hydropower plant, distribution lines, and connections for households, businesses, and public entities. A hydropower plant near Kolahun on the Kaiha River would be developed to provide electricity during the wet season (approximately eight months). The feasibility study will optimize the design of the hydropower plant to maximize the year-round hydroelectricity generation. Two sites are being studied; a site known as 'Kaiha 2' appears to be the most likely site to be selected to supply electricity to the mini-grid. The final results of the prefeasibility study will be used to validate the site selection and technology configurations.
- ***Subcomponent 1B. Thermal diesel generation (estimated cost US\$2 million –IDA financing).*** This subcomponent would finance the diesel back-up generation of the mini-grid. Diesel generation would be used during the dry season (approximately four months of the year), in order to provide reliable service for productive activities year round. As mentioned

above, the feasibility study would optimize the design of the hydropower plant to minimize the use of diesel-based generation.

- ***Subcomponent 1C. Technical Assistance for decentralized electrification (estimated cost US\$1.1 million –SREP financing).*** This subcomponent would finance:
 - *Owner’s Engineer.* The Owner’s Engineer would assist RREA with: (i) overall component management and supervision of the procurement, design, construction, management, and operations and maintenance (O&M) arrangements; and (ii) coordination of the implementation of the Environmental and Social Management Plans (ESMPs) and Resettlement Action Plans (RAPs).
 - *O&M arrangements for mini-grid in Lofa County.* Technical assistance would be provided to define O&M arrangements and the tariff required to ensure sustainability of the mini-grid. Technical assistance under this component would build on the IPRE, which outlines a range of O&M business models, and ongoing work on such business models by international consultants financed by USAID and the Government of Norway.

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

22. 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. It would support the development of regulations and standards for isolated mini-grids in complement to the September 2015 Law for the Electricity Sector and the Rural and Renewable Energy Act. It would also finance capacity building of RREA, document the lessons learned in establishing decentralized hybrid renewable energy mini-grids, support Project implementation, and finance the preparation of safeguards instruments, other preparation studies, and the Project audits.

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

23. This component would finance the development of a national market for solar systems. It would help provide access to modern energy services to over 100,000 people. The component aims to support the development of the market by increasing the sustainability of the supply chain and by addressing demand-side constraints. The sustainability of the supply chain would be increased through strengthening of the retail network and facilitating the transfer of procurement and import responsibilities from RREA to the private sector.² The component would be based on the experience and achievements of the ongoing LLL Program.

- ***Sub-Component 3A. Import of stand-alone solar systems (estimated cost US\$2.3 million-SREP financing).*** Under this sub-component, RREA would finance the bulk import of high quality solar systems on behalf of local retailers. Retailers would then pay RREA the cost of the products, and RREA would use the funds to buy more products and foster the sustainability of the market. The sub-component would partly subsidize the cost of the imports by RREA

² Constraints to the transfer include: import duties on private importers, unfavorable payment terms from the manufacturer to new importers, limited access to finance etc.

and by private importers. To foster long-term sustainability, this subsidy would be phased out gradually during the life of the Project, and RREA would decrease its role in the market as the private sector takes on the task of importing the products directly from the manufacturers.³

- **Subcomponent 3B. Enabling environment for commercialization of stand-alone solar systems (estimated cost US\$0.7 million-SREP financing).** This sub-component would finance: (i) technical assistance to strengthen the national policy and quality assurance framework for solar systems to foster the competitiveness of these products in the market; (ii) public awareness campaigns to inform consumers about the benefits of solar products and the characteristics of good quality products; (iii) technical assistance to strengthen importers’ and retailers’ technical knowledge, business and financial management skills; and (iv) technical assistance to strengthen RREA’s technical and financial capacity in regard to off-grid lighting.

B. Project Financing

24. The lending instrument for the proposed Project is Investment Project Financing (IPF). The Government would receive a SREP grant of US\$25 million and an IDA credit of US\$2 million equivalent that will be on-granted to RREA.

Project Cost and Financing

25. The total Project cost is estimated at US\$27 million (see Table 1). Project cost estimates include a 30 percent contingency for component 1 given the limited experience with construction of isolated mini-grids in Liberia, and a 10 percent contingency for component 3.

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

Project Components	Project Cost	SCF-SREP Financing	IDA ⁴	% of Total Cost Project
Component 1. Decentralized electrification in Lofa County	22.00	20.00	2.00	81.5
Component 2: Technical assistance to strengthen rural institutions	2.00	2.00	0.00	7.4
Component 3. Market development of stand-alone solar systems	3.00	3.00	0.00	11.1
Total Project Costs including contingencies	27.00	25.00	2.00	100

C. Lessons Learned and Reflected in the Project Design

26. The Project has been designed taking into account lessons learned from experiences of the World Bank and others in decentralized electrification, including the use of mini-grids in Sub-Saharan Africa and other regions. Experiences from specific projects in Bangladesh, Guinea, Haiti,

³ Details on the subsidy arrangement and the phase out procedure will be described in the Project Implementation Manual.

⁴ IDA resources are used to finance diesel back up generation, which is not eligible for SREP financing.

Lao PDR, Mali, Nicaragua, Peru, and Senegal have been considered, as well as lessons from hybrid mini-grids for decentralized electrification around the world. The Project also takes into consideration the experience of Lighting Africa⁵ and countries that are making efforts to expand the solar market, such as Ethiopia, Uganda, and Liberia itself.

27. Particular attention was paid to incorporating lessons learned regarding technical and financial sustainability.⁶ First, cost estimates for decentralized electrification need to have significant contingencies to anticipate uncontrollable factors such as exchange rate changes and 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 of poorer households. 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.

28. The Project builds on dramatic improvements in solar system technologies in recent years. This includes 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.

29. The Project design takes into account lessons learned on the sustainability of off-grid decentralized electrification projects.⁷ First, such projects must be consistent with the overall national electrification plan. Second, projects 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, as well as spare parts over the long term. Finally, training should be provided to participating government staff, service providers, and consumers.

30. Recent experience with innovative renewable energy electrification projects in Mali and Senegal provides additional lessons. First, innovative projects take time. Given the lack of experience of governments 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

⁵ See <https://www.lightingafrica.org>.

⁶ See *The Welfare Impact of Rural Electrification: a Reassessment of the Costs and Benefits, an IEG Impact Evaluation (2008)* and Project documents.

⁷ See *Operational Guidance for World Bank Group Staff: Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices (2008)*.

approaches adapted to local conditions, which 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.

31. During the implementation of the LLL Program, lessons have emerged with regard to the promotion of solar systems in Liberia. First, procurement of solar 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, as the private sector expresses interest in importing directly the solar products, 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 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 to address the challenges posed by weak road infrastructure in order to get products to rural customers.

D. Partnership Arrangement

32. The proposed Project complements projects financed by other donors under the umbrella of IPRE. Ongoing or planned activities related to rural electrification in Liberia include: (i) a US\$28 million biomass and hydropower project in the south of the country with SREP and AfDB financing; (ii) the “Beyond the Grid” initiative financed by USAID, which provides technical assistance and capacity building to strengthen RREA’s capacity; (iii) training and technical assistance to MLME, RREA, and the Liberia Hydrologic Institute as well as a US\$18 million investment project using a Payment-for-Results approach financed by the Government of Norway; and (v) a planned EUR 30 million investment project to support rural electrification projects to be financed by the European Union. In addition, the Agence Française de Développement (AFD) has expressed interest in co-financing projects to foster energy access in Liberia.

33. RREA is the implementing agency of the projects listed above. It has taken the lead in donor coordination in the sub-sector, including systematic sharing of information and periodic working sessions to discuss progress, avoid duplication, and share results. The proposed Project has been designed to maximize synergies and avoid duplication with projects financed by other donors, and to build on shared knowledge and active dialogue among the donors working with RREA in the area of renewable energy.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

34. 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. RREA operates under the guidance of MLME, with RREA's Executive Director appointed by and reporting to the Minister of MLME. This arrangement will continue until RREA's Board of Directors, in charge of providing strategic guidance and general oversight, is appointed. Board members will include representatives of MLME, LEC, 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. As part of its functions, the Board would facilitate inter-ministerial cooperation. The appointment of the Board is a dated covenant under the Project.

35. 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 report to the Executive Director of RREA and work with RREA's Technical Director and other technical and fiduciary staff already in place to implement the Project. RREA will hire a community outreach officer, based in Lofa County, who will facilitate communications with the populations benefiting from the Project. RREA's pico-PV specialist has been the focal person for the LLL Program and would also 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.

36. Project implementation arrangements, including fiduciary responsibilities, are described in Annex 3. A Project Implementation Manual (PIM) would be prepared and adopted by RREA prior to Project effectiveness.

B. Results Monitoring and Evaluation

37. 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.

38. In addition to the Project indicators in the Project results framework, 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, distribution lines, and substations; the effective implementation of the safeguard instruments; and the successful completion of studies and training activities. In addition, attention would be paid to generating gender-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.

C. Sustainability

39. *Financial sustainability of the decentralized electrification program.* The financial sustainability of the Project would be secured through the application of a tariff regime that would cover O&M expenditures.

40. *Technical sustainability.* In addition to the technical assistance to be provided under the Project, RREA benefits from technical assistance from a number of other sources, including assistance from the U.S.-based nonprofit National Rural Electric Cooperative Association (NRECA), which has strong experience 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 for three years to the technical staff of RREA in the different areas of rural electrification projects (identification, design, supervision, monitoring, and sustainable O&M models).

41. *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 would 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 of shipment and import costs would be phased out during 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. RREA's revolving fund, with incoming payments from retailers, also aims at increasing sustainability of the market after the close of the Project.⁸

42. *RREA's legal mandate for 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, reaffirmed through the passage of the Rural and Renewable Energy Act. The Project would finance the elaboration of regulations and technical standards that guarantee the enabling environment for efficient and sustainable operation of the mini-grid.

