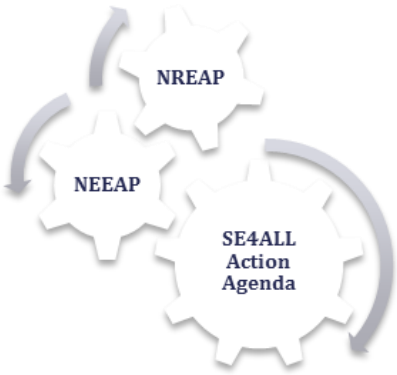
LIBERIA SUSTAINABLE ENERGY FOR ALL (SE4ALL) ACTION AGENDA REPORT 2015



Within the Process and Strategy on the Development of Sustainable Energy for all (SE4All) Action Agendas, National Renewable Energy Action Plans (NREAPs) and National Energy Efficiency Action Plans (NEEAPs) in the ECOWAS Member States

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With support of:

TABLE OF ABBREVIATIONS AND ACRONYMS

AA – Action Agenda
ADf – African Development Fund
AEA – Austrian Energy Agency
AfT – Agenda for Transformation
BTG – Beyond the Grid
CAPEX – Capital Expenditure
CLSG – Côte d'Ivoire-Liberia-Sierra Leone-Guinea Transmission Line Project implemented by the West African Power Pool (WAPP)
DESD – Decentralized Energy Services Delivery
DFID – United Kingdom Department for International Development
ECOWAS – Economic Community of West African States
ECREEE – ECOWAS Center for Renewable Energy and Energy Efficiency
EE – Energy Efficiency
EEEP – ECOWAS Energy Efficiency Policy
EPA – Environmental Protection Agency
EPA – Environmental Protection Agency of Liberia
EREP – ECOWAS Renewable Energy Policy
EU – The European Union
EUEI-PDF – EU Energy Initiative – Partnership Dialogue Facility
FAO -Food and Agriculture Organization
FAOSTAT -The FAO Statistical Database
FDA – Forestry Development Authority
FDI - Foreign Direct Investment
GAA – Action Agenda
GDP – Gross Domestic Product
GEA – Global Environmental Assessment
GEF-SPWA – GEF Strategic Program for West Africa
GHG – Greenhouse Gas
GIS – Geographic Information System
GOL – Government of Liberia
GTF – Global Tracking Framework
HIO – High Impact Opportunity
HIV/AIDS – Human Immune Deficiency Syndrome/Anti Immune Diseased
IDAE – Spanish Institute for Energy Diversification and Saving
IIASA – International Institute for Applied Systems Analysis
IMF – International Monitory Fund
IPRE – Investment Plan for Renewable Energy
JICA – Japanese International Cooperation Agency
LCSP – Large Scale Solar Projects
LESSP – Liberia Energy Sector Support Program by USAID
LHV – Low Heating Value
LISGIS – Liberia Institute for Statistical and Geographic Information System
LPG – Liquefied Petroleum Gas
MDG – Millennium Development Goals
MFDP – Ministry of Finance and Development Planning
MLME – Ministry of Lands Mines and Energy
MOA – Liberia's Ministry of Agriculture
MSW – Municipal Solid Waste
NEC – National Energy Committee
NEEAP – National Energy Efficiency Action Plan

NORAD – Norwegian Agency for Development Cooperation
NREAP – National Renewable Energy Action Plan
OPEX – Operational Expenditure
OPIC – Overseas Private Investment Corporation
PRS – Poverty Reduction Strategy
PV – Photovoltaic Solar Technology
RE – Renewable Energy
RESCOs – Rural Energy Service Companies
RFUND – Rural Energy Development Fund
RRA – Renewable Readiness Assessment
RREA – Rural Renewable Energy Agency
SE4ALL – Sustainable Energy for All
SREP – Scaling-up Renewable Energy Plan
UN – The United Nations
UNDP – United Nations Development Program
UNEP – United Nations Environmental Program
UNICEF –The United Nations Children's Fund
UNIDO – United Nations Industrial Development Organization
USAID – United States Agency for International Development
WAPP – West African Power Pool
WB – The World Bank

Units of Measure

dam^3 – cubic decameter or 1,000 m^3 or 10^6 L, described in some sources as a ML (Megaliter) GWh – Gigawatt hour (10^9 Wh)
ha – hectare
hm^3 – cubic hectometer or 1,000,000 m^3 or 10^9 L, described in some sources as a GL (Gigaliter) kg – kilogram
kWh – kilowatt hour (10^3 Wh)
L – liter (decimeter or dm^3)
m^3 – cubic meter
Mt – Megatons (10^6 tonnes)
MW – Megawatt (10^6 Watts)
MWh – Megawatt hour (10^6 Wh)
TJ – Terajoule (10^{12} J) Tonne -metric ton

LIBERIA SUSTAINABLE ENERGY FOR ALL (SE4ALL) ACTION AGENDA

EXECUTIVE SUMMARY

This report provides an overview of the Liberia Sustainable Energy for All (SE4All) Action Agenda for the transformation and development of the Liberian Energy Sector to achieve the ECOWAS policy objectives and energy access Targets for 2020 and 2030 for Liberia. It provides an evaluation of the 2009 approved National Energy Policy of Liberia (NEPL) and analyses the current status and gaps and the revised NEPL targets.

The ECOWAS Renewable Energy Policy (EREP) and the ECOWAS Energy Efficiency Policy (EEEP) were adopted by the ECOWAS Member States in October 2012 and the ECOWAS Heads of States on 18 July 2013. The policy documents were prepared with technical support of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and a broad range of international partners (UNIDO, EUEI-PDF, GEF-SPWA, Austria, and Spain). The policies include minimum targets and scenarios for renewable energy (RE) and energy efficiency (EE) and measures, standards and incentives to be implemented at both regional and national levels.

Implementation of power sector liberalization reforms aimed at stimulating private sector participation through the ECOWAS Renewable Energy Policy and Energy Efficiency Policy initiatives in Liberia, will enable the country to mobilize significant private sector investments in the energy sector.

The SE4All Action Agenda for Liberia is intended to address the energy challenges of ending energy poverty; ensuring access to electricity and modern energy sources for cooking and heating to everyone; and strengthening equitable economic growth; addressing growing energy demand; slowing down the adverse impacts of climate change in Liberia by reducing GHG emissions; and combating local environmental impacts from energy-use.

Liberia recently passed into law the act creating the Rural Renewable Energy Agency (RREA) and also passed into law the 2015 Electricity Law of Liberia. Among other projects, the SE4All Action Agenda is also promoting projects to develop both grid and off-grid solutions expected to become the first non-governmental (non-LEC operated) utility ventures.

If these projects are funded and implemented, they will demonstrate that mini-/off-grid and stand alone solutions have potentials to make high-value impacts in Liberia. The programs are also intended to provide both the policy and the enabling legal and regulatory framework, as well as operations and management structures that demonstrate commercial viability. This could enable a nationwide rollout of more mini/off-grids and stand alone systems in the peri-urban and rural areas.

Based on an assessment of the current status of the Liberian power sector, the SE4ALL Action Agenda has charted a map for Liberia to achieve sustainable energy for all and a way to make faster progress in the energy sector development process. Currently, renewable energy (for electricity generation) accounts for less than 2 percent of the electricity generation mix in 2014, and energy generation and consumption efficiencies are among the least in the West African region.

This SE4ALL Action Agenda report along with the accompanying NREAP and NEEAP present the comprehensive package of policy measures, including legal, fiscal, financial and economic incentives, and investment plans for phasing out (or substantially reducing) fossil fuel use for electric power generation and

creating the enabling environment for private sector players in the Liberian electricity sector. The NREAP and NEEAP contain targets for renewable energy, energy efficiency and electricity access, and the required policies and measures to achieve the set targets. Energy investments must increase by more than 200% of their current values per year until 2030 in order to double the current energy access levels by the target year.

The planned SE4ALL Action Agenda has set the stage for near-term growth and will contribute to the achievement of Liberia's electricity access targets.

PREAMBLE

This SE4All Action Agenda is based on the baseline data from a review of previous studies conducted by GOL and other national and international organizations, in Liberia.

The Sustainable Energy for All (SE4ALL) Action Agenda Initiative

The UN Secretary General established the Sustainable Energy for All Action Agenda Initiative (SE4ALL) in order to guide and support efforts to achieve universal access to modern energy, rapidly increase energy efficiency, and expand the use of renewable energy resources and technologies. The three core objectives of the SE4ALL are:

- Ensuring universal access to modern energy services.
- Doubling the global rate of improvement in energy efficiency.
- Doubling the share of renewable energy in the global energy mix.

The SE4ALL Action Agenda for Liberia has been developed with the back drop of key guiding principles namely:

(i) Building on existing plans/programs/strategies;
(ii) Political commitment and leadership exhibited for the ECOWAS Policies on renewable energy and energy efficiency;
(iii) A balanced and integrated approach;
(iv) An inter-ministerial and cross-sectoral approach;
(v) Adherence to sustainable development principles;
(vi) Participation and meaningful involvement of all stakeholders;
(vii) Gender equality and inclusiveness; and
(viii) Transparency and accountability.

Liberia as member state of ECOWAS is committed to the SE4ALL and desires to make progress with the United Nations (UN) SE4ALL Initiative, the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs). The commitment of the government of Liberia to SE4ALL Action Agenda has been developed with the backdrop of the country's overall development objectives of the Poverty Reduction Strategy (PRS), the national Agenda for Transformation (AfT) objectives, the National Energy Policy of Liberia (NEPL) and achievement of the MDGs, SDGs and the SE4ALL objectives in Liberia.

As member state of ECOWAS, Liberia subscribed and participated in the adoption of the ECOWAS policies on Renewable Energy and Energy Efficiency (RE&EE) to be implemented at the national level. This Action Agenda represents Liberia's contribution to the achievement of the UN Sustainable Energy for All (SE4ALL) initiative.

The Baseline Data Report is contained in a separate document developed with support of the ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE). This SE4All Action Agenda report for Liberia was validated by the Liberian Energy Sector Stakeholders Experts Group Meeting on April 22, 2016 and approved by the MLME in Monrovia and is in line with the findings from the above mentioned review of previous studies and resources assessments for the development of grid, off-grid, mini-grid, micro systems and beyond the grid (BTG) programs, measures and capacities to connect services or apply renewable energy technologies over the planning period.

The technologies herein intended are based on those considered most appropriate least-cost technologies for the rural, peri-urban, and urban areas and other specific systems and applications in Liberia. This will

contribute to foster low-carbon economic growth and development. There is need for urgency and speed in the process of achieving the GOL's strategic national energy policy objectives of cost effective and quality energy access for all, and institutional reforms that provide the enabling environment for sustainable power sector development. These objectives are in line with the GOL's Agenda for Transformation (AfT). The Agenda for Transformation (AfT) is the Government of Liberia's five-year development strategy. It follows the Lift Liberia Poverty Reduction Strategy (PRS), which raised Liberia from post-conflict emergency reconstruction and positioned the country for future sustainable growth. The AfT — in its five year timeframe — is the first step in achieving the goals set out in "*Liberia Rising 2030"*, Liberia's long-term vision of socio-economic development.

This SE4All Action Agenda for Liberia has been developed along with the National Renewable Energy Action Plans (NREAP) and the National Renewable Energy Efficiency Action Plans (NREEAP), all of which have the objective of Liberia meeting the ECOWAS regional targets by 2020 and 2030. To support this planning process, ECREEE and its partners provided support for national and international experts to assist Liberia. In order to fulfill the quantitative and qualitative targets, portfolios of bankable projects that are considered attractive for private investors and financial institutions have been developed. In addition, the required transformations of the enabling policy environment have been planned and concrete actions designed for the implementation of renewable energy policies highlighted in this report. The Liberia National Energy Policy (NEPL) contains a set of national goals and activities that must be revisited, and a modern National Renewable Energy Policy (NREP) shall be crafted if Liberia is to meet the MDGs and the SE4All targets.

The accompanying reports (NREAP and NEEAP and the Scenario Appendix) have all been developed to map out a comprehensive policy and implementation strategy based on the targets, trajectories and the selected technology covering the period up to 2030**.**

Cross Cutting Issues in particular on gender and energy, creation of employment, environment and energy, energy poverty, energy and health, energy and education, energy and agriculture and economic empowerment, etc. are mainstreamed to advance equality for all citizens of Liberia so that all sectors including women and men, girls and boys all enjoy equal rights, opportunities, and access to electricity services and economic opportunities derived thereof.

The accompanying Liberia NREAP and NEEAP to this SE4ALL are proposed for the period up to 2030 and expected to be reviewed every five years from the date of launching. We have also proposed a selected modus operandi for implementing the NREAP based on the action plan and mobilization of stakeholder engagements, coordination, international and national government support and capacity development.

In addition to other targets and objectives, emphasis are made on the development of improved rural energy planning and technical department capacity, transparency in operations, and/or enhanced management skills and structures to effectively accelerate rural electrification and ensure long-term sustainability and oversight of rural electrification.

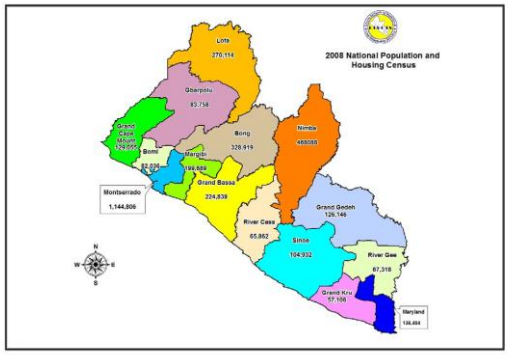
This SE4ALL AA takes into account and is in full alignment with the Liberia Investment Plan for Renewable Energy (IPRE) which was done by the MLME and the RREA in July 2013 with the aim of supporting the Government's objectives to provide access to electricity services to the rural and urban populations in order to accelerate the reconstruction and economic revitalization of the country. In 2008, Liberia approved the Poverty Reduction Strategy (PRS).The PRS was a medium term national development plan that laid out policies and programs that Liberia implemented for three years (from April 2008 through June 2011) in order to enhance national security, increase economic growth, strengthen governance and the rule of law, and develop infrastructure while providing basic services which over the three year period focused on things that would make a difference to the lives of ordinary Liberians: roads, clinics, schools, security, good governance, economic opportunities, clean water and electricity.

Following the PRS, the Government of Liberia in 2012 adopted the Agenda for Transformation (AfT) as the successor to the PRS as the country's five-year (2012 – 2017), medium term economic growth and development strategy that positioned the country for future growth. It is cast in the context of a long-term vision plan with the aim to "transform Liberia into a more prosperous and inclusive society and to create wealth to achieve middle income country status with annual per capita income of between US$1,000 and US$3,000 by 2030" in line with the UN definition.

1.0 INTRODUCTION

1.1 POLITICAL CONTEXT

The Government of Liberia (GOL) is a Republic form of government and declared independence on July 26, 1847. The current Constitution was approved on January 6, 1986. There are currently (December 2015) 20 approved political parties in Liberia.



The population of Liberia consists of 17 ethnic groups that make up the country's indigenous languages and population with English as the official language. Including indigenous population and descendants of repatriated American slaves who founded modern Liberia in 1822, the country is the oldest independent nation on the West coast of Africa. There is also a sizable number of Lebanese, Indians, and other West African nationals who comprise part of Liberia's business community. The capital city, Monrovia is the seat of the central government and the country is further divided into 15 administrative divisions known as counties: Bomi, Bong, Gparbolu, Grand Bassa, Grand Cape Mount, Grand Gedeh, Grand Kru, Lofa, Margibi, Maryland, Montserrado, Nimba, River Cess, River Gee, and Sinoe. The most populous county is Montserrado County, which houses the capital, followed by Nimba, Lofa and Grand Bassa (See Map Figure 1).

1.2 GEOGRAPHY & DEMOGRAPHY

Liberia covers a land area of 111,369 sq. km (37,420 square miles) and has 563 km boundaries with Guinea, 716 km with Cote d'Ivoire, 306 km with Sierra Leone and an Atlantic Ocean coast line of 579 km (350 miles). Several cities and fishing communities line the coast with some scenic tourism potentials.

According to the 2008 population census of Liberia the total population was 3,489,072. Most literature sources estimate the 2010 population to be 3,887,886 and the current (2014) population of Liberia to be approximately 4.1 million. The average annual Liberian population increase rose between 1974 and 1984 but had declined slightly by 2008 (Table 1 below). The table shows that the percent growth rate was appreciably high and increasing in the seventies and eighties but the current situation shows a decreasing trend. The national average population density of Liberia was 93 persons per square mile in 2008. This represents a 66 percent rise over the figure of 56 attained in 1984.

Montserrado County has the highest population density of 1,540 persons per square mile, and can be much higher in Monrovia and its environs. The total population of Montserrado County is approximately 29 percent of the national population). The city, Monrovia, is the business as well as political capital. Other urban areas of 5,000 or more persons in 2008 accounted 10% of the population while the remaining 61% was the rural population.

TABLE 1: LIBERIA POPULATION TREND, 1962 – 2008 INDEX				
	1962	**1974**	**1984**	**2008**
Population	1,016,443	1,503,368	2,101,628	3,489,072
Annual rate of growth	-	3.3	3.4	2.1

The mean **household size** declined from 6.2 in 1984 to 5.1 in 2008. In 2008 the population was 1,764,555 males (51%) and 1,724,517 females (49%). Average number of households was estimated to be 747,670 households in 2010.

Liberia's terrain consists of three areas: mangrove swamps and beaches along the coast; wooded hills and semi-deciduous shrub lands along the immediate interior; and dense tropical rain forests and mountainous plateaus in the interior. Liberia has 40% of West Africa's rain forest. The rain forest occupies roughly 45% of Liberia's land and is the source of its timber resources. The plateaus are cultivated for agriculture (27% of land) and the mountains (including Mount Nimba and Putu Mountain) are home to mineral resources—especially iron ore, gold and diamonds.

1.3 ENERGY RESOURCES

Liberia has significant **hydroelectric potentials** including the Cavalla River, the St John River and the St Paul River, conducive for the development of hydro-electricity. Studies show that Liberia could be a net exporter of electricity if its hydroelectric potentials are substantially developed. Table 2 below lists the six principal river basins along with their areas in Liberia.

TABLE 2: PRINCIPAL RIVER BASINS OF LIBERIA.		
River Basin	**Total Area (sq km)**	**Area in Liberia (sq km)**
Cavalla	11,670	5,300
Cestos	4,850	3,900
St. John	6,650	5,700
St. Paul	8,460	4,950
Lofa	4,100	3,550
Mano	3,200	2,440

The geographic location of Liberia means that the sun is overhead at noon throughout the year because of the country's close proximity to the equator. Solar Insolation is very intensive in all parts of the country. The potentials for **solar energy** are relatively high especially during the six months of Dry Season. Limited systematic solar radiation measurements are being done presently in Liberia and data quality on solar energy in the country is approximate. The average temperature ranges from 28°C in November (the beginning of the Dry Season in Liberia) to 32°C in June (the beginning of the Rainy Season).

Liberia has great potential for solar energy because it falls in the equatorial belt (which lies between latitudes 15°S and 15°N) and receives the second highest annual solar radiation on earth. Liberia's Solar Energy potentials, as in the case with hydro electric potentials, could meet all the electricity needs if substantially or

fully developed. Despite these enormous solar energy potentials, not much has been done to generate electricity from solar.

Liberia is endowed with a large variety of **biomass resources** believed to be more than enough to meet the country's electricity needs if developed. About 85% of the current annual energy consumption in the coastal regions is charcoal and 9% is firewood, while the hinterland uses up to 90% firewood and 9% charcoal as the sources of fuel for cooking, heating and drying. The charcoal cook-stove in general use in Liberia is referred to as "Coalpot" with the efficiency believed to be less than 10%. However, other more efficient biomass technologies (including biofuels, gasification, and charcoal production technologies, etc.) are available that could open opportunities for energy efficiency improvements and agriculture and rural development, and provide other socio-economic and environmental benefits A relatively small quantity of LPG is being used for cooking by a negligible number of households and commercial establishments.

There is very little or no potential for **wind energy** that can be commercially exploited in Liberia. Small potentials may exist at some coastal beaches but no systematic data has been assessed on wind energy resource potential.

1.4 MACROECONOMIC AND SOCIO-ECONOMIC CONTEXT

Liberia was traditionally noted for its academic institutions, iron ore mining, and rubber plantations. Political upheavals beginning in the 1980s and a 14-year civil war (1989-2003) largely destroyed Liberia's economy and brought a steep decline in living standards. Poverty in Liberia over the last quarter of a century has spread and deepened, with thousands losing their livelihoods and becoming displaced. It is estimated that 76% of the population live below US$1 a day (an increase from 55% in 1997) and 52% live in extreme poverty of under US$ 0.50 a day.

Liberia's GDP (IMF 2007 estimate) was $473.9 million with 2008 projected Real GDP growth of 9.6%. In 2011 GDP growth was estimated at 6.8%, a small increase from 5.6% in 2010 and 4.6% in 2009. The Per capita GDP (2006) was $185.50, and average annual inflation (2008, projected) was 9.0%.