V. KEY RISKS AND MITIGATION MEASURES

A. Overall Risk Rating Explanation

43. The overall risk rating of the proposed Project is high. The main risks identified are summarized below.

44. *Sector Strategy and Policies Risk.* Liberia lacks specific regulations for decentralized electrification. A new Electricity Law was approved in September 2015. However, regulations have yet to be written, including those for decentralized electrification. 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-grid in the Project provides an opportunity to inform the formulation of this regulatory regime. The technical assistance 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

⁸ 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 a RREA-contracted entity.

proceeding in advance of regulations and using the experience gained to inform the regulatory regime.

45. **Technical Design Risks.** There are uncertainties about costs given the limited experience with construction of small-scale hydropower project facilities in Liberia. Capital and operating cost estimates for these facilities are highly uncertain, especially at prefeasibility stage. In addition, there is no experience with the O&M of decentralized mini-grids on which to base cost estimates. Finally, costs may be higher than usual and fewer firms may bid on the contracts due to fears of a re-emergence of Ebola. These large uncertainties are mitigated by adopting a simple Project design and using contingency factors of 30 percent in capital cost estimates.

46. There is also a risk of delays in construction due to the rainy season. Difficulties in accessing the site in Yandohun during the rainy season resulted in a delay in construction under an AFREA-financed project. The same situation may occur in this Project, which is located in a remote part of Liberia. The Project design has taken into consideration potential delays that could increase the construction time of the mini-grid.

47. There may also be an overestimation of electricity demand. 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 forecasted, reducing the financial viability of the mini-grid. 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 below international standards, at 20 kWh per month per household. Tariff setting would increase affordability for households through mechanisms such as fee-for-services arrangements, lifeline tariffs, or deferred payment schedules. Finally, a conservative approach of not including the demand of large users, such as plantations, has been adopted in the base case for the economic and financial analysis of the relevant component.⁹

48. **Institutional Capacity Risks.** The proposed Project faces a high implementation risk as it is the first megawatt-size decentralized hybrid electrification project for public service in Liberia. Thus, the risk that the mini-grid operator fails is real. However, this is not a rationale for not pursuing the Project, which has the potential to serve as a demonstration project and provide lessons learned for similar projects in the future. Mitigation measures under this Project include: (i) simple design; (ii) the contracting of an Owner's Engineer to supervise Project activities with respect to the decentralized mini-grid; and (iii) funding of capacity building, workshops, and technical assistance for the final beneficiaries, public institutions, and the operator.

49. Regarding the promotion of household solar systems, the market for solar systems in Liberia is at a nascent stage and is mainly public sector driven. There are substantial risks that retailers would not be sufficiently interested in selling solar 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 RREA's use of the payments from retailers which, if necessary, can be used to support

⁹ The 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.

the market beyond the Project. The funds may be used to support the private sector with working capital loans, subsidies, or other financial instruments aimed at encouraging their participation in the solar 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 by an entity contracted by RREA.

50. ***Climate and Disaster Risks.*** A 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

51. The rationale for public sector financing for investments under the proposed project rests primarily on the characteristics of the Project. It would finance the first mega-watt scale hydropower based decentralized grid for public electricity provision that would be installed by RREA, as well as provision of solar systems throughout the country. The Project would also assist in the development of regulations for decentralized electricity services through technical assistance. The high-risk country environment, a legal, regulatory, and institutional framework that is under development, and the high capital costs of renewable energy make it an unlikely candidate for private sector financing. The SREP grant would finance the capital costs of the small hydropower plant that would supply most of the electricity for the mini-grid and part of the costs of the solar systems, making the electricity services affordable and sustainable.

52. In the context of this Project, the World Bank provides significant value added. It is already a close partner of the GoL in other energy sector, activities and has played a critical role in development of the Project, including: (i) carrying out a pilot hydro-based mini-grid in Yandohun; (ii) implementing the LLL Program; (iii) assisting in mobilizing SREP financing, together with AfDB; and (iv) bringing experience with renewable energy based electricity services from other countries in Africa.

53. ***Economic Analysis of Component 1.*** An economic analysis shows that Component 1 is economically viable with an economic internal rate of return (EIRR) of 18 percent and a net present value (NPV) of US\$11.5 million at a 10 percent discount rate. Economic benefits were estimated conservatively based on avoided costs of electricity substitutes. Currently, there is no electricity service to the Project area, thus the households and businesses use diesel generators, lamps using dry cell batteries, kerosene lamps, candles, and communication devices powered by dry cell batteries. Details, including a sensitivity analysis, are provided in Annex 5.

54. ***Economic Analysis of Component 3.*** Component 3 is economically viable with an NPV of US\$4.2 million at a 10 percent discount rate. The analysis assumed that PV LED lamps would replace dry cell lamps. The analysis is conservative as it does not take into account the environmental and health benefits.

55. ***Financial Analysis of Component 1.*** Since the capital costs of the mini-grid would be mostly grant financed, its financial viability was determined by: (i) estimating the average electricity tariff required to recover the O&M costs (including generation costs, client service within the area of the mini-grid, O&M activities as well as non-technical losses), and to yield a financial rate of return equal to 14 percent (pre-tax values) on the working capital needed by the operator. The financial analysis shows that a tariff of US\$0.26/kWh would be cost-reflective. This is approximately half of the current average tariff in Liberia.

56. ***Financial Analysis of Component 3.*** 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). While the rate of return appears quite high, the sensitivity analysis showed that the returns were sensitive to small reductions in expected sales and increases in costs, highlighting the narrow profit margins and risks of entering an innovative business in a competitive environment.

B. Technical Analysis

57. The hydropower/diesel technology mix was selected based on a comparative analysis of a number of technology alternatives taking into account local circumstances. Lofa County's small hydro resources are not highly seasonal and hydropower can meet peak demand during eight months of the year. The proposed Project location is more than 200 km from the national grid and will not be connected to the national grid even in the medium term. Lofa County is an important economic and agricultural hub and requires reliable electricity for productive uses. Diesel is easily available given its uses in transport and agricultural production. The hydro/diesel option has the lowest capital cost to provide uninterrupted electricity service for households and productive uses. Hydro/solar with batteries present the highest capital costs and the option of hydro/solar without batteries is too intermittent for productive uses (no energy in the night during the dry season).

58. A triple technology mix (using hydropower, solar PV, and diesel) is too expensive because solar PV would not be used during eight months and the reduction of diesel/thermal generation needs would only affect the four months of the dry season. While a hydropower/diesel mix results in a higher tariff than other options, the US\$0.26/kWh tariff is well below the current US\$0.52/kWh paid by LEC customers.

59. The technologies to be used are commercially available, well-known, and in use in other countries in Sub-Saharan Africa (see Annex 2 for details). Initial findings of the prefeasibility on hydropower sites show that the best sites for development are two sites in Lofa County. The final results of the prefeasibility study will be used to validate the site selection and technology configurations.

60. The solar products promoted under the Project meet Lighting Africa Minimum Quality Assurance Standards, which ensures high energy system performance, such as lighting output and run time as well as high quality and durability, such as physical ingress and 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. Findings from consumer surveys conducted by RREA show that the performance of the solar products is considered high by consumers and that the solar products are preferred over alternative lighting sources because they are safer, economical, and higher quality.

C. Financial Management

61. The Project would build on existing financial management (FM) arrangements of 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, quarterly unaudited interim financial reports (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.

62. For each financing source (IDA, SCF), RREA would prepare a separate 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 be included in the Project Implementation Manual. Accounting reports on the use of Project funds would be prepared by the PMT using the International Public Sector Accounting Standards (IPSAS) cash basis of accounting. RREA would prepare two separate quarterly IFRs and submit them to the Bank 45 days after the end of each quarter. The Project would prepare two annual financial statements at the end of each fiscal year in accordance with IPSAS and submit two annual audited financial statements six months after the end of the Borrower's fiscal year. Details on the FM assessment are included in Annex 3.

D. Procurement

63. Procurement related responsibilities of the 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, evaluation reports, and contracts in compliance with World Bank procedures; and (iv) seeking and obtaining approval of IDA on procurement documents as required.

64. 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 was agreed during appraisal.

E. Social and Environment

65. The Project is rated Environmental Assessment category B as the proposed activities are small-scale, site-specific, and manageable. No adverse long-term impacts are anticipated. The Project triggers four safeguards policies: Environmental Assessment (OP 4.01), Involuntary Resettlement (OP 4.12.), Physical Cultural Resources (OP 4.11), and International Waterways (OP 7.50). OP 7.50 is triggered since the Kaiha River is a tributary of Mano River, which is an international waterway since it runs along the boundary between Sierra Leone and Liberia. However, an exception to the requirement of riparian notification has been approved in accordance with the policy by 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 that runs exclusively within Liberia; (ii) Liberia and Sierra Leone are both the lowest downstream riparians of the Mano River; and (iii) the Project would not cause appreciable harm to other riparian states.

66. The Natural Habitats (OP 4.04), Forest (OP 4.36), and Safety of Dams (OP4.37) policies are not triggered. The Project areas of the two possible mini-hydropower sites are farm-bush areas. There is a strip of approximately 100 meters on both sides of the river where disturbed natural forest is still present. The impacts on this disturbed natural forest strips will be local in the area of the weir and the reservoir. According to available information, no important wildlife exists in the area. There are no chimpanzees in the wider Project area and no endemic or endangered species are present. For these reasons, the Natural Habitat Policy is not triggered. Local people use the remaining forest areas for their own daily use. There are no logging activities near the two possible mini-hydropower facility locations. For these reasons, the Forest Policy is not triggered. The Safety of Dams Policy is also not triggered. The design of the five meter high weir will take sound engineering practices into account. Any dam safety issues, including the safe routing of an exceptional flood, have been addressed in the Environmental and Social Management Framework (ESMF, see paragraph below) and will be addressed in any Environmental and Social Impact Assessment (ESIA) undertaken for this activity.

67. An Environmental and Social Management Framework (ESMF) and a Resettlement Policy Framework (RPF) have been prepared, consulted on, and disclosed in-country and in the Bank's Infoshop on November 12, 2015. The ESMF identified the potential impacts of Project-financed activities. It is expected that the environmental, social, 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) will apply applied, as well as other applicable EHSGs. The ESMF contains a screening mechanism to identify whether 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.