Current impediments to growth include a small domestic market, lack of adequate infrastructure, high transportation costs, poor trade links with neighboring countries and the high dollarization of the economy. Liberia used the United States dollar 100% as its currency from 1943 until 1982 when the Liberian dollar was introduced, and continues to use the U.S. dollar alongside the Liberian dollar. Liberia is a low income country heavily reliant on foreign assistance for revenue. Richly endowed with water, mineral resources, forests, and a climate favorable to agriculture, Liberia has been a producer and exporter of basic products, primarily raw timber and rubber and is in the process of reviving those sectors. The **natural resources of Liberia** include iron ore, rubber, timber, diamonds, gold, and tin. Agriculture products include coffee, cocoa, sugarcane, rice, cassava, palm oil, bananas, plantains, citrus, pineapples, sweet potatoes, corn, and a variety of vegetables. The types of industrial sectors in Liberia consist of agriculture, iron ore, rubber, forestry, diamonds, gold, beverages, construction and small scale industries. Local manufacturing, mainly foreign owned, has been small in scope.

The **national budgets of Liberia** for fiscal years 2010/2011 to 2015/2016 are shown on table 3 below. The Fiscal Year runs from July to June of the following year.

TABLE 3: NATIONAL BUDGETS OF LIBERIA	
Fiscal Year	Approved Budget (Million US Dollars)
FY 2010/2011	369.4
FY 2011/2012	516.4
FY 2012/2013	672.1
FY 2013/2014	582.9
FY 2014/2015	660.2
FY 2015/2016	635.2

To revitalize the economy, the GOL developed a three pronged economic strategies in its Poverty Reduction Strategy (PRS) focused on:

1. Rebuilding critical infrastructure;
2. Reviving traditional resource sectors; and
3. Establishing a competitive business environment.

Initial actions in these areas have set the stage for near term growth. Infrastructure and basic services are being renovated or reconstructed (including airports, sea ports and roads). To revive traditional economic sectors, Liberia has since 2006 attracted foreign companies that have begun to reinvest in forestry, rubber, mining and ports. In addition, Liberia attracted foreign direct investments (FDI) in several non-traditional sectors including petroleum (the Government of Liberia believes there may be sizable deposits of crude oil along its Atlantic Coast), oil palm, hotels, finance and banking, industry and infrastructure. The table 4 below lists some basic current and projected economic data for Liberia 2010 – 2016.

1.5 ASSESSMENT OF LIBERIA'S FINANCIAL SECTOR

The financial statistics of the Liberian economy for the indicated year for which data was available to the author shows that Agriculture is the highest percentage contributor to GDP while the industrial sector is very small. Below are some estimated economic indicators for 2011. More detailed economic and financial statistics are contained in Appendix I of this report.

TABLE 4: ESTIMATED ECONOMIC INDICATORS OF LIBERIA (2011 US$)*	
GDP – Composition by sector (2002)	Agriculture (76.9%), Industry (5.4%), Services (17.7%) 2002 est.
Labor force	1.372 million (2007), world ranking 132
Labor force – by occupation	Agriculture (70%), industry (8%) and services (22%) (2000 est.)
Taxes and other revenues	35% of GDP (2011 est.), world ranking 66
Budget surplus (+) or deficit (-)	-0.9% of GDP (2011 est.), world ranking 53
Inflation rate (consumer price)	7.3% (2010 est.), 10% (2011 est.), world ranking 188
Commercial bank prime lending rate	14.3% (Dec. 31, 2010 est.), 15.7% (31 Dec. 2011 est.)
Current account balance	-$511.2 million (2011 est.), world ranking 111, -$692.5 million (2010 est.)
Reserves of foreign exchange	$579.5 million (Dec. 31, 2011 est.), world ranking 149
Exchange rates – Liberian $ per US$	74.2 (2011 est.); 85.0 (2015 est.); 90.0 (2016 est.)
**Source: EPA, "Liberia Initial National Communication"*	

1.6 LIBERIAN ELECTRICITY SITUATION

1.6.1 Current Access to Electricity

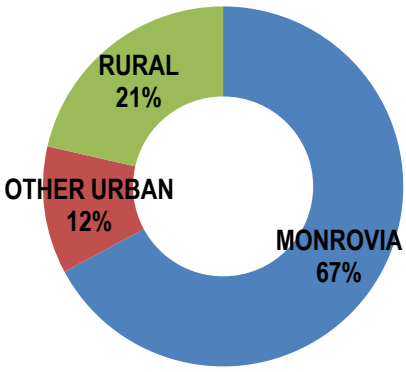
Currently (2015), only about 1.4% of Liberia's total population has access to electricity. Most households are largely dependent on traditional energy sources such as firewood and charcoal for cooking and heating and candles, battery-powered lights, and kerosene for lighting. The Liberia's Poverty Reduction Strategy (PRS, 2008) program made an assessment of households relying on self-generation (small size diesel and gasoline generator units) and reported access to electricity (including non-LEC generated electricity) to be approximately 0.94% in Monrovia, 0.16% in other Urban Areas (Other Cities and Towns with populations greater than 5,000) and around 0.3% in rural areas (Rural Areas here refers to almost all parts of Liberia other than the greater Monrovia area and towns, villages and communities less than 5,000 people). Table 5 below shows the 2010 rate of electricity access in Liberia.

TABLE 5: THE 2010 TOTAL POPULATION ACCESS TO ELECTRICITY

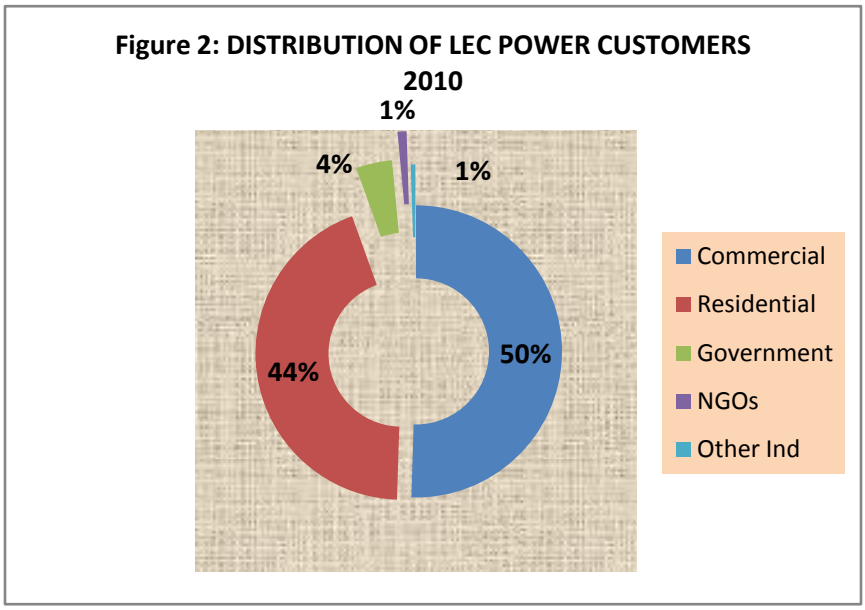
Sector of the Population	For 2010 Population	Population Share %	Population Having Access	Access as % share of Total Population	Estimated Households Connected
MONROVIA	1,127,487	29%	36,546	0.94%	7,166
OTHER URBAN	388,789	10%	6,221	0.16%	1,220
RURAL (68%)	2,371,610	61%	11,664	0.30%	2,287
TOTAL POPULATION	**3,887,886**	**100%**	**54,430**	**1.40%**	**10,673**

Out of the 1.4% of the population with access to electricity, 79% are in the urban areas (Monrovia & Others) and the remaining 21% in rural areas. See fugure 1 below.

Figure1: Sector of the 1.4% of Population Served With Grid Electricity Connections



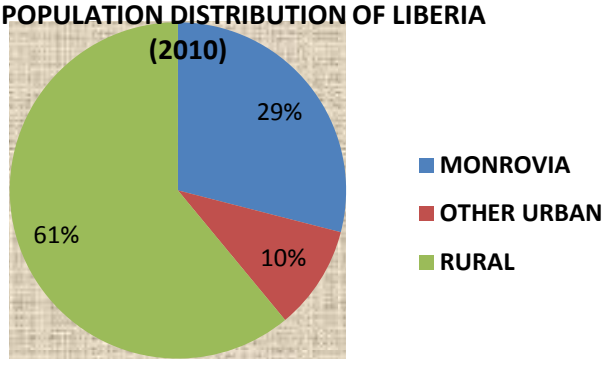
As of the end of 2010, LEC's system provided electricity to only around 7, 000 customers or connections as follows: commercial, 50.5%; residential, 44%; government buildings, 4%; nongovernmental organizations (NGOs), 1%; and the LEC and other corporations, 0.50%. Electricity supply by LEC only covered about 0.94% of Monrovia's households. See figure 2 below.



The most recent report (2014) estimated LEC's connections to total 9,000 customers which would increase Monrovia's population having access to electricity to nearly 1.2% of the city. Overall electricity access of Liberia still stands at approximately 2%, a slight increase over 2010. The remainder of the population depends on small gasoline and diesel private generators, firewood, charcoal, candles, kerosene, and palm oil burners. These methods are highly inefficient, costly and polluting sources of energy.

LEC is currently experiencing problems such as lack of financing for spare parts and funding for new connections to increase its customers and fully utilize the current small generation capacity. In addition, there is the problem of limited distribution infrastructure and high tariffs all of which make off-grid; self-generation or IPPs generation options though costly but the only viable alternatives to the grid connected supply.

The total Liberian population distribution estimates for 2010 stands at about 29% were in Monrovia, 10% in other urban areas (such as rural county and district headquarters and towns other than greater Monrovia having population greater than 5,000) and 61% were rural areas. See figure 3 below.



1.7 PRIMARY ENERGY SUPPLY (ENERGY MIX, EXPORT/IMPORT)

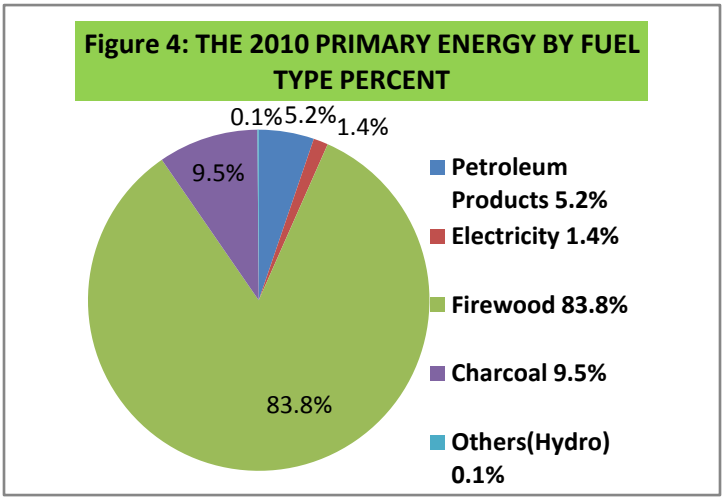
The total Liberia primary energy consumption for the year 2010 was estimated to be 13,683 GWh equivalents. The distribution of primary energy in percent of total energy consumption by fuel type is shown in table 6 below. In 2010 firewood represented approximately 84% of the total energy; charcoal came second with a little over 9% and petroleum products at about 5%; while the rest total slightly less than 2%. Firewood and charcoal consumption together constituted up to 93% of the energy mix. See the table 6 below.

TABLE 6: THE 2010 PRIMARY ENERGY BY FUEL TYPE

FUEL TYPE	PERCENT
Petroleum Products	5.24%
Electricity Generation	1.39%
Firewood*	83.76%
Charcoal	9.49%
Others(Hydro)	0.12%
TOTAL	**100.00%**

The primary energy situation in Liberia is characterized by a dominance of traditional biomass (solid fuels) consumption and low access to poor quality and relatively expensive modern energy services. Over 95% of the population of the low income category relies on firewood, charcoal, and palm oil, candles and kerosene for their cooking and lighting energy needs.

Modern energy services based on electricity and petroleum products are predominantly used for economic production, electricity generation and transportation, and mainly in the Monrovia area. Figure 4 below shows the relative percent share of the primary energy sources by fuel type for Liberia in 2010.



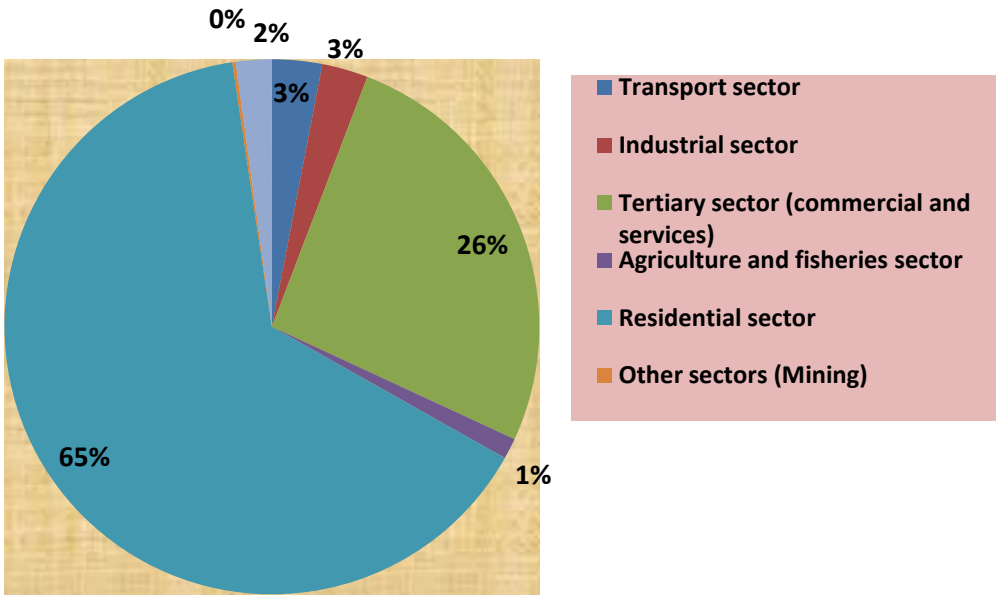
The sectorial distribution of primary energy in 2010 is presented in Table 7 below.

TABLE 7: THE 2010 SECTORAL DISTRIBUTION OF TOTAL PRIMARY ENERGY IN LIBERIA

Sector	Percent of Total
Transport sector	3.0
Industrial sector	2.8
Tertiary sector (commercial and services)	26.1
Agriculture and fisheries sector	1.3
Residential sector	64.5
Other sectors (Mining)	0.2
Non-energy use	2.2
TOTAL	**100.0**

The residential sector (mainly firewood and charcoal) was the leading consumer with 64.5%, followed by the tertiary sector (commercial and services including Government) with 26.1%. On the national level, the transport sector which uses petroleum products (mainly gasoline and diesel) came third with 3%, and the remaining sectors amounted to 6%. A pictorial representation is shown on the graph Figure 6 below.

Figure 6: PERCENT OF TOTAL PRIMARY ENERGY CONSUMPTION BY SECTOR



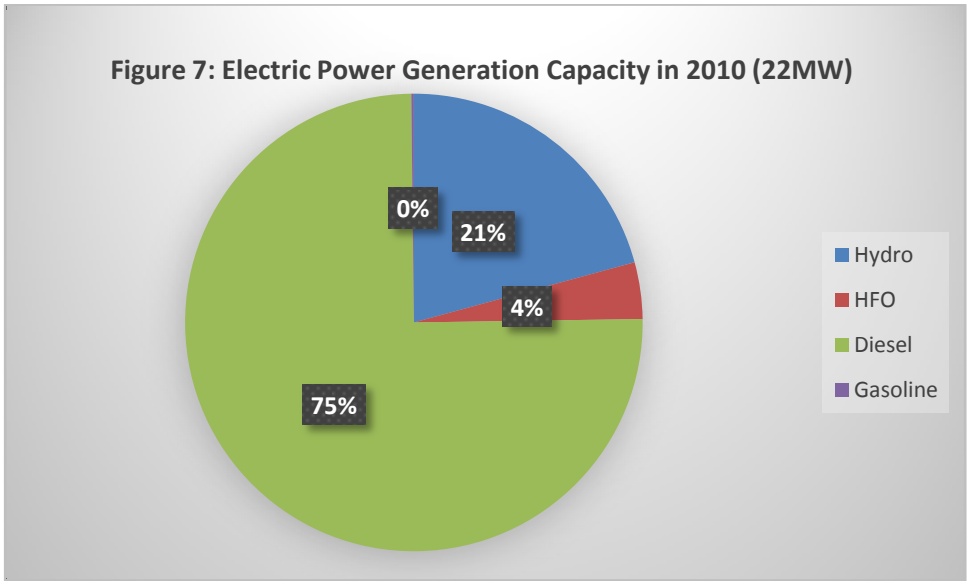
1.8 POWER INSTALLED CAPACITY, GENERATION, IMPORT/EXPORT)

The table 8 below gives the estimated electric power generation capacity for 2010 by type of fuel.

TABLE 8: THE 2010 INSTALLED GRID CONNECTED ELECTRIC POWER CAPACIY AND GENERATION BY FUEL TYPE

Installed Capacity (2010)			Estimated Generation	
Fuel Type	MW	% of Total	GWh	%
Hydro	4.6	21%	39.5	21%
HFO	0.9	4%	7.6	4%
Diesel	16.5	75%	142.7	75%
Gasoline	0.0	0%	0.3	0%
TOTAL	**22.0**	**100%**	**190.2**	**100%**

In 2010, the electric power installed capacity in Liberia was approximately 22 MW distributed as follows: Hydro Power, 21%; Thermal (HFO) capacity, 4%; Thermal (Diesel) 75% and Thermal (gasoline) <1% of the total installed capacity in Liberia. Power generation for 2010 is estimated at 190.2 GWh of which Hydro electric generation was 21%; HFO, 4%, Diesel, 75% and Gasoline, <1%. See Figure 7 below.



A negligible amount of solar power capacity is currently in Liberia but is increasing steadily. No firm figures as to the total solar capacity are available. The Biomass energy (Firewood and Charcoal) together constituted 93.3% of total primary energy while Petroleum Products was about 5.2% and electricity accounted for a negligible 1.4% of total energy consumption.

1.9 CROSS BORDER POWER EXCHANGE (IMPORT/EXPORT)

There are currently two important interconnection projects in operation between Liberia and the neighboring country of Côte d'Ivoire. i) **The Cross Border Rural Electrification** project which connects the Côte d'Ivoire network to three Northern and Eastern counties of Liberia (Nimba, Grand Gedeh and Maryland borders respectively). The project was completed in mid 2013 and is currently earmarked to supply up to 8MW of electric capacity and will eventually provide electricity to approximately 130,000 people. ii) **The "Côte d'Ivoire-Liberia-Sierra Leone-Guinea" (CLSG)** project earmarked to serve as a power transmission line. The project is being implemented by the West African Power Pool (WAPP), financed by several donors and is progressing well; all funding arrangements and legal issues having been resolved. The project is planned to bring up to 18 MW of power and will allow the connection of urban centers and rural areas along the route of the High Voltage lines tranveling across the country connecting the four Mano River Union Countries.

1.10 CURRENT RENEWABLE ENERGY SECTOR

1.10.1 National Actions and Status of the SE4ALL RE and EE Action Plans

To realize the objectives of the Sustainable Energy for All (SE4All), the Liberian government is in the process of developing integrated action plans that, if implemented will strategically transform the electricity systems of Liberia.

An SE4ALL Rapid Assessment Gap Analysis

An SE4ALL Rapid Assessment Gap Analysis Draft Report was completed in March 2013. The Gap Analysis provides a brief look at the energy situation in Liberia and reviews the state of the country in terms of the three SE4ALL goals, the main challenges and opportunities for major investments, and the required policies and enabling environments. The Action Plans Process now being undertaken is the next stage of activities that set the basis and background of the SE4ALL Action Agenda activities in Liberia. For the Action Plans, the project activities have commenced and are currently ongoing. The National Inception Report to ECREEE was submitted on the 3rd of June 2014 and the National Kick off Meeting took place on the 27th of June 2014. Liberia is planning to establish a country expert group or build up on an existing group (i.e. inter-ministerial group such as the NEC) which will serve as the national steering committee (SC) for the development and review of the National Action Plans in close partnership with the Ministry of Lands Mines and Energy and other key national stakeholders. In addition, an Action Plan is being developed to lay the groundwork to scale up actions in priority areas, undertake strategic reforms where needed, and attract new investments and financial support in Liberia**.**

1.10.2 The Power Africa Initiative in Liberia

Liberia has signed the MOU with the United States Government (USG) to implement the Power Africa Initiative in Liberia. This will spur investments, by the many partner companies and USG agencies that have signed up with the initiative. Action is needed to create national policy and financial environments that enable changes required for private sector investors, developers and financiers to participate actively in the electricity development sector of Liberia.