68. The RPF addresses issues related to potential land acquisition and/or resettlement. Physical resettlement is not foreseen based on the results of a field visit to the project site of Kaiha 1, which is very similar to the site of Kaiha 2. Given that the site selection and physical footprint of the civil works are not yet decided, losses of assets or access to resources are not yet 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. The RPF 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.

69. The RPF contains a screening mechanism to identify whether an Environmental and Social Impact Assessment (ESIA) would need to be prepared after the feasibility studies have been finalized and the location of the hybrid mini-grid facilities and their social and gender impacts are known.

70. The preparation of the safeguard documents (i.e., ESMF, RPF) followed 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. The terms of reference for the ESIA and RAPs would include a strong gender component. Any ESIA or RAPs that would be prepared during Project implementation would include a consultation process and would be reviewed and cleared by the Liberian Environmental Protection Agency and the World Bank and disclosed in-country and in the Bank's Infoshop before any construction begins.

71. RREA will hire a qualified Environmental and Social Specialist to strengthen its Environmental and Social Department. The RREA Environmental/Social Specialist would be responsible for the overall supervision of the CESMP and the environmental and social aspects outside the scope of the CESMP, including the adequate implementation of the RAP/ARAPs and monitoring of the grievances. The Owner's Engineer will supplement RREA's capacity to supervise the adequate preparation and implementation of the ESMF and RPF. During construction, the contractor would prepare and implement its own Construction ESMP (CESMP) and hire qualified staff to supervise the implementation of this CESMP. The Owner's Engineer would supervise the implementation of the CESMP and hire qualified staff for this purpose.

F. Gender

72. GoL 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 was 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 will 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 access to energy.

73. The Bank-executed Africa Renewable Energy and Access Program (AFREA) Gender and Energy Program would complement the various components of the Project through the following activities: (i) supporting a gender assessment for the decentralized electrification in Lofa; (ii) supporting RREA's development and implementation of a gender sensitive stakeholder consultation strategy for Project activities; (iii) 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; (iv) delivering training and capacity building on gender and energy to RREA; and (v) supporting the collection of sex-disaggregated data to adequately monitor and report on the outcome and impact of improved energy services on female and male beneficiaries.

G. World Bank Grievance Redress

74. 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.

H. Citizen Engagement/Beneficiary Feedback

75. Beneficiary feedback would be recorded and monitored for component 1 through the grievance redress mechanism, which is further described in the RPF. The PMT would gather information about component 1 activities where complaints have been brought forward, including information on how they were resolved and relevant follow-up. This information would be included in an annual Project progress report and taken into account under the Project, as relevant, during implementation. For component 3, RREA will collect, record, and report on inputs received from beneficiaries through the market research and consumer surveys conducted to better understand solar systems' performance, consumer satisfaction, energy needs, and any other service issues. These reports would be gender informed and the survey results would be sex disaggregated.

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 Objectives (PDOs) are 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 under the Project by household connections - Off-grid/mini-grid (Number) - (Core)	0.00	0	0	0	25,000	50,000	50,000
People provided with access to modern energy services under the Project through stand-alone solar PV systems (Number)	0.00	0	30,000	50,000	70,000	100,000	100,000
Direct project beneficiaries (Number) - (Core)	0.00	0	30,000	50,000	95,000	150,000	150,000
Female beneficiaries (Percentage - Sub-Type: Supplemental) - (Core)	49.6	49.6	49.6	49.6	49.6	49.6	49.6

Intermediate Results Indicators							
Indicator Name	Baseline	Cumulative Target Value					
		YR1	YR2	YR3	YR4	YR5	End Target
Annual electricity output from renewable energy 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
Generation Capacity of Hydropower constructed under the Project (MW - Sub-Type: Supplemental) (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
Distribution lines constructed under the Project (km - Sub-Type: Supplemental) (Core)	0	0	0	0	58	58	58
Business plan of Project electricity service elaborated (Yes/No)	No	No	Yes	Yes	Yes	Yes	Yes
Project-related grievances registered under the project grievance redress mechanism and addressed (percentage)	0	100	100	100	100	100	100
RREA published reports on beneficiary feedback and how it has been incorporated in the Project (Yes/No)	No	Yes	Yes	Yes	Yes	Yes	Yes

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 under the Project 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-grid. Project progress report. Each household connection has an average of 5.5 people (according to the National Census).	RREA
People provided with access to modern energy services under the project through stand-alone solar PV systems (Number)	This indicator measures the number of people provided with access to modern energy services under the Project via a solar or solar home system.	Semi-annual	List of imported products, list of products picked up from RREA by retailers and Lighting Global conversion methodology for estimating number of people, based on Sustainable Energy for All (SE4ALL) tracking framework and Lighting Global Impact Data. The financial analysis in Annex 5 assumes a target of 75,000 systems to be sold under the project and uses a conversion factor of 1.8 person per system. The target of systems and the conversion factor is based on the current distribution of systems sold by the local retailers.	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-grid. List of imported Solar products, retailer's list of buyers of systems, and	RREA

			conversion methodology of Lighting Africa. Census data from Liberia Institute of Statistics and Geo-Information Services (LISGIS) of electrified towns	
Female beneficiaries(Percentage - Sub-Type: Supplemental) - (Core)	Based on the assessment and definition of direct project beneficiaries, this indicator specifies what percentage of the direct project beneficiaries are female.	Semi-annual	Census data from LISGIS the inclusion of sex-disaggregated indicators in the monitoring, reporting and evaluation requirements under the Project Implementation Manual.	RREA
Intermediate Results Indicators				
Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Annual electricity output from renewable energy 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 of hydropower constructed or rehabilitated under the project. For indicators measuring access provided to households or through community connections, refer to “T&D of electricity” (LT) sector code. The baseline value is expected to be zero.	Semi-annual	Project progress report	RREA
Generation Capacity of Hydropower constructed under the Project (MW - Sub-Type: Supplemental) (Core)	See above.	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

Distribution lines constructed under the Project (km - Sub-Type: Supplemental) (Core)	See above.	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 grievance redress mechanism and addressed (percentage)	This indicator measures, the number of addressed grievances over the number of registered grievances (in percentage)	Annual	Project progress report	RREA
RREA published reports on beneficiary feedback and how it has been incorporated in the Project (Yes/No)	This indicator measures whether RREA has taken into consideration beneficiary feedback related to Project.	Semi-annual	Project progress report	RREA

Annex 2: Detailed Project Description

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, the Government of Norway, USAID, the EU, and the GoL. 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 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) micro-hydro and 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.

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 conducted 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 Global Environment Facility (GEF) since 2012, aims at developing the local market for solar products. LLL's long term goal is to kick start a larger, sustainable, private-sector led, commercial market for solar products. To date, about 20,000 products have been sold, demonstrating the demand for solar products. However, the market 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.

5. The proposed Project would support a mini-grid powered mainly by renewable energy in small towns and rural areas, strengthen institutions and regulations for decentralized electricity services, and support the scale-up of the Government's initiative to foster a market in Liberia for off-grid solar energy devices. The Project includes three components. The first component would finance decentralized electrification through a mini-grid in Lofa County, an economic and agricultural hub on the border with Guinea and Sierra Leone. The second component would finance the development of regulations for decentralized electricity services and institutional strengthening of RREA. The third component would support RREA to continue fostering the growth of a market for solar energy lighting devices.

Component 1. Decentralized electrification in Lofa County (estimated cost US\$22 million, of which SREP US\$20 million and IDA US\$2 million equivalent)

6. This component would support expansion of access to affordable, reliable, year-round electricity services to at about 50,000 people in North Lofa County, an economic and agricultural hub in North-West Liberia close to 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, and there are no prospects in the medium term to provide service from the national grid. The component would focus on the towns of Vonjaima, Foya, Kolahun, and Massambolahun/Bolahun and surrounding areas. The component would support service provision to households, business and public institutions. Financing would be provided for installation of facilities, and technical assistance to define the most suitable arrangements for operation and maintenance services, and selection of the operator.

7. Currently, some large businesses in the area such as agricultural processing plants, as well as commercial and public entities 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 as 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 users, which represent almost 50 percent of the electricity demand.

8. Since the mini-grid would supply productive and commercial users as well as households, it would be important to provide a reliable and continuous supply of electricity. Electricity generation would include hydropower and back up thermal generation based on diesel. A study is ongoing to optimize the hydropower plant design and thus reduce the use of diesel during the dry season.

9. ***Subcomponent 1A. Hydropower generation and hybrid mini-grid (estimated cost US\$18.9 million – SREP financing)***. This subcomponent would finance the hydropower plant, distribution lines, and connections for households, businesses, and public entities. A hydropower plant near Kolahun on the Kaiha River would be developed to provide electricity during the wet

season (approximately eight months). The feasibility study will optimize the design of the hydropower plant to maximize the year-round hydroelectricity generation.

10. Two potential small hydropower sites are being studied. The final results of the prefeasibility study will be used to validate the site selection and technology configurations. Among the sites for hydroelectricity under study, Kaiha 2 appears to be the most likely 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 weir and intake structure upstream of the waterfall, a short penstock and a power station downstream. It has an approximate total head of 13 meters (five meters high weir and eight meters 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 site under study has similar characteristics.

11. This subcomponent would also finance a distribution network (33 kV line) that 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). The service connections would also be financed.

12. ***Subcomponent 1B. Thermal diesel generation (estimated cost US\$2 million –IDA financing).*** This subcomponent would finance the diesel back-up generation of the mini-grid. Diesel generation would be used during the dry season (approximately four months of the year), in order to provide reliable service for productive activities year round. As mentioned above, the feasibility study will optimize the design of the hydropower plant to minimize the use of diesel-based generation.

13. ***Subcomponent 1C. Technical Assistance for decentralized electrification (estimated cost US\$1.1 million –SREP financing).*** This subcomponent would finance:

- *Owner’s Engineer.* The Owner’s Engineer would assist RREA with: (i) overall component management and supervision of the procurement, design, construction, management, and operations and maintenance (O&M) arrangements; and (ii) coordination of the implementation of the Environmental and Social Management Plans (ESMPs) and Resettlement Action Plans (RAPs).
- *O&M arrangements for mini-grid in Lofa County.* Technical assistance would be provided to define O&M arrangements and the tariff required to ensure sustainability of the mini-grid. Technical assistance under this component would build on the IPRE, which outlines a range of O&M business models, and ongoing work on such business models by international consultants financed by USAID and the Government of Norway.

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

14. 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. It

would support the development of regulations and standards for isolated mini-grids in complement to the September 2015 Law for the Electricity Sector and the Rural and Renewable Energy Act. It would also finance capacity building of RREA, document the lessons learned in establishing decentralized hybrid renewable energy mini-grids, support Project implementation, and finance the preparation of safeguards instruments, other preparation studies, and the Project audits. It would include the following subcomponents:

- ***Regulation for decentralized mini-grids (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 line with the Law for Rural and Renewable Energy and the legal framework of the sector. These would include technical and financial standards, and 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.
- ***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 studies, consultancies, operating costs, and the realization of Project audits. It would finance the hiring of consultants with fiduciary and/or safeguards expertise, as needed, to strengthen the RREA's Project management team and 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, including MLME, LEC, local authorities, 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-SREP financing)

15. This component would finance the development of a national market for solar systems. It would help provide access to modern energy services to over 100,000 people. The component would aim to support the development of the market by increasing the sustainability of the supply chain and by addressing demand-side constraints. The sustainability of the supply chain would be increased through strengthening of the retail network and facilitating the transfer of procurement and import responsibilities from RREA to the private sector.¹⁰ The component would be based on the experience and achievements of the ongoing LLL Program.

16. Solar 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, candles and dry cell batteries traditionally used; and (ii) often the first modern energy services used by rural households. The first large order of solar products was brought into Liberia under the LLL Program in 2012. As no market for solar products existed, the focus of the program has

¹⁰ Constraints to the transfer include: import duties on private importers, unfavorable payment terms from the manufacturer to new importers, limited access to finance etc.

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.

17. 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 uses 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 for retailers and has lowered their costs. In addition, the program has provided business development support, such as matching grants to retailers,¹¹ trade shows linking up local retailers with international manufacturers, and technical training for local retailers, as well as market intelligence¹² and consumer education.

18. The rate of sales of solar products has steadily increased. To date, 20,000 solar products have been sold, demonstrating strong demand. Even though the market is growing, it is still at a very nascent and fragile stage, which was adversely affected by the Ebola outbreak.

19. 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. There are also in the past few years a few specialized electronic and solar energy shops selling small numbers of solar systems in downtown Monrovia, as well as several small convenience shops selling cheap, low-quality solar products in public markets.

20. 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 solar products that meet the lighting needs of those who cannot obtain grid electricity. To reach this goal, supply and demand side constraints need to be addressed and a gradual transition of import responsibilities to the private sector needs to take place.¹³

21. Several factors constrain importation by private actors and the growth of the market,¹⁴ 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 as well as lack of distribution networks in rural areas.

22. This component would tackle these barriers through the activities described below.

¹¹ 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.

¹² *Willingness to Pay Analysis* (July 2012) and *Market Opportunities for Solar Portable Lights Study* (October 2012).

¹³ This transition needs to take place gradually. Actors interested in importing pico-PV products 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 would be provided to these actors to build their capacity in these areas.

¹⁴ Constraints were identified in *Market Opportunities for Solar Portable Lights Study* (October 2012) and *Local Retail Partners Business Capacity Assessment Report* (August 2015).

23. ***Subcomponent 3A. Provision of financing for import of stand-alone solar systems (estimated cost US\$2.3 million-SREP financing).*** Under this subcomponent, RREA would finance the bulk import of high quality solar systems on behalf of local retailers. Retailers would then pay RREA the cost of the products, and RREA would use the funds to buy more products and foster the sustainability of the market. The subcomponent would subsidize the cost of the imports by RREA and by private importers. To foster long-term sustainability, this subsidy would be phased out gradually during the life of the Project, and RREA would decrease its role in the market as the private sector takes on the task of importing the products directly from the manufacturers.¹⁵

24. ***Subcomponent 3B. Creation of an enabling environment for commercialization of stand-alone solar systems (estimated cost US\$0.7 million-SREP financing).*** This subcomponent would finance: (i) technical assistance to strengthen the national policy and quality assurance framework for solar systems to foster the competitiveness of these products in the market; (ii) public awareness campaigns to inform consumers about the benefits of solar products and the characteristics of good quality products; (iii) technical assistance to strengthen importers' and retailers' technical knowledge, business and financial management skills; and (iv) technical assistance to strengthen RREA's technical and financial capacity in regard to off-grid lighting.

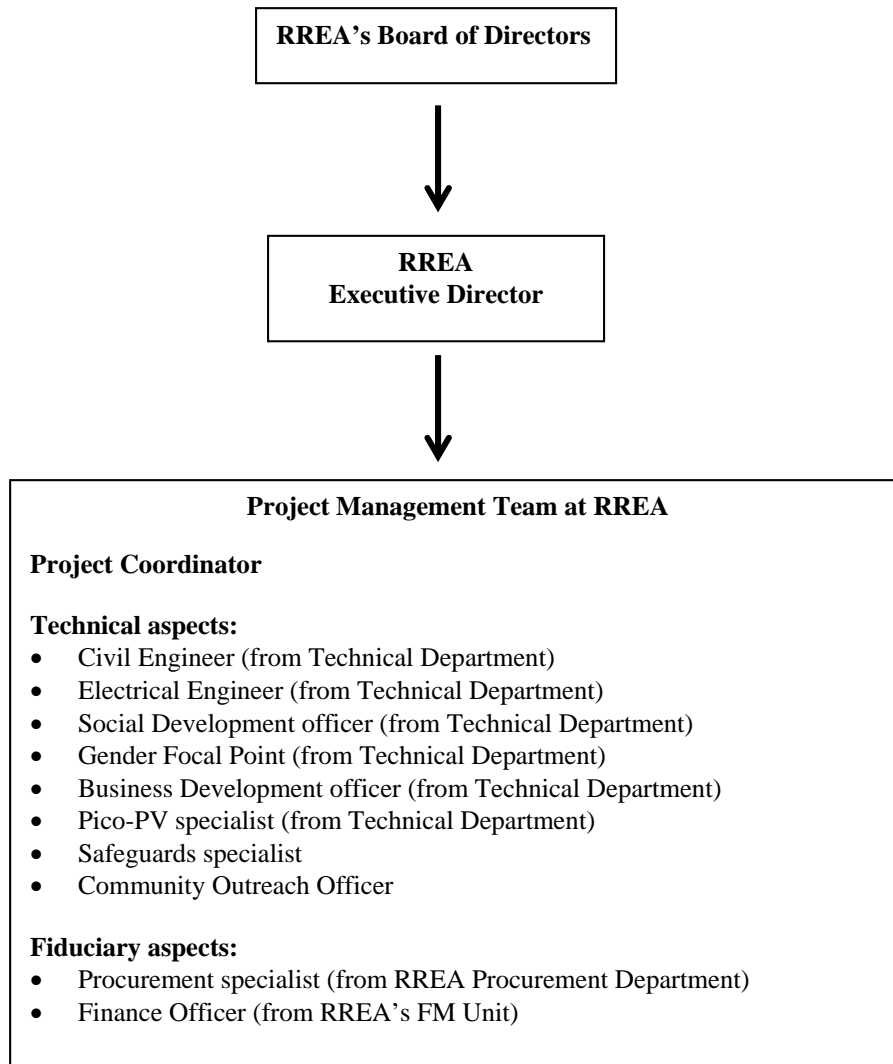
¹⁵ Details on the subsidy arrangement and the phase out procedure will be described in the Project Implementation Manual.

Annex 3: Implementation Arrangements

Project Institutional and Implementation Arrangements

1. 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. RREA is a permanent and autonomous agency that officially entered into effect in July 2015. RREA operates under the guidance of MLME, with RREA's Executive Director appointed by and reporting to the Minister of MLME. This arrangement will continue until RREA's Board of Directors, in charge of providing strategic guidance and general oversight, is appointed. Board members will include representatives of MLME, LEC, 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. As part of its functions, the Board would facilitate inter-ministerial cooperation. The appointment of the Board is a dated covenant under the Project.
2. 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 report to the Executive Director of RREA and work with RREA's Technical Director and other technical and fiduciary staff already in place to implement the Project. RREA will also hire a community outreach officer, based in Lofa County, who will facilitate communications with the populations benefiting from the Project. RREA's pico-PV specialist has been the focal person for the LLL Program and will also 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.
3. RREA would be supported in implementing component 1 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 would be funded by the Project.
4. RREA would conduct the bulk procurement and importing of solar systems on behalf of local retailers. Local retailers would pay RREA the cost of the products and these payments would go into RREA's revolving fund to buy more products or finance other needs aimed to foster sustainability of the market (see component 3). Component 3 would subsidize the cost of the imports of systems 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.
5. A Project Implementation Manual (PIM) would be prepared and adopted by RREA prior to Project effectiveness.

Figure 1: Project Implementation Arrangements



Financial Management and Disbursements, and Procurement

Financial Management

6. The FM arrangements under the LLL 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.

7. The accounting and financial management function of the RREA is being managed by a Finance Director (FD) who is well experienced in managing FM services for Bank assisted projects. The FD is being assisted by a project accountant and a finance officer and; the both have relative experiences in the FM services for Bank assisted projects. The FD at the RREA would

designate a qualified accountant to serve as the accountant for the project and to be supervised directly by the FD. The project accountant would be supported by a finance officer to be assigned to the project. The accountant would be expected to possess the requisite qualifications and experience in Bank financial management and disbursement procedures. The internal audit activities for the project would be provided by the Internal Audit Agency (IAA) and the IAA would be expected to deploy a qualified internal auditor for the Project.