1.10.3 Current Programs of the RREA

The RREA is currently undertaking several programs and projects that are in line with the SE4ALL initiatives, including the following:

- Technical Support to Yandohun (Village level) Micro Hydropower Project Management Team;
- Lighting Lives in Liberia – commercialization of solar lighting products in Liberia;
- Development of Rural Renewable Energy Master Plan (REMP) and Solar Electrification of Public facilities in Zorzor, Lofa County;
- Scaling-Up Renewable Energy Programs (SREP);
- Proposed USAID's funded Beyond the Grid (BTG) Project to Support SREP Program Implementation;
- Cooperation Area-5 of Norwegian Institutional Cooperation Program with MLME/NVE;
- Management of Technical Assistance Contact for Small Hydropower Feasibility and Project Development in Rural Liberia funded by GOL
- Donation of 500 Solar Lanterns/Lamps with Mobile Phone Chargers to Ebola Response Teams in the 15 counties

To elaborate on some of the above listed projects we have highlighted the following two programs which hold potential for high impacts on the development of sustainable energy for rural and peri-urban populations of Liberia:

1.10.4 The Scaling-Up Renewable Energy Program (SREP)

Under the SREP project, the RREA through WB technical support has prepared a Renewable Energy Investment Plan for Climate Investment Fund (CIF) financing. Liberia has a USD $50 million allocation to be shared equally between the WB and AfDB. The WB will undertake projects in North-Central Liberia for a Small hydro in Bomi County (12 – 15MW) as priority of two options that were evaluated. Option one – Rural Access in Lofa County 0.5 – 1.5MW was not selected because Lofa sites will not have uninterrupted access and will need grid extension or back-up system, while the Bomi County site will benefit from overall system connection of residential and industrial load (including mines and plantations) in the area and seasonality compensation by diesel use will not be needed.

The AfDB on the other hand plans to focus on the South-Eastern Liberia (Maryland, River Gee, Grand Gedeh, and Nimba Counties - 3 sites to be assessed). The Norwegian Government/NVE Funded SREP Project Preparation will do pre-feasibility and feasibility studies of two mini-hydropower sites on the Kaiha River in Kolahun District, and Makona River field reconnaissance in Lofa County.

USAID Funded "Beyond the Grid" Project proposes to Support SREP Program Implementation – The Program is developed to strengthen RREA capacity to implement the USD$178 million SREP Investment Plan. The six key activities of the BTG activities are: (a) Strengthen RREA institutional capacity, (b) Transaction support facility, (c) Project implementation support, (d) Knowledge and training services,(e) Promotion of productive uses, and (f) Construction supervision and grid-tied renewable energy (optional).

1.10.5 GOL Funded Small Hydropower Feasibility and Project Development

The RREA and ENCO (Private) Limited of Sri Lanka have completed feasibility studies for four (4) Mini- and Micro-hydroelectric Power projects including technical design, specification, detailed cost estimates for construction as well as access road, and associated transmission and distribution networks for each mini/micro hydropower plant in four counties listed in the table 9 below.

TABLE 9: SMALL HYDRO FEASIBILITY PROJECTS

No.	Project	Location	Power Capacity	Estimated Cost (US$)
1	Wozi Mini-Hydro Power	Zorzor, Lofa County	1.7 MW	8,778,342
2	Ya Mini-Hydro Power	Bopolu, Gbarpolu County	450 kW	3,952,643
3	Marvo Mini-Hydro Power	Bopolu, Gbarpolu County	90 kW	2,229,568
4	Robertsport Micro-Hydro Power	Robertsport, Grand Cape Mount County	70 kW	922,324

1.10.6 MLME Through the Office of the Energy Advisor

The MLME through its office of the Energy Advisor to the Ministry outlined a number of programs that were in progress and some in the pipeline prior to the unfortunate outbreak of the deadly EVD which when implemented, will have high impact and value for the development of RE and EE in Liberia within the framework of the SE4ALL Action Agenda..
These include:

- Mein Creek (Kpatawee) Mini-hydroelectric Project which should have been one of Win Rock implementation projects is expected to be commenced with USAID funding when the Ebola Crises subsides;
- St. John River has three sites totaling approximately 100MW potential;
- Ya Creek potential hydro sites to be accessed;
- Solar Energy for the RIA – a concept paper on this potential was discussed with the MLME for up to 10MW Solar Project;
- Solumba Renewable (Biomass) Electricity Project – this project construction work through USAID funding commenced but is on stand still till the Ebola Crises end;
- Buchanan Renewable had a contract to do a 35MW Biomass Power Plant but the concession agreement has been canceled;
- Greenville Ports project has projects to develop renewable energy;
- Lofa County has potentials for mini-hydroelectric development at Kahai River, Boalahun River, and etc. where field assessment visit was made and found one of the sites to have potential of up to 1.5MW capacity.

1.10.7 Programs Outlined By LEC in Support of the Objectives of SE4ALL

The LEC outlined a number of programs which are in support of the objectives of the SE4ALL. These include the ongoing but temporarily suspended reconstruction of the 64MW Mount Coffee Hydro electric project. Other projects were in progress and some in the pipeline prior to the unfortunate outbreak of the deadly EVD bringing us to the current stand still.
These include:

- ESRAP a good program that has a $50 million allocation still sitting;
- Mein River Mini-hydroelectric Project;
- Solar-Diesel hybrid project proposal;
- RREA Rural Energy Master Plan;
- Solumba Biomass Electricity Project;
- Kwendi Biomass Electricity Project;
- Solar PV Home Systems for Gbarnway and Rural Homes;
- CLSG Transmission Line Project;
- Cross-border Towns Electrification project;
- T & D Transmission Extension Project; among others.

The Ministry of Lands Mines and Energy is expected to make follow up for the reactivation of the above itemized projects as soon as the EVD subsides. The role of LEC is to implement the technical and engineering operations.

The Development of Standalone systems, off-grid and mini-grid systems should be emphasized because the plan for the LEC Central grid connections to reach all the rural areas is off the LEC's table, the economics for such a plan are just not there. The concept of mini-grids appears to be the viable alternative, if approved by the Ministry and financed by investors or donors.

The contribution of renewable energy to the overall electric power generation capacity in Liberia is less than 10% of the total, even though Liberia is endowed with vast amounts of potential hydroelectric sites and great biomass resources. The Mount Coffee hydropower plant which had the capacity of 64 MW was destroyed during the wars. With the support of donors and the government, rehabilitation or reconstruction is currently in process to rebuild it to 64 – 70 MW capacity. It is yet uncertain when this might come on line; estimates are that the first phase of 1-2MW might come on line by 2017/2018. With the rehabilitated increased capacity and once commissioned, it will contribute to a significant share of the generated energy in the country. Studies show that the St. Paul River has other hydro potential sites upstream such as the Via reservoir scheme through dams regulating the river flow to provide large hydropower both during the dry and rainy seasons. Including other potential hydropower sites across the country, Liberia's hydropower potential could technically and economically provide up to 1,000 MW.

Wind energy does not constitute an attractive alternative in Liberia due to the very limited sites where the wind speeds can satisfy the required minimum wind speed of 7m/s for wind power turbans plants.
Solar energy is currently being exploited at increasing but still small isolated photovoltaic (PV) mini-grid systems through USAID support such as Gbarngway Village system in Lofa County, Solar system in BWI Kakata, and a few other systems supplying individual buildings (dispensary, clinics, and schools). Large scale solar plants (of PV or LCSP types) are currently not in Liberia but have the potentials of being economically and technically feasible.

On-grid and off-grid renewable energy technologies are particularly well suited to an off-grid, distributed generation system, and Liberia is endowed with significant renewable energy resources, including solar, biomass, and hydropower resources.

1.10.8 Existing Plans/Strategies and the Gaps

The RREA has launched a rural electrification planning process that will map out the strategies for the development of renewable energy, such as the Scaling-up Renewable Energy Program (SREP) that is being implemented including the distribution of solar lanterns with the initial target of 10,000 lights for the homes. The MLME also has the rural renewable energy assessment program that has not been funded for some time after the initial launching in five (5) south eastern counties. There is a need to complete the program in the remaining 10 counties; and also identify plans and technical analysis that are missing at this point and which should be developed subsequently to complete the picture. Furthermore, the Action Agenda should contain an assessment of existing management and operations strategies in light of the SE4ALL objectives as defined at the outset.
As an example, the GOL dedicated a rural micro-hydroelectric plant in the town of Yandahun, Lofa County (a 65Kw micro-hydro power plant) as the first community owned power system. The tariffs of the Yandohun power system were established by the board of the Yandohun Development Cooperative. The GOL shall provide support and empowerment for the development of such mini/micro grids around the country with the full participation and management of the local community and village level mini-grids as in the case with Yandohun.

In Yandohun, the tariffs were calculated to ensure sufficient funds for operation, maintenance and repair work as well as for savings for periodical overhauls. During the first 3 years RREA will provide support for any larger repairs. The monthly tariff per household will initially range from 70 -500 LD (1-6.25 USD/month in 2010) and will be calculated based on consumption and number of appliances owned by a customer. The tariff will be reviewed bi-annually by the board.

The National Energy Policy of Liberia provides for off-grid power operators to be given the opportunity to operate in Liberia at cost-reflective rates to enable all citizens including the poor to have sustainable access to clean electricity. Studies have shown that poor people are willing and able to pay for electricity if one takes into account the cost prayed by the poor for other sources of energy (for cooking and lighting). A recent study (by the WB AFTEG) revealed the average willingness to pay for electricity in the rural areas of Liberia to be US$2.17 per kWh which is more than four times the current LEC's tariff.

The GOL as a policy shall limit the extension of the central grid to where it makes economic sense, and to support and permit the operations of economically viable mini-grids in villages and towns outside the reach of the central grid, and to apply stand-alone systems (like Solar Home Systems and pico-PV systems) in sparsely populated areas with weak demand potentials.

In line with the SE4ALL initiative the GOL shall enphasize the creation of public-private partnerships (PPPs) in recognition of the power of hernersing the private sector to sustainably develop large sacle energy that quickly impact the country's energy-mix.

1.11 LEGAL, REGULATORY AND INSTITUTIONAL FRAMEWORK

1.11.1 Institutional Framework

The SE4ALL specifies policy objectives to establish an adequate delivery process for energy products and services through a public and private partnership where investments in new infrastructure and services are provided by the private sector to the greatest extent possible, including power sector transactions with the public sector providing the supporting policy environment as well as regulatory oversight. The SE4ALL expresses the GOL commitment to establish an independent and transparent regulatory process for the creation of an investment environment conducive to increased private sector involvement in the energy sector. Currently, the institutions in the electricity sub-sector in Liberia comprise: the Ministry of Lands, Mines and Energy (MLME), the Liberia Electricity Corporation (LEC) and the Rural and Renewable Energy Agency (RREA). Each institution's mandate is described below:

1.11.2 Ministry of Lands, Mines and Energy (MLME)

The MLNE was established by an Act of Legislature in 1972 to administer all activities related to land, mineral, water and energy resources exploration, coordination and development in Liberia. In adherence to its statutory mandate, the Ministry formulates and implements policies and regulations in collaboration with other sector related agencies for the delivery to the public, efficient services from the land, mineral, water and energy sectors. The three functional areas of the Ministry - lands, minerals and energy - are clustered under a Deputy Minister for Operations.