Budgeting

8. Two separate annual work planning and budgeting (AWPB) would be prepared for the LIRENAP. The project team, together with the accountant, would be responsible for preparing the AWPBs based upon the agreed programs to be financed by the IDA and the SCF. The key components are already known and these would be included in the AWPB to be submitted to the Bank two months before the commencement of each fiscal year. The AWPB would be reviewed and agreed with the World Bank, and no objection issued by the World Bank TTL.

Internal Controls and Audit

9. RREA has laid down internal control procedures and processes that ensure that transactions are authorized by appropriate officials. There is a clear segregation of duties for expenditure initiation, approval and authorization. The centralized Internal Audit Agency of the Liberia is staffed with qualified Internal Auditors who conduct internal audit reviews at the Ministries, Agencies and Commissions, including the RREA. This unit which is headed by an executive director would be responsible for the deployment of internal auditors to the Project. Periodic internal control reviews would be conducted by the finance director. The internal auditor would prepare quarterly internal reports and furnish these to the Bank 45 days after the end of each quarter. The project would be expected to put in place adequate internal controls including fixed assets register in order to safeguard the material assets to be procured or created using the Project funds.

10. A Project Implementation Manual (PIM) would be developed prior to Effectiveness and the 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

11. Accounting for the use of the Project funds would be prepared by the Project using IPSAS cash basis of accounting and; this would be carried out the using the Quick Books accounting system. The system provides for adequate recording of all accounting transactions for the Project and; it is also capable of producing accurate periodic financial reports including interim un-audited financial reports (IFR) and annual Project financial statements. The RREA has a chart of accounts (CoA) that adequately classify project expenditures and the Project would utilize the 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. The RREA would deploy a competent accountant to the Project, to be the Project accountant. Two separate set of accounting

would be maintained for the two funding sources (IDA, SCF) under the Project using the Quick books. The project accountant would be supported by a finance officer; and to be supervised by the finance director of the RREA.

Periodic Financial Reporting

12. Two separate set of unaudited interim financial reports (IFRs) would be prepared for the two funding sources (IDA, SCF) under the Project. The Project accountant would be responsible for preparing the quarterly IFRs and the IFRs would be submitted to the Bank 45 days after the end of each quarter. The constituents of the IFRs would include sources and uses of funds, uses of funds by activity/component, explanation for material variances, funds disbursement status, commitment schedule, withdrawal application schedule, fixed assets schedule and bank reconciliation statement. The existing IFR format currently used by the LLL Program would be applied for the proposed Project.

13. The Project would also prepare two separate annual financial statements for two funding sources (IDA, SCF) under the Project at the end of fiscal year in accordance with International Public Sector Accounting Standards (IPSAS) – cash basis. The Project management would submit the said financial statements to the auditor no later than four months after the end of each fiscal year. The audited financial statements and the management letter therewith would be submitted to the Bank within six months after the end of each fiscal year. The financial statements would comprise, at a minimum, of: (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

14. 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 and the selection of auditors shall be on competitive basis and in accordance with the Bank's procurement guidelines. The terms of reference of the auditors would be cleared by the Bank. The Project would select the auditor within four months of project effectiveness. 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. The two designated account (DAs) each would be audited on annual basis under the auditing arrangement described above.

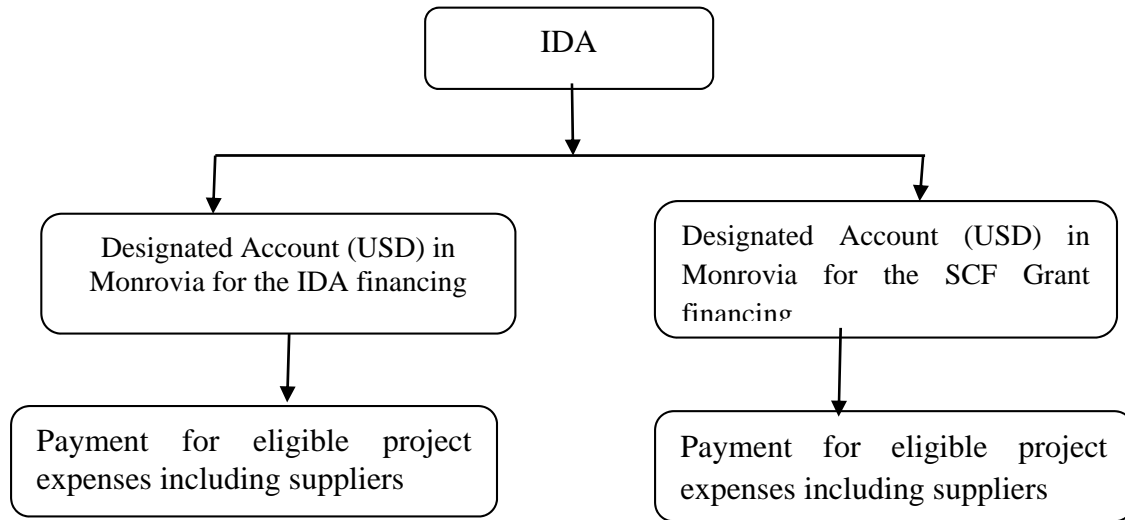
Funds Flow and Disbursement Arrangements

15. There would be two designated accounts (DAs), one for the SCF grant and one for the IDA credit. Funds would be disbursed directly into a DA set up and managed by the RREA. These accounts (DAs) 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 deposits for each of the DAs and subsequent replenishments as per the Disbursement Letter. The Statement of Expenditures (SOE) disbursement method would be used as the basis for the withdrawal of the SCF and the IDA proceeds. 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 letters. Replenishments, through fresh withdrawal applications to the Bank, into the separate designated accounts 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 to be made for contracts would be secured by a bank guarantee or performance-based bonds and a retention amount withheld. However, 100 percent down payment would be required for the quantity of products to be purchased by the retailers and; the bank guarantee arrangement would apply to the retailers.

16. The funds flow arrangement for the subcomponent 3A for the financing for import of stand-alone solar systems provides support to facilitate the transfer of procurement and import responsibilities from RREA to the private sector. The RREA would provide a subsidy for interested importers consistent with the provisions of the PIM for the import of the solar products under the Project.

17. Advance contracting and retroactive financing shall apply for this Project. To be eligible for financing, the procurements shall follow the arrangements in the financing and grant agreements and the procurement plan. Retroactive financing is sought for an amount not more than 20 percent of the grant amount and of the credit amount for payments pre-financed by the client made on or after July 1, 2015 and prior to Project's signing date. The disbursement funds flow diagram are as follows:

Disbursement flow



18. A description of the project’s financial management arrangements above indicates that they satisfy the Bank’s minimum requirements under OP/BP10.0. The overall FM risk is assessed as *Substantial*.

Financial Management Project Risk Assessment and Mitigation

19. 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

20. Procurement for the proposed Liberia Renewable Energy Access Project, 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.

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

22. **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.

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

24. **Selection of Consultants.** Consultancy services valued at about US\$3 million are provided for the recruitment of various consultants such as of an Owner's Engineer and other Project staff. Consultancy firms would 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 (IC) 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 would 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.

25. **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.

26. **Operating Costs.** Incremental recurrent expenditures incurred on account of Project implementation, based on periodic budgets acceptable to the Association, including, *inter alia*: travel expenditures and other travel-related allowances such as per diems and reasonable accommodation costs; equipment rental and maintenance; vehicle operation (including fuel), maintenance, insurance and repair; office rental and maintenance; office materials and supplies; consumables; utilities; internet service charges; media information campaigns and communications' expenses; advertising expenses; banking charges and local contractual support staff salaries, but excluding the salaries of officials and public servants of the Recipient's civil service.

B. Assessment of RREA's capacity to implement procurement

27. An assessment of the capacity of the Rural and Renewable Energy Agency (RREA) to implement procurement actions under the Project 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.

28. 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 Ghana Institute of Management and Public Administration (GIMPA) workshop on World Bank procurement procedures in 2016 to sharpen their skills.

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

Procurement Risk and Mitigation Measures

30. 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 GIMPA workshop on World Bank procurement guidelines, in June 2016.

C. Procurement Plan

31. 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 is 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 2: Thresholds, Procurement Methods, and Prior Review**

No	Expenditure Category	Contract Value Threshold**	Procurement Method	Contracts Subject to Prior Review /(US\$)
1	Works	C \geq 3,000,000	ICB	All contracts
		100,000= \leq 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 \geq 500,000	ICB / LIB	All contracts
		50,000= \leq 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 \geq 300,000 (firms)	QCBS	All contracts
		100,000= \leq C<300,000 (firms)	LCS, FBS, CQS and QBS	TORs and first three contracts
		C \geq 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.

32. *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.

33. *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.

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, (editions January 2011, revised in July 2014). (Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants", dated October 15, 2006 and revised in January 2011).

**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	Construction of Small Hydro Power Plant in Kaiha River	13,000,000	ICB	Yes	No	Prior	Jan 2017	
02	Supply of Diesel Generators	2,000,000	ICB	No	No	Prior	Jan 2017	
03	Supply and installation of distribution network and customer service	5,000,000	ICB	No	No	Prior	Jan 2017	

	connections in Lofa County							
Component 2								
04	Vehicles	80,000	NCB	No	No	Post	Oct 2016	
Component 3								
05	Lighting Africa-approved off-grid solar lights (batch 1)	350,000	Direct Contracting	No	No	Prior	Aug 2016	
06	Lighting Africa-approved off-grid solar lights (batch 2)	350,000	Direct Contracting	No	No	Prior	Feb 2017	
07	Lighting Africa-approved off-grid solar lights (batch 3)	350,000	Direct Contracting	No	No	Prior	Aug 2017	
08	Lighting Africa-approved off-grid solar lights (batch 4)	350,000	Direct Contracting	No	No	Prior	Feb 2018	

(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	CQS	Prior	June 2017	
Component 2						
03	Development of regulation for rural electrification	100,000	CQS	Post	June 2017	
04	External audit /Others	25,000	CQS	Prior	July 2016	
05	Project Coordinator	60,000	SSS	Prior	Dec 2016	
06	Procurement officer	40,000	SSS	Prior	June 2016	

07	Safeguards specialist	40,000	ICS	Prior	June 2016	
08	Pico-PV program specialist	40,000	SSS	Prior	July 2016	Currently an expert is recruited by RREA, salary funded through LLL-GEF project until June 2016
Component 3						
09	Production and dissemination of public awareness messages	25,000	CQS	Post	June 2017	
10	Training consultant	100,000	CQS	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

34. Overall monitoring and coordination of Project activities would be performed by RREA. This would be a key responsibility of the Project Coordinator. 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 safeguard instruments; successful completion of studies and training activities; and Project implementation including the agreed Project indicators. In addition, attention would 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

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

36. 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.).

37. 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 EHSs.

38. The Project triggers four safeguards policies: Environmental Assessment (OP 4.01), Involuntary Resettlement (OP 4.12.), Physical Cultural Resources (OP 4.11) and International Waterways (OP 7.50). OP 7.50 is triggered since the Kaiha River is a tributary of Mano River, which is an international waterway since it runs along the boundary between Sierra Leone and Liberia. However, the requirement of riparian notification has been approved in accordance with the policy by 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 that runs exclusively within Liberia; (ii) Liberia and Sierra Leone are both the lowest downstream riparians of the Mano River; and (iii) the Project would not cause appreciable harm to other riparian states.

39. The Natural Habitats (OP 4.04), Forest (OP 4.36), and Safety of Dams (OP4.37) policies are not triggered. The Project areas of the two possible mini-hydropower sites are farm-bush areas. There is a strip of approximately 100 meters on both sides of the river where disturbed natural forest is still present. The impacts on this disturbed natural forest strips will be local in the area of the weir and the reservoir. According to available information, no important wildlife exists in the area. There are no chimpanzees in the wider Project area and no endemic or endangered species are present. For these reasons, the Natural Habitat Policy is not triggered. Local people use the remaining forest areas for their own daily use. There are no logging activities near the two possible mini-hydropower facility locations. For these reasons, the Forest Policy is not triggered. The

Safety of Dams Policy is also not triggered. The design of the five meter high weir will take sound engineering practices into account. Any dam safety issues, including the safe routing of an exceptional flood, have been addressed in the Environmental and Social Management Framework (ESMF, see paragraph below) and will be addressed in any Environmental and Social Impact Assessment (ESIA) undertaken for this activity.

Safeguard policies triggered

Safeguard Policies	Yes	No
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

40. RREA has prepared 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 yet 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. The RPF 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.

41. The RPF contains a screening mechanism to identify whether an Environmental and Social Impact Assessment (ESIA) would need to be prepared would need to be prepared after the feasibility studies have been finalized and the location of the hybrid mini-grid facilities and their social and gender impacts are known.

42. An Environmental and Social Management Framework (ESMF) has been prepared to identify the potential impacts of Project activities, especially the impacts of the mini-hydropower plant. 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) will apply, 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.

43. The preparation of the safeguard documents (i.e., ESMF, RPF) followed a broad-based and in-depth consultation approach that includes 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 would be the beneficiary feedback mechanism. Main concerns raised would be listed, based on the conclusions of the ESMF and RPF. The terms of reference for the ESIA and RAPs would include a strong gender component. Any ESIA or RAP that would be prepared during Project implementation would include a consultation process and would be reviewed and cleared by the Liberian Environmental Protection Agency and the World Bank, and disclosed in-country and in the Bank's Infoshop before any construction begins.

44. The ESMF and RPF were disclosed in-country and at the World Bank InfoShop on November 12, 2015. The subsequent ESIA 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

45. 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 a qualified Environmental and Social Specialist to be responsible for overseeing Project compliance with the environmental and social policies and guidelines established under the ESMF and RPF related to component 1 in accordance with national and Bank safeguard policies, environmental, health and safety guidelines and procedures. The RREA Environmental/Social Specialist would be responsible for the overall supervision of the CESMP and the environmental and social aspects outside the scope of the CESMP, including the adequate implementation of the RAP/ARAPs and monitoring of the grievances. This new staff would be trained on World Bank safeguards requirements. The Owner's Engineer will supplement RREA's capacity to supervise the adequate preparation and implementation of the ESMF and RPF. 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 Construction Environmental and Social Management Plan (CESMP). The Owner's Engineer would supervise the implementation of the CESMP and hire qualified staff for this purpose.

Annex 4: Implementation Support Plan

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 the low capacity for implementation and a challenging and fragile country situation.

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 that NRECA's technical assistance is aligned with the Project's and the safeguards measures are correctly applied. It would also ensure proper application of the PIM. 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 the 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 would continue to ensure compliance with environmental and social safeguards related to the infrastructure projects.

Overall Support Implementation Needs

8. The Bank team would 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 12 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-grid	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		

12-60 months	Technical implementation support	Energy Specialist and Hydropower Engineer	550	
	Social and environmental safeguard implementation support	Social Safeguard Specialist & Environmental Specialist		
	Development of regulation for rural electrification	Rural electrification specialist		
	M&E implementation support	M&E Specialist		
	Financial management & procurement implementation support	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	30	1	HQ based
Power Engineer	20	0	Country office based
Renewable Energy Specialist	15	1	HQ based
Procurement Specialist	10	2	Based in region
Financial Management Specialist	10	0	Country office based
Environmental Specialist	15	1	Field based
Social Specialist	20	2	Field based
Gender Specialist	10	1	Field based

Annex 5: Economic and Financial Analysis

1. This annex provides an economic and financial analysis for decentralized electrification activities (Component 1) and for the market development of stand-alone systems (Component 3).
2. The rationale for public sector financing for investments under the proposed project rests primarily on the characteristics of the Project. It would finance the first mega-watt scale hydropower based decentralized grid for public electricity provision that would be installed by RREA, as well as provision of solar systems throughout the country. The Project would also assist in the development of regulations for decentralized electricity services through technical assistance. The high-risk country environment, a legal, regulatory and institutional framework that is under development, and the high capital costs of renewable energy make it an unlikely candidate for private sector financing. The SREP grant would finance the capital costs of the small hydropower plant that would supply most of the electricity for the mini-grid and part of the costs of the solar systems, making the electricity services affordable and sustainable.
3. In the context of this Project, the World Bank provides significant value added. It is already a close partner of the GoL in other energy sector, activities and has played a critical role in development of the Project, including: (i) carrying out a pilot hydro-based mini-grid in Yandohun; (ii) implementing the LLL Program; (iii) assisting in mobilizing SREP financing, together with AfDB; and (iv) bringing experience with renewable energy based electricity services from other countries in Africa.

Economic Analysis of Component 1

4. The economic analysis shows that component 1 is 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 (see Table 3). 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, in order to select the optimum technology configuration based on the information currently available. The main investment costs of the Component include the capital investments and operation and maintenance activities related to the mini-grid, both excluding the impact of any tax or subsidy for the purposes of the economic analysis. Economic benefits were estimated based on avoided costs of electricity substitutes. The economic analysis takes into account the impact of CO₂ derived from the use of diesel generation as a back-up but does not account for the positive impact of the displaced diesel self-generation by productive, commercial, and public entities or other positive externalities directly or indirectly derived from the Project. The following table presents a summary of the macroeconomic assumptions used in the economic and financial models:

Table 1: Main macroeconomic assumptions (first 10 years 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

5. 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-grid in Lofa County would be households, 3.6 percent would be businesses, and 0.4 percent would be institutional customers.

6. The economic benefit of electricity services from the mini-grid for households is estimated at US\$11 per month based on avoided costs for electricity substitutes for lighting and communication. Poor grid-connected households in Monrovia spend US\$11 per month on energy while households outside of Monrovia pay US\$12 per month for the equivalent of 6 kWh in lighting and other energy services from electricity substitutes such as kerosene, candles and dry cell batteries (see Table 2). The economic analysis assumes that household demand for electricity from the mini-grid would reach 20 kWh/month in the fifth year of Project implementation. After the fifth year, it is assumed that residential demand grows at 1.5 percent per year for three more years.

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

	HH using	% of Sample	Average kWh/Month-Users	Average kWh/Month-Sample	Average Cost/kWh	Average Spent per Month - Users	Average 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%	.30	0.03	\$18.00	\$5.37	\$0.65	5.5%
Palm Oil Lamp	108	7.0%	.10	0.01	\$20.67	\$2.11	\$0.25	2.1%
Candles	137	8.9%	.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

7. For businesses and institutions, benefits are estimated as the avoided cost of generating electricity using diesel generators (including economic capital and fixed operating costs of generation equipment, and using the border price of diesel plus economic cost of diesel transport to site). It is assumed that 80 percent of the population in the areas benefitted by the Project would connect to the mini-grid. 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.

Table 3: 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
<i>Subtotal</i>	<i>000 USD</i>	<i>-9,964</i>	<i>-8,391</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>-1,310</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>-1,310</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>-1,310</i>	<i>0</i>	<i>0</i>	<i>9,385</i>
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
<i>Subtotal</i>	<i>000 USD</i>	<i>0</i>	<i>0</i>	<i>-554</i>	<i>-639</i>	<i>-734</i>	<i>-771</i>	<i>-812</i>	<i>-855</i>	<i>-892</i>	<i>-931</i>	<i>-973</i>	<i>-1,017</i>	<i>-1,064</i>	<i>-1,115</i>	<i>-1,168</i>	<i>-1,225</i>	<i>-1,286</i>	<i>-1,351</i>	<i>-1,421</i>	<i>-1,495</i>
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
<i>Subtotal</i>	<i>000 USD</i>	<i>0</i>	<i>-86</i>	<i>-115</i>	<i>-114</i>	<i>-113</i>	<i>-112</i>	<i>-111</i>	<i>-110</i>	<i>-109</i>	<i>-108</i>	<i>-107</i>	<i>-106</i>	<i>-105</i>	<i>-104</i>	<i>-103</i>	<i>-103</i>	<i>-102</i>	<i>-101</i>	<i>-100</i>	<i>-99</i>
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%																			

8. *Sensitivity analysis.* A sensitivity analysis shows that the economic viability of the Project is robust to changes in the key parameters (see Table 4). The analysis was performed following a “break-even” methodology under which, for every scenario, the parameter being tested is stressed until the NPV (at a 10 percent discount rate) of the mini-grid is equal to zero. Variations in the following parameters were analyzed: construction delays, cost increases, lower than expected number of connections, purchase by plantations of 25 percent of the hydropower generation surplus during the wet season to replace diesel-based self-generation, and reduction of electricity demand from households.