The MLME has the mandate to develop national energy policies and master plans and the administration, implementation and enforcement of the electricity law; and also has a policy making and planning role as defined in the National Energy Policy.

1.11.3 The Department of Energy (DOE), MLME

Need to Create the Office of Deputy Minister of Energy

Up to the time of developing the Action Agenda, the DOE was headed by an Assistant Minister for Energy and not yet elevated to the Deputy Minister status as planned in the 2009 NEPL. Secondly, the position of Assistant Minister has been unoccupied for a long time and the latest appointment in 2016 just take up office resently. There is a need to upgrade the technical manpower capacity especially in the field of energy at this very important department of the Liberian Energy Sector and to fund its operations adequately.

The NEPL commits the GOL to reorganizing the MLME to elevate the DOE to have the office of Deputy Minister for Energy to give it the required attention for energy and its crusial impacts for the country. The GOL is further committed to ensure that the Ministry's Department of Energy (DOE) is organized efficiently and resourced adequately to discharge its oversight role over all the different energy sub-sectors as well as to direct and supervise, through policy making and planning, the efficient development of the energy sector as a whole.

The DOE is currently headed by an Assistant Minister for Energy and consists of the Bureau of Hydrocarbons and the Bureau of Energy Technology and Policy Development (presently called Bureau of Alternative Energy). MLME and DOE play an essential policy guidance role, complementing other players in the energy sector. The MLME is part of the Board of Directors of LEC and RREA.

Presently the Bureau of Hydrocarbon has since the year 2000 been dissolved and the National Oil Company of Liberia (NOCAL) was created to take the functions of the Bureau of Hydrocarbon. This left the Department of energy with only the Alternative Energy Bureau. With the creation of the RREA, the remaining functions of the Department of Energy performed by the Alternative Energy Bureau are effectively transferred to the RREA leaving this Bureau's mandate essentially undefined.

1.11.4 The Rural and Renewable Energy Agency (RREA)

The GOL on July 6, 2015 fulfilled its commitment to facilitate and accelerate the economic transformation of rural Liberia by establishing a wholly government owned autonomous Rural and Renewable Energy Agency (RREA) dedicated to the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources. In fulfillment of this policy, the Rural and Renewable Energy Agency (RREA) and the Renewable Energy Fund (REFUND), which up to this year (2015) was constituted through executive order in January 2010 that had to be renewed annually has now been enacted into law.

The RREA's mandate includes integrating energy into rural development planning; promotion of renewable energy technologies; facilitating delivery of energy products and services through rural energy service companies (RESCOs) and community initiatives;

The RREA also has the mandate to facilitate and accelerate the economic transformation of rural Liberia by promoting the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources. One of the RREA's principle functions is the planning and financing of rural energy projects for implementation by public, private and community developers. This includes educating the general public about renewable energy options and opportunities.

1.11.5 Establishment of the Rural Energy Fund (REFUND)

The Act Establishing the RREA also includes the establishment of the Rural Energy Fund (REFUND) as the funding mechanism that provides for the coordinated and sustainable financing of projects and programs for rural and/or renewable energy projects and through which domestic and international financial resources intended for rural and renewable energy delivery in Liberia shall be managed.

The Rural Energy Fund (REFUND) is a transparent financial management to help achieve universal energy access in Liberia. Through the REFUND the RREA can provide low interest loans, loan guarantees, and grants as targeted subsidies to ensure energy access by the poor. The Fund shall be managed by a Fund Management Committee of five (5) persons whose functions shall be to ensure that processing of applications for the funds are conducted in accordance with the procedures and criteria approved by the Board, monitor financial transactions and facilitate the periodic reporting and auditing of the activities of the Fund.

Use of the REFUND

The fund shall be used for purposes such as co-financing or grants for different categories of investments, and public entities, co-operatives, and local community organizations provision of technical assistance, training and other forms of capacity building to project proponents, market studies, resource assessments, monitoring and evaluation, payment of remuneration or allowances to RREA employees and etc.

1.11.6 Electricity Regulatory Board (ERB)

The NEPL commits the GOL to balance the interests of consumers with those of firms engaged in the importation, production, transportation, distribution, and sale of energy products and services through the creation of an autonomous regulatory body, enabled by legislation, to eliminate distortions in energy-related markets through transparent, predictable and stable oversight. The Independent Electricity Regulatory Board (ERB) when created shall be responsible for monitoring and enforcement of all electric power policies, agreements, contracts and standards established, or entered into or licensed by the MLME and other GOL agencies.

1.11.7 Liberia Electricity Corporation (LEC)

The Liberia Electricity Corporation (LEC) is a public corporation, established in 1973, with the responsibility for generation, transmission and distribution of electricity throughout Liberia. The LEC has the mandate to supply electricity to the whole country; however, its supply network has so far mainly been limited to Monrovia. At the end of the 14 years Republic of Liberia civil war (1989-2003), the electric power generation capacity had for the most part been completely destroyed along with the transmission and distribution network due to warfare along with erosion of manpower capacity and declining energy institutions. Whatever remained was destroyed by looting which occurred up until 2005, including the entire hydropower plant at Mount Coffee and all the transmission lines and the distribution network.

Following the war, the government in 2006 under the Ellen Johnson-Sirleaf Administration began the rehabilitation of the electrical system, designating energy development as one of the government's major priority development pillars. The LEC was given assistance from the European Union (EU), USAID, the Government of Norway (GON) and the IDA/World Bank (WB) who provided concessional loans and donor grants for the Emergency Power Programs Phases I and II (EPP-I and EPP-II) for the reconstruction process in the urban area, mainly Monrovia, focusing on basic electricity supply for key customers such as hospitals, schools, government buildings, and street lights, etc. The support included funding for connections for the poor, and construction of biomass based power generation for renewable energy access in rural and peri-urban areas outside Monrovia.

The LEC initially reconstructed a generation system in the city using high-speed diesel generators. The current (2015) total LEC installed generation capacity is 22.0 MW. Total non-LEC power generation capacity in Liberia is estimated at 42 MW giving the total for the country as approximately 65 MW, 95% of which is run by using imported oil (diesel or gasoline) fired generators.

The reported peak load of LEC was 13.8 MW in February 2010. Recently 3 MW diesel generators were added through the NORAD-funding and 10 MW diesel generators through USAID funding. In order to increase the customer base and fully utilize the generation capacity, NORAD and USAID are financing a 66 kV transmission line and a 22 kV distribution line. The emergency power program also includeds the construction of distribution lines comprising four substations of 400 volts, 11 kilovolts (kV) and 22 kV.

1.11.8 LEC Technical and Commercial Electric Generation Losses

LEC experiences technical and commercial losses whose averages have been reported to range from 25-40% of the generated power. Unless these high losses are resolved, the sustainability of the LEC operations will continue to be severely limited and does not give any prospect for LEC to get anywhere near its mandate to supply the whole country.

The LEC is currently (2015-2016) embarked on a Loss Prevention Program with support from USAID. The ongoing loss reduction program includes a management reform program to transform the organization to commercially sustainable operations, and expand its overall operations. To ensure the efficient operation of LEC after the war, a five-year management contract was signed between LEC, the Ministry of Lands, Mines, and Energy (MLME), and Manitoba Hydro International (MHI). A management reform study is also ongoing with USAID Support through the McKinsey International Company to determine the new management system for LEC after the MHI contract expires.

1.11.9 Indipendent Power Producers, Transmission and Distribution Companies (IPP, IPTs and IPDs)

The NEPL expresses Government's commitments to encourage and support investments in the power sector by Independent Power Producers (IPPs) and Independent Power Transmission and Power Distribution companies (IPTs and IPDs). The Government will also encourage large commercial and industrial facilities to utilize co-generation schemes and to increase the scale of their power sources to provide power for neighboring communities. The ECOWAS Energy Protocol constitutes a key building block of Liberia's national energy policy.

1.11.10 Institutions for Off-Grid Power and Renewable Energy Unit

In support for the above IPPs policy, the Government plans to establish Mini-Grid and Off-Grid Power and Renewable Energy Unit in the DOE (within the Division of Electricity and Renewable Energy) or under the Rural and Renewable Energy Agency and its associated Rural Energy Fund as institutions dedicated to provide the special support required for remote and low income communities. The RREA, which shall be responsible for managing the REFUND, shall provide technical and financial support, but the actual delivery of services will be undertaken by the public and private sectors, and community developers, with the regulatory oversight of the ERB.

1.11.11 Saint Paul River Authority (SPRA)

Liberia commits itself to establish a Saint Paul River Authority (SPRA), modeled on the US Tennessee Valley Authority (TVA) for the development of its large-scale hydropower potential to fuel the economy and to export power to the West African Power Pool (WAPP). It is essential that this be brought before the Legislature for enactment and could be operated under IPP and IPT & IPD arrangements. This SPRA was earmarked in the NEPL but to date; the St. Paul Power Authority has not been created by the Legislature.

1.11.12 The National Energy Committee (NEC)

The GOL recognizes that there are areas of overlap and inter-linkages between energy and other sectors. With this view, the NEPL states that it is necessary to re-establish the National Energy Committee (NEC), which was in place before the civil crisis, to facilitate coordination between energy-oriented organizations in the public and private sector and developers and users of related infrastructure services. The NEC when reactivated and made functional, will also provide a forum for coordination among domestic, regional, and international stakeholders. The NEC will therefore fulfill the ECOWAS recommendations for member countries to set up a cross-sectoral and multi-actor cooperation mechanism equipped with the human, technical, and financial resources required to discharge its coordination mandate.

1.12 ELECTRICITY LAW

A draft Electricity Law entitled "2015 Electricity Law of Liberia" was prepared and sent to the Legislature for enactment into Law. A Liberian citizens group also submitted to the Senate a draft alternative "Act to Reform Liberia's Electricity Sector" for approval. The legislature held sessions to debate the two versions and come up with the current approved "2015 Electricity Law of Liberia" which was approved on October 23, 2015 and printed into handbill on October 26, 2015.

1.12.1 Purpose and Scope of the Electricity Law

The Purpose and Scope of the Electricity Law is to establish the legal and regulatory framework for the production, transportation, distribution and sale of energy products and services in Liberia and regulates the import and export of the same and defines the rights and obligations of all entities and parties involved in or affected by the energy activities.

The Law creates the following institutions and assigns to each the functions intended in the Law:

1. The Liberia Electricity Regulatory Commission (LERC) (or authority) within the Ministry for some time after the electricity law is effective and thereafter becomes autonomous (the alternative version proposes that it be an independent authority with enforcement powers);
2. The position of Deputy Minister for Energy for the Department of Energy of the MLME
3. The Rural and Renewable Energy Agency (RREA) and the Rural Energy Fund (REFUND);
4. Reduces the mandates of the Liberia Electricity Corporation and converts the Liberia Electricity Company (LEC) into a transmission and distribution company;
5. Provides for the amendment of all other enactments dealing with matters incidental or connected to the foregoing.

2.0 VISION AND TARGETS UNTIL 2030

Liberia has set the Vision called **"*Liberia RISING 2030*"** which is the aspiration of becoming a Middle Income Country by the year 2030. Liberia was on the verge of becoming a middle-income country by the 1980s; it was one of the highest-income countries in Africa. But years of conflict have reversed the country's development. As part of its development agenda, the government developed the vision that includes the perspectives of diverse stakeholders from the Liberian society and takes a broad view of Liberia's economic, political, social and human development over an 18-year timeframe (2012–2030). The aspiration of becoming a middle-income country characterized by prosperity and inclusion by 2030 is already in the implementation stages.

While there is no strict definition of "middle income" status, it is often defined as per capita income of more than USD $1,000 – US$3,000 (in constant terms).Starting at its current level of annual average per capita income (around US$400), the technical goal of crossing this middle-income threshold means that Liberia needs to grow at an average rate of approximately 6% to 12% per year from 2012 until 2030. This goal is ambitious, but not unachievable.

The Agenda for Transformation (AfT) strategy recognizes that Liberia should not attempt to address all shortcomings at once but acknowledges the need to prioritize investments and acknowledges that investments in infrastructure (energy, roads and information communications technology [ICT]) are the key priorities necessary to unlocking growth while taking conscious efforts to ensure universal access and inclusiveness (gender mainstreaming, the poor, women, children, etc) in their provision. This strategy recognizes that investments in **energy** to unlock the urban and rural economies have the greatest return on investments and should be prioritized by **expanding electricity access** throughout the country.

The SE4All Action Agenda in Liberia, developed with regard to the country's overall development objectives, is in conformity with the government's AfT and the commitments of the Government and people of Liberia to the Poverty Reduction Strategy (PRS, 2008) program. The targets and trajectories for energy access, energy efficiency and renewable energy are based on the results from the baseline report for the NREAP, NEEAP and the SE4ALL analysis for the period 2010 – 2030. In setting the targets, the intermediate targets, as well as risks to implementation are kept in mind. Due consideration is also given to the synergies in terms of economies of scale and efficiency that can derive from approaching targets in an interconnected manner (i.e. electrification and enforcement of energy efficient appliances at the same time).

2.1 INTRODUCTION TO THE VISION

2.1.1 The Country's Overall Vision for SE4All

Below are Liberia's specific national interpretation of the global SE4ALL targets of ensuring universal energy access, doubling the share of renewable energy and doubling the rate of improvement in energy efficiency as stated in the National Energy Policy of Liberia.

The GOL Vision 2030 proposes the targets of 70% of Monrovia to be connected to the grid and 35% of the rural areas of Liberia connected to mini-grids/isolated, stand-alone units by 2030.

The Government, through the Ministry of Lands, Mines and Energy (MLME) in May 2009 adopted its energy strategy and relevant targets (access, capacity, generation, energy security) in the National Energy

Policy for Liberia (NEPL); an Agenda for Action and Economic and Social Development with the technical and financial assistance from USAID.

The principal objective of the National Energy Policy was to ensure universal access to modern energy services in an affordable, sustainable and environmentally-friendly manner in order to foster the economic, political, and social development of Liberia.

The PRS and the follow up AfT were built on four pillars:

(1) Consolidating peace and security;
(2) Revitalizing the economy;
(3) Strengthening governance and the rule of law; and
(4) Rehabilitating infrastructure and delivering basic services.

The development of the NEPL came about as an essential exercise towards the realization of the goals and objectives of the PRS as well as contributing to the achievement of the Millennium Development Goals (MDGs).

The NEPL visualized implementation of energy sector reforms to be founded on three essential features:

- Demonstrating the Government's resolve for good governance and ensuring financial transparency in all sector transactions;
- Overcoming the significant obstacles to private sector investment in energy supply; and
- Creating the requisite institutional and legal framework and an independent regulatory regime.

These issues refer to the need for the various technologies and delivery options for energy products and services to be available, acceptable, affordable, and adequate.

2.1.2 The GOL 2009 Adopted NEPL Energy Access Target

At the time of approval of the NEPL, the GOL reports that about 10% of urban residents and less than 2% of rural residents had access to electricity largely from self-generation using expensive imported fuel. The NEPL in 2009 predicted that within 6 years (i.e. by 2015), in line with the Millennium Development Goals (MDGs) as adopted by the Economic Community of West African States (ECOWAS), the Government expected to have achieved the following targets:

40% of Liberian citizens living in rural and peri-urban areas and using traditional biomass for cooking shall have access to improved stoves and kerosene or efficient-gas cookers in order to reduce indoor pollution;

30% of the urban and peri-urban population shall have access to reliable modern energy services enabling them to meet their basic needs (lighting, cooking, communication, and small production-related activities);

15% of the rural population and 25% of the schools, clinics, and community centers in rural areas shall have access to modern energy services to meet the same basic needs. The long-term strategy is to make Liberia a carbon neutral country by 2050

The GOL in its approved policy is committed to promoting the use of renewable energy such as solar and wind systems in power plants and all large commercial facilities such as supermarkets, hotels, restaurants, entertainment centers, hospitals, and large retail shops and stores. The GOL through the newly dedicated Rural and Rural Energy Agency (RREA) will vigorously pursue the development of mini and micro hydro on the country's numerous rivers and streams. It is the policy of the GOL to ensure the availability of quality

energy products on a cost recoverable, competitive, and affordable basis throughout the nation. In the long term substitute renewable sources such as biodiesel will be employed as fuel for transportation.

2.1.3 NEPL Quality Standards

The GOL in the NEPL committed to establishing quality standards for all energy products and services which will be monitored and enforced by the Energy Regulatory Board (ERB) and the Bureau of Standards as appropriate; standards will be established to ensure accuracy of meters and gauges, product safety, security, reliability, consistency, purity, and availability as well as timeliness in responding to stakeholder service requests. The GOL shall also establish energy efficiency standards for all government and commercial buildings and industrial facilities and for importation of fuel-efficient vehicles and energy-efficient light bulbs and home appliances. It is the policy of the GOL to minimize and eliminate loss, theft, and corruption and to promote international best practices in wholesale and retail energy transactions and in the granting of licenses and concessions.

2.1.4 NEPL Policy to Reducing GHG Emissions and Improving Energy Efficiency

The NEPL policy objective was stated as ensuring affordability through least-cost production and utilization of energy services. The GOL supports the collective global effort to **control harmful greenhouse gas (GHG) e**missions responsible for climate change and will seek to balance the environmental costs and benefits of all energy programs.

The 2009 NEPL states that the GOL expects to achieve its access goals for 2015 while reducing GHG emissions by 10%, improving energy efficiency by 20%, raising the share of renewable energy to 30% of electricity production and 10% of overall energy consumption, and increasing the level of biofuels in transport fuel to 5%. The GOL further committed to the provision of energy services on a full cost-recovery basis to those who are able to pay and on a targeted subsidized basis to those who can only afford to pay a portion of the cost. Prices will be set by the operators subject to costs allowed by the Energy Regulatory Board and principles set by the Ministry of Lands, Mines and Energy (MLME) to ensure universal access. The Government will establish a **regulatory process for monitoring** all costs – economic, financial, social, and environmental – and allocating these to the user (rate payer or polluter) or public (taxpayer) as appropriate.

2.1.5 The Objectives Achieved to Date (August 2015)

Up to the present (2015, the original NEPL target year) the majority of the above predicted targets have yet to be achieved and conversely, some of the gains made during the years since 2009 have been rolled back by many factors including the recent coming of the **Ebola Virus Disease Epidemic (EVD).**

Recently the GOL initiated concrete actions to change the electric power and renewable energy sector from the planning and emergency recovery stages and activities undertaken since 2006 following the fourteen (14) years civil war, into instituting transformation of the national regulatory and enabling environment for private sector driven power generation, transmission and distribution transactions and cross border electricity trade based on sustainable renewable energy resources and technologies. The GOL passed into law; the RREA Act approved July 6, 2015 and published into handbills on July 15, 2015. In addition, the President of Liberia submitted the draft "2015 Electricity Law of Liberia" that includes the creation of a legal and regulatory framework for the generation, transmission, distribution and sale of electricity in Liberia. The law was subsequently

passed by the Legislature. There is need for urgency and speed in the process of achieving the ECOWAS energy policy and SE4All goals of ensuring comprehensive access, doubling the current rate of efficiency improvements and doubling the share of renewable energy in the total energy mix as well as achieving GOL's strategic national energy policy objectives of cost effective and quality energy access for all, and creating the institutional reforms that provide the enabling environment for sustainable power sector development. These objectives are in line with the GOL's Agenda for Transformation (AfT). In July this year, the President appointed another Assistant Minister for Energy (AME) to fill the vacancy that has been there for nearly a year after the last AME departed and electricity has been listed as one of the immediate priorities of the AfT.

2.1.6 Expected Energy Sector Development Trajectory

The above NEPL targets were ambitious and laudable but implementation was limited. In light of the coming in of the fully mandated RREA through its constituting Act, and the subsequent enactment of the electricity law which took place in October 2015 approved by the legislature, these energy sector targets are being revised by the GOL. These are based on available data and estimates where gaps can be reasonably estimated to be generally in line with the SE4All access targets, and taking the 2030 timeline as the target time period. Below are the overall expected energy sector development trajectories for calculated and estimated energy access, renewable energy and energy efficiency including summary energy demand projections per sector required to meet national energy development objectives for the forecast period.

2.1.7 Setting the Level of SE4ALL Ambition for Liberia

In the process of setting up the level of SE4ALL Ambitions for Liberia, scenarios were developed based on the review of all relevant parameters of the baseline data. The results of the scenario tool projections, and targets for the planning period were determined. With this the GOL has presented this sector development plans for the period until 2030 mainly in relation to electricity demand and supply projections and targets. In the process of setting these targets we included the considerations of expected outcomes under ECOWAS energy policies, and consideration for intermediate targets, as well as risks to implementation. Due consideration was also given to the synergies in terms of economies of scale and efficiency that can derive from approaching targets in an interconnected manner including measures for standards and labels at the same time. The emphasis is being placed on the specific targets depending on the overall needs of the various parts of the country, resource availability, end user applications and priorities (i.e. in rural, peri-urban and urban areas, and critical energy access agenda solutions specific for lighting, cooking, food processing, etc.).

2.1.8 Tracking Framework Set by the GTF - The Way Forward

For consistency, data for the development of this matrix was sourced from the GTF from the IIASA estimates for Sub-Saharan African Countries.