Table 4: Results of the sensitivity analysis of Voinjama-Foya-Kolahun-Massambolahun/Bolahun minigrid based on 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 capital cost 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

Financial analysis of component 1

9. The financial analysis shows that an average tariff of US\$0.26 would be required to fully recover capital and recurrent costs and allow a return on working capital to the operator. This is about half the average tariff in Liberia (US\$0.52/kWh tariff). A household served by the mini-grid would pay US\$5.20 per month for 20 kWh of electricity compared to the US\$12 per month currently paid for poor quality energy services. The tariff would include the fuel costs for diesel in the dry season, service to the users within the area of the mini-grid, operating and maintenance costs and a return to the operator. The financial analysis uses a standard project financial model to determine the discounted cash flow to the mini-grid in nominal US Dollars.

10. The following assumptions were used for the financial analysis in addition to the assumptions for the economic analysis:

- 20 percent tax on diesel;
- Initial capital expenditures financed through grants; no other subsidies provided.

- Financial rate of return equal to 14 percent (pre-tax current USD) on the operator's working capital.

11. *Sensitivity Analysis.* A sensitivity analysis shows that eliminating the tax on diesel would decrease by 10 percent the average electricity tariff required from US\$0.26 to US\$0.23 per kWh.

Economic Analysis of Component 3

12. The NPV over the five year life of the PV LED systems sold under the Project would total US\$4.2 million, discounted at 10 percent based on an economic cash flow analysis in real 2015 US\$. The economic cost of the PV LED lamps is recovered within the first year, making this a highly attractive investment for lighting services.

13. Since the quality of light from alternative sources varies, 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 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. There is a clear cost advantage for pico-PV products on the basis of equivalent lighting provided.

Table 5: Economic analysis of lighting alternatives¹⁶

	PV LED lamp	PV LED lamp	Lantern powered by dry cell batteries	Kerosene Lamp	Candles
	1*3W LED	4*3W LED	(3 * type D)		
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
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

¹⁶ Data from *Renewable Off-Grid Power & Lighting Market Development in Liberia* (2012)

14. Benefits in the economic analysis of the component are estimated as the avoided costs of the services to be replaced by the solar products. The replacement of one lantern powered by dry cell batteries by two solar lamps equals an economic benefit of approximately US\$61 per year (see Table 5). It is assumed that the 75,000 solar systems¹⁷ 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 Table 5 are assumed to replace one battery powered lantern of the type in column 3).¹⁸ The analysis provides a lower bound for the economic benefits, because it does not account for the fact that the solar systems provide a greater level of service by providing more lumens of better quality light and allow for mobile phone charging. It also does not take into account the environmental and health benefits in comparison with the alternatives based on fossil fuel or disposal batteries.

15. The estimated costs of the PV systems exclude duties and taxes. Costs are estimated at 24.4/unit (CIF) and the average selling price is estimated at US\$32.5/unit.

Financial Analysis of Component 3

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). While the rate of return appears quite high, the sensitivity analysis showed that the returns were highly sensitive to small reductions in expected sales and increases in costs, highlighting the narrow profit margins and risks of entering an innovative business in a very competitive environment.

16. The financial analysis assumes that the Project's retail network would 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 would be five years, at the end of which it is expected that the market participants would have accumulated enough capital to phase in a gradual transition where private actors are incentivized to increase their responsibilities while the support by RREA is scaled down.

17. The Project would promote the sale of solar 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 provide an initial small amount of capital to finance: (i) an initial purchase of solar products from RREA; (ii) purchase of equipment needed to perform sales (laptops, mobile phones, etc.); and (iii) retain some money for working capital needs.

18. The financial analysis also assumes:

a. Local retailers buy and sell solar products in cash, no credit is available.

¹⁷ The economic and financial analysis uses the ratio of 1.8 people given electricity access per solar PV system. The conversion factor is based on current distribution of systems and the SE4ALL and Lighting Global access framework.

¹⁸ Pico-PV lamps are shown to have a reasonably long life based on 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 analysis a 25 percent mortality rate per year was assumed.

- b. The annual sales of pico-PV products are estimated to be 15,000 units at a selling price of US\$32.5/unit and a purchase price of US\$24.4/unit.¹⁹
- c. The Project provides a subsidy for the transport costs of importing the systems estimated at US\$4.88/unit. However, this subsidy is phased out in two years at 50 percent rate per year. A full pass-through of the transport costs to the selling price is further assumed after two years.
- 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.

19. The financial analysis of this component was 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. Table 6 below presents the results for the base case scenario.

Table 6: Projected financial statements of retailers selling solar products under the Project (in nominal US\$)

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	-	-	-	-	-	-
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	-	-	-	-	-	-

¹⁹ 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.

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 ²⁰				
FIRR	25.2%					

20. 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). They also show that the financial ratios are adequate for this type of business (competitive environment with low operational margin).

Sensitivity Analysis

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

²⁰ Assumed dividend distribution policy equal to 70% of cash flow to equity

22. 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 do expenses need to increase to make FIRR = 14%?	+10.3%
Decrease in sales (switch value)	% reduction in solar products sold to make FIRR = 14%?	-8.3%

23. As can be observed, the 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. This occurs because of the small operational margin ratios already observed in the financial model. These results show that the local retailers need to be aware of the importance of maintaining tight control on expenditures.

Annex 6: Scaling-Up Renewable Energy Program (SREP) in Low Income Countries

Indicator	SREP/IDA Project	Transformational Scaled-up Phase (IPRE ²¹ Targets by 2020)
Annual electricity output from RE as a result of SREP interventions (GWh)	5 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: <ul style="list-style-type: none"> • 50,000 people (mini-grid) • 100,000 people (solar) 	360,000 people (mini-grid, solar), representing 9% of Liberia's population
Financing leveraged through SREP funding [US\$ million]	US\$4.5 million, of which: <ul style="list-style-type: none"> • WB (IDA) US\$2.5 million • Norway US\$1.5 million • AFREA/SE4ALL US\$0.5 million 	US\$128.5 million, of which: <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Tons per year [tCO_{2eq}/yr] • Tons over lifetime of the investment [tCO_{2eq}] 	<ul style="list-style-type: none"> • 3,174 – 4,762 tCO_{2eq} /yr • 63,496 – 95,244 tCO_{2eq} over 20 year lifetime 	<ul style="list-style-type: none"> • 22,279 tCO_{2eq} /yr • n/a
Other co-benefits <ul style="list-style-type: none"> • 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 used for lightning or communication • Incomes raised and decentralization strengthened 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-grid and standalone solar systems • Support for effective and wide delivery 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 through the provision of access to increased economic opportunities to female 		

²¹ The SREP Liberia Investment Plan for Renewable Energy (IPRE) was endorsed by the SREP Sub-Committee in October 2013.

A. Introduction

Country and sector context

1. **Problem Statement.** Liberia is a low-income country with a population of 4.4 million and a Gross Domestic Product (GDP) estimated at US\$2 billion in 2014. 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. Liberia made notable progress in the reduction of poverty between 2007 and 2010, in 2010 approximately 56.3 percent of the population was estimated to live below the poverty line (56.9 percent in rural areas).²² In 2014, Liberia ranked 175 out of 187 countries on the Human Development Index (HDI) and 145 out of 152 countries on the Gender Inequality Index (GII), highlighting the immense poverty and social development needs of the country. Liberia still faces many challenges in laying the foundation to transition from post-conflict recovery to long-term development. 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 quarter of the population lives.

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

3. Improved 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, reducing 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. The majority of households in the towns are engaged in agriculture and trade with Monrovia and other locations, related services (such as 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 local economies and hinders

²² Liberia Poverty Note – Tracking the Dimensions of Poverty (World Bank, 2012)

the development of income-generating activities. Women are still amongst the poorest in rural communities.

5. LEC's customer base has increased more than tenfold in five years, from 2,469 customers in July 2010 to 30,485 customers in January 2015. 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 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 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.

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 electricity services targets, 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 is beginning to exploit its renewable energy potential. Hydropower potential on some major rivers is seasonal. The generally flat topography requires extensive civil works, which increases the costs of the hydropower plants. Liberia has good prospects for solar photovoltaic (PV) systems with global horizontal irradiation similar to Spain. While traditional biomass meets the energy needs for cooking and heating of 90 percent of the population, its use 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 GoL, with the support of donors, has started to develop electricity and lighting services in rural areas and small towns. In 2010, the GoL 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 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-grid	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 Renewable Resource Assessment	1.0	-	1.0	-	-	-	-	-	2.0	-	-	2.0
	-	-	-	0.5	-	-	-	-	0.5	-	-	0.5
Regulatory/Policy Support	-	-	0.5	0.5	-	-	-	-	1.0	-	-	1.0
Training & Capacity Building Knowledge Management—M&E	0.5	0.5	-	0.5	-	-	-	-	1.5	-	-	1.5
	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-grid	-	-	-	-	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 objectives of the Liberia Renewable Energy Access Project (US\$25 million SREP, US\$2 million equivalent IDA) are to increase access to electricity and to foster the use of renewable energy sources. The proposed Project would support a mini-grid powered mainly by renewable energy in small towns and rural areas, strengthen institutions and regulations for decentralized electricity services, and support the scale-up of the Government's initiative to foster a market in Liberia for off-grid solar energy 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-grid, as well as the same entities nationwide through stand-alone solar systems. The Project would also contribute to enhancing the capabilities of RREA.

11. The Project is comprised of three components. The *first* component would finance the expansion of access to affordable, reliable, year-round electricity services through the implementation of decentralized electrification through a mini-grid with a capacity of about 2 MW in Lofa County, benefitting approximately 50,000 people. SREP would finance hydro-based power generation facilities, as well as distribution lines and connections for households, businesses, and public entities. Based on preliminary analysis, the Project would focus on the Northwest corridor connecting the main towns of the county, which are Voinjama, the county capital, Foya and Kolahun. The mini-grid would supply electricity based on hydropower during the wet season (approximately eight months) and diesel-based power during the dry season. The feasibility study will optimize the design of the hydropower plant to maximize the year-round hydroelectricity generation. Funding from SREP would be used to finance the hydropower generation and distribution system, while IDA would cover the diesel back-up generation.

12. Two potential hydroelectric generation sites have been identified near Kolahun in the Kaiha River, a site known as 'Kaiha 2' appears to be the most likely site to be selected to supply electricity to the mini-grid. The final results of the prefeasibility study will be used to validate the site selection and technology configurations. Preliminary analysis indicates that the total cost for the 2 MW mini-grid, including generation assets, distribution grid and connections, would be approximately US\$20 million. Technical assistance would help define adequate O&M contract arrangements that would assure the sustainability of the mini-grid 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, would be made by RREA based on a sound business plan and legal framework of the sector that would be developed with the technical assistance financed under this Component of the Project. The business model selected for the proposed mini-grid would also serve as a model for future rural electrification efforts in the country.

13. The *second* component would 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 would finance the development and strengthening of the local market for solar products and the provision of access to modern energy services for over 100,000 people. See Annex 2 for the detailed description of all Project components.

14. **Transformation.** The proposed Project would 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 solar products nationwide. The successful implementation of the Project would 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 mini-grid, combined with the technical assistance offered under the Project, would support the transformation by improving the enabling environment to attract private investments in the medium to long term.

15. The Project would scale-up the pilot decentralized electrification projects already underway by RREA with the implementation of a MW-size mini-grid and the implementation of a sustainable business model to operate and maintain the electricity service. The technical assistance component would help identify and assess the suitability to local conditions of different business models to engage the private sector in rural electrification. Additionally, the Project would support the development of solar 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 solar products and the resulting competition from low quality products.

16. **Rationale for SREP financing.** Lofa County has a substantial untapped potential for renewables, especially hydro and solar. The proposed Project would help demonstrate the viability of renewable energy based 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. The use of SREP grant funding would be crucial to lower the high upfront costs of hydro-based renewable energy generation, thereby making end-user consumer tariffs more affordable. The demonstration effect of the proposed mini-grid would increase the attractiveness of this type of operation to donors and investors potentially interested in rural electrification. SREP support would also help demonstrate the feasibility of business models to operate renewable energy based rural electrification projects, which would increase the capacity of private sector to participate in this type of project, either as operators, developers, and/or investors in future projects. SREP support would also help increase the availability of clean energy in rural areas, therefore reducing the dependency on fossil fuel and shifting Liberia onto a low carbon development pathway.

17. The proposed Project would also help ramp up the local market for 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 would be crucial to strengthen the incipient commercial market for solar in Liberia. The use of SREP funding would support the development of a sustainable, private-sector led market for solar products in Liberia. SREP support in this segment is expected to be phased out during the Project. Therefore, the proposed Project would directly contribute to increasing and strengthening renewable energy-based rural electrification efforts in Liberia through mini-grids and stand-alone solar solutions. In the absence of SREP support, both the targeted areas of Lofa County and those people who would be served by stand-alone solar systems would not have electricity in the next decade; the limited provision of diesel-based electricity would continue in Lofa County and elsewhere in the country.

C. Assessment of Proposed Project with SREP Investment Criteria

Increased installed capacity from renewable energy sources

18. 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 the Firestone plantation (Margibi county) and the 30 kW SHP in Yandohun (Lofa County). Two additional kW-sized mini-grids are being installed elsewhere in the country. The proposed Liberia Renewable Energy Access Project would build about 2 MW of hydro-power installed capacity in Lofa County, generating around 5 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 Solar products would 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

19. The proposed 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 would also contribute to the Government's efforts to rebuild the economy post-Ebola, as the Ebola outbreak that hit Liberia starting 2014 originated in the area that is primarily targeted by the Project, namely Lofa County. The proposed mini-grid in Lofa County would benefit approximately 9,000 households (around 50,000 people). The solar system component would provide energy access to at least 100,000 people (Tier 2 access according to the SE4ALL multitier framework).

Low Emission Development

20. The proposed project would promote the utilization of sustainable energy in rural areas by providing electricity through a hybrid MW-scale mini-grid primarily powered using renewable energy, hydropower with backup diesel especially during the dry season. The Project would also promote the use of solar energy products nationwide through the development of a commercial market for solar products in Liberia. The CO_{2eq} emission savings capacity of the proposed 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 solar component. Applying the proxy-based method to estimate emissions of CO₂ equivalent based on diesel generated electricity (793.7 tCO_{2eq} per GWh), the proposed 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

21. Preliminary results of prefeasibility on hydropower sites in Lofa and Bomi Counties show 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's energy policy and also of the proposed 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.

22. 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.

23. 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 results of the prefeasibility study will be used to validate the site selection and technology configurations. Priority would 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.

24. The hydropower/diesel technology mix was selected based on a comparative analysis of a number of technology alternatives taking into account local circumstances. Lofa County's small hydro resources are not highly seasonal and hydropower can meet peak demand in 8 months per year. The proposed project location is more than 200 km from the national grid and will not be connected to the national grid even in the medium term. Lofa County is an important economic and agricultural hub and requires reliable electricity for productive uses. Diesel is easily available given its uses in transport and agricultural production. The hydro/diesel option has the lowest capital cost to provide uninterrupted electricity service for households and productive uses. Hydro/solar with batteries present the highest capital costs and the option of hydro/solar without batteries is too intermittent for productive uses (no energy in the night during the dry season). A triple technology mix (using hydropower, solar PV, and diesel) is too expensive because solar PV would not be used during eight months and the reduction of diesel/thermal generation needs will only affect the four months of the dry season. While a hydropower/diesel mix results in a higher tariff than other options, the US\$0.26/kWh tariff is well below the current US\$0.52/kWh paid by LEC customers.

25. Based on the 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 weir 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 meter high weir and 8 meters 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.

26. A distribution 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). The service connections would also be financed.

27. For component 3, meeting the existing lighting needs of consumers was analyzed, including use of dry cell battery powered lanterns, kerosene lamps, and candles, even though it does not account for the fact that the solar 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 solar products on the basis of equivalent lighting provided. In addition to the estimated economic benefits of solar 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, reduced risk for indoor pollution and fire hazards as well as reduced amount of hazardous waste.

Productive use of energy

28. Component 1 of the Project would provide reliable and affordable electricity through a mini-grid 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

29. The proposed Project is in line with the vision of the Government for the electricity sector. It would contribute to the expansion of electricity infrastructure for economic and social development using renewable energy (low carbon sources). The proposed Project would help to: (i) increase quantity and quality of electricity services in remote areas for households, public sector facilities, businesses and industrial loads; (ii) generate 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 by 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 (vi) increased public safety in service areas due to street lighting.

Economic and financial viability

30. 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. Since there is no electricity service to the Project area, 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 solar products and compare them to the costs of the systems. With this approach, 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.

31. 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 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 50 percent below the current electricity tariff in Monrovia. The analysis would 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 a 14 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

32. The proposed Project is defined to complement projects financed by other donors under the umbrella of IPRE. RREA would be responsible for coordinating various donor-financed activities in the sector. SREP financing for this project has facilitated the crowding-in of 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 prefeasibility 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 for an 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) the Agence Française de Développement has expressed a strong interest in cofinancing projects fostering access to electricity in Liberia. The current IDA portfolio in the energy sector of Liberia is focused on supporting 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

33. GoL 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 was 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 will 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 access to energy.

34. The Bank-executed Africa Renewable Energy and Access Program (AFREA) Gender and Energy Program would complement the various components of the Project through the following activities: (i) supporting a gender assessment for the decentralized electrification in Lofa; (ii) supporting RREA's development and implementation of a gender sensitive stakeholder consultation strategy for Project activities; (iii) 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; (iv) delivering training and capacity building on gender and energy to RREA; and (v) supporting the collection of sex-disaggregated data to adequately monitor and report on the outcome and impact of improved energy services on female and male beneficiaries.

Co-benefits of renewable energy scale up

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

36. *Environmental co-benefit:* An amount of 92,440 tons of carbon dioxide (CO₂) emissions would be avoided over a 20 years by the generation of electricity using renewable energy in the generation facilities of the mini-grid and standalone solar systems. In addition, the Project would

lead to local pollution reduction from diesel generators, kerosene lamps, candles, and dry cell batteries that would have otherwise been used for lighting or communication.

37. *Economic co-benefit:* Employment opportunities would 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 would help to build and sustain management and technical skills within rural communities, which would support increases in income and economic decentralization. Increased access to electricity would support income-generating activities in the evening as well as enhance communication over cell-phones and access to information on useful matters for business or agricultural production 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 would be also achieved.

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

D. Monitoring and Evaluation

39. Overall monitoring and evaluation of the Project activities would 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 would be conducted by RREA. RREA would 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

40. 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, 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 would 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

41. *Institutional Arrangements.* The Act establishing RREA as a permanent and autonomous agency entered into effect in July 2015. RREA operates under the guidance of MLME, with RREA's Executive Director appointed by and reporting to the MLME Minister. This arrangement will continue until RREA's Board of Directors, in charge of providing strategic guidance and general oversight, is appointed. Board members 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 Board would facilitate inter-ministerial cooperation. The appointment of the Board is a dated covenant under the Project.

42. *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.

43. 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 report to the Executive Director of RREA and work with RREA's Technical Director and other technical and fiduciary staff already in place to implement the Project. 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

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

45. *Financial and technical viability of the rural electrification program.* Sustainability of the system 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-grid 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 environment for efficient and sustainable operation of the mini-grid.

46. *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.

47. *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.

48. *RREA's legal mandate for 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.

ANNEX 7: MAP

Liberia Renewable Energy Access Project