Below is the table of **Tracking Framework set by the GTF** as the **starting points for Liberia** against which progress will be measured under the SE4ALL initiative (Table10 below) The rate of population having access to electricity and the use of non-solid fuel as the primary fuel for cooking was set at the 2010 levels of 1 percent and <5 percent, respectively. These are set to increase to 100 percent by 2030. The rate of improvement of energy intensity will have to double from 0.97 percent for 2010 to 1.94 – 2.2 percent for 2010–2030.

The 2010 starting point for Liberia's renewable energy share is 92.5% of the total final energy consumption (TFEC), consisting mainly of firewood and charcoal widely used for residential cooking and commercial heating purposes. The GOL plans to reduce the traditional biomass use and will as substitution, increase the use of modern renewable energy (non-solid fuels) from an estimated current rate of less than 5% to 60 – 73% of the population using modern renewable energy (non-solid fuels based primarily on cleaner cooking gas and electrical energy) produced efficiently from using solar and other energy resources by 2030. See table 10 below for the SE4ALL objectives and starting data points for projecting targets for Liberia.

TABLE 10: SE4ALL OBJECTIVES IN HISTORICAL PERSPECTIVES FOR ENERGY TARGETS FOR 2020 AND 2030

	Objective 1		*Objective 2*	*Objective 3*
	Universal Access to Modern Energy Services		*Doubling National Rate of Improvement of Energy Efficiency*	*Doubling Share of Renewable Energy in the National Energy Mix*
Proxy Indicator	Percent of Population With Electricity Access	Percent of Population With Primary Reliance on Non-Solid Fuels	Rate of Improvement in Energy Intensity* (1990 – 2010)	Renewable Energy Share Total Final Energy Consumption (TFEC)
Starting Point 2010	1.4	<5	0.97	92.5**
SE4ALL Objective 2030	70	70	1.94 – 2.2	60 - 73

SOURCE: IIASA 2012

Note: TFEC = total final energy consumption
**Measured in primary energy terms and GDP at purchasing power parity*
*** consisting mainly of firewood and charcoal*

2.2 ENERGY ACCESS TARGETS UNTIL 2030

Renewable energy offers many benefits for the economy. They include but are not limited to enhanced energy security, reduced import dependency on fossil fuels, improved local environment and health, reduced levels of greenhouse gas emissions, and increased options for access to energy.

The renewable energy targets are defined as renewable energy in the final energy consumption in line with the definition in the GTF, and should provide ambitious, yet realistic, targets for the share of renewable energy at the national level until 2030.

The ECOWAS Renewable Energy Policy mandates member states to adopt targets and action plans which contribute to the achievement of the regional targets. Three groups of targets are set by the ECOWAS Renewable Energy Policy:

a. for grid-connected renewable energy applications;
b. for off-grid and stand-alone applications; and
c. for "domestic renewable energy applications":

The national access to electricity in percent of the population is shown on table 11 below. Liberia is expected to raise its 2010 and 2015 access of 1.4% of the population having access to electricity, to 34.2% by 2020, and reach the 100% (universal access) of the population on or before the target year 2030.

TABLE 11: ELECTRICITY ACCESS TARGETS (%) OF POPULATION)					
YEAR	2010	2015	2020	2025	2030
Share of population with Electricity Access (%)	1.4	1.4	34.2	67.1	100

2.3 TARGETS FOR GRID CONNECTED INSTALLED CAPACITY AND SHARE OF RE

By opting-in to SE4ALL AA Liberia has signed up to the SE4ALL targets. Liberia has therefor decided to set its goals on energy access for electricity and clean cooking solutions respectively with the goals of making accelerated efforts to reach universal access by the 2030 deadline. In order to rapidly meet the targets, renewable energy is planned to play a major role in the energy supply technology development in the years to come.

2.3.1 Renewable Energy Share in Total Grid Consumptions

Table 12 below shows the electric power installed capacity (including medium scale hydro) in MW. The Renewable Energy Share of the total Grid Connected Electricity Power Generation Mix (including medium and large hydro) will constitute only 3%, 1% and1% respectively in 2020, 2025 and 2030 based on the Baseline Scenario. However, with the NREAP-SE4ALL measures as planned, which will make available additional mix of various RE power resources, the RE share is expected to constitute 43%, 39% and 23% of the total electricity capacity for the years 2020, 2025 and 2030 respectively. Total Grid Connected Electric Power Installed Capacity for 2010 and 2015, is 22MW and 48MW respectively and is targeted to rise to about 178MW in 2020, 378MW in 2025 and 659MW in 2030. The baseline addition, of a constant capacity of 4.6MW RE mainly small scale hydro projected for each of the planning years is projected to increase by an additional 46MW of hydro in 2020, and additional 91MW each of hydro capacity in 2025 and 2030. Table 12 below presents the targets for grid connected installed capacity and resultant generation in GWh for the selected years.The successful implementation of the NREAP-SE4ALL will result to the reduction of fossil fuel based power generation in 2020 from 102MW down to 25MW and in 2025 from 230MW down to 81MW and from 510MW of FF based generation in 2030 down to 362MW FF based generation. The total electric power generation is projected to increase from 190GWh in 2010 to 418GWh in 2015 and 1,542GWh, 3,267GWh and 5,694GWh in 2020, 2025 and 2030 respectively.

TABLE 12: TARGETS FOR GRID CONNECTED INSTALLED CAPACITY AND SHARE OF RE					
In MW Installed Capacity	**2010**	**2015**	**2020**	**2025**	**2030**
Baseline scenario ("Baseline") for the power sector of Liberia					
Electricity Generation (FF) MW installed capacity	17.42	43.81	101.86	229.57	510.53
Small Scale Hydro energy installed capacity in MW (excluding medium and large hydro)	4.57	4.57	4.57	4.57	4.57
Small Scale hydro share of the total installed capacity in % (excluding medium and large hydro)	21%	9%	3%	1%	1%
SUB-TOTAL BASELINE INSTALLED CAMACITY	**21.99**	**48.38**	**106.43**	**234.14**	**515.10**
Scenario NREAP- SE4ALL					

TABLE 12: TARGETS FOR GRID CONNECTED INSTALLED CAPACITY AND SHARE OF RE					
In MW Installed Capacity	**2010**	**2015**	**2020**	**2025**	**2030**
Additional hydropower - Large- and medium scale hydropower capacity installed in MW (more than 30 MW)	0	0	45.63	91.25	91.25
Additional hydropower - Large- and medium scale hydropower (more than 30 MW) share of total installed capacity in %	0%	0%	26%	24%	14%
Additional - Other renewable energy capacity (Solar PV, Wind, and others excluding hydro) in MW	0	0	26.35	52.71	52.71
Additional - Other renewable energy capacity (Solar PV, Wind, and others excluding hydro) Share of total Capacity in %	0%	0%	15%	14%	8%
SUB-TOTAL RE CAPACITY in MW	**4.57**	**4.57**	**76.55**	**148.53**	**148.53**
Renewable energy share of the total installed Grid Connected capacity in % (including medium and large hydro)	21%	9%	43%	39%	23%
TOTAL INSTALLED CAPACITY in MW	**21.99**	**48.38**	**178.41**	**378.10**	**659.06**
Remaining Generation Capacity (fossil fuel (FF) minus RE) after replacement of FF by RE (MW)	**12.85**	**39.24**	**25.31**	**81.04**	**362**
TOTAL POWER GENERATION in MW	**190.0**	**418.0**	**1,541.5**	**3,266.8**	**5,694.3**

2.4 OFF-GRID APPLICATIONS TARGETS

Rural populations receiving access to electricity through off-grid installations (stand alone or mini-grid electric power applications) will increase from the 2010 level of 0.3% to 34.5% in 2020 and 100% (*universal access*) in 2030. See table 13 below.

TABLE 13: TARGETS FOR OFF-GRID APPLICATIONS			
	2010	2020	2030
Share of Rural Population Served with Off-Grid (mini-grids and stand-alone) Renewable Energy Electricity Services in %	0.3%	34.5%	100%

2.5 DOMESTIC COOKING UTILIZING IMPROVED COOK-STOVES TECHNOLOGIES

In this section, Liberia's targets regarding renewable energy applications for domestic uses in 2020 and 2030 as well as the trajectory are presented. Considering the major contributions firewood and charcoal make in the energy demand for cooking, improved cook-stoves technologies and more efficient technologies for charcoal production from fire wood are areas that have the potentials to bring considerable gains in energy efficiency for Liberia. The GOL shall develop national programs for the adoption of technological standards for cooking fuels and appliances in terms of efficiency, (safety and health impacts) in accordance with international bodies such as the Global Alliance for Clean Cook Stoves (GACC)

2.6 TARGETS FOR DOMESTIC COOKING ENERGY

Domestic cooking utilizing improved cook-stoves technologies and the use of efficiently consuming charcoal stoves technologies are planned to be introduced, promoted and encouraged extensively over the planning period. The share of population targeted for using modern cooking devices is projected to be 26%. The set targets therefore are presented in tables 14 below.

TABLE 14: BASELINE SCENARIO FOR DOMESTIC COOKING ENERGY

	2010	2015	2020	2025	2030
Share of Population Using Improved Cook-Stoves in %	15%	15%	15%	15%	15%
Share of households using an alternative technology (%)	1%	1%	1%	1%	1%
Share of households using LPG (%)	10%	10%	10%	10%	10%
Total families using modern cooking devices (%)	**26%**	**26%**	**26%**	**26%**	**26%**

2.7 SCENARIO WITH UNIVERSAL ACCESS TO MODERN COOKING, "COOKING PLAN"

The **"modern cooking solutions"** shall involve electricity or gaseous fuels (including liquefied petroleum gas (LPG)), or solid/liquid fuels paired with stoves exhibiting overall emissions rates at or near those of liquefied petroleum gas.

The share of population targeted for using modern cooking devices is projected to increase from 26% each in 2010 and in 2015 to move towards achieving universal access to modern cooking ("Cooking Plan") and efficient cook-stoves increase to 49% in 2020, 72% in 2025 and finally arriving to 95% in 2030. The use of measures to achieve universal access to modern cooking ("Cooking Plan") and efficient cook-stoves technologies is projected to raise the targets for the share of population using improved cook-stoves by more than double, see table 15 below.

TABLE 15: SCENARIO WITH MEASURES TO ACHIEVE UNIVERSAL ACCESS TO MODERN COOKING, "COOKING PLAN"

	2010	2015	2020	2025	2030
Share of Population Using Improved Cook-Stoves in %	15%	15%	26%	37%	48%
Shareof households using an alternative technology (%)	1%	1%	2%	4%	5%
Share of households using LPG (%)	10%	10%	21%	32%	43%
Total families using modern cooking devices (%)	**26%**	**26%**	**49%**	**72%**	**95%**

2.8 SOLAR WATER HEATERS TARGETS

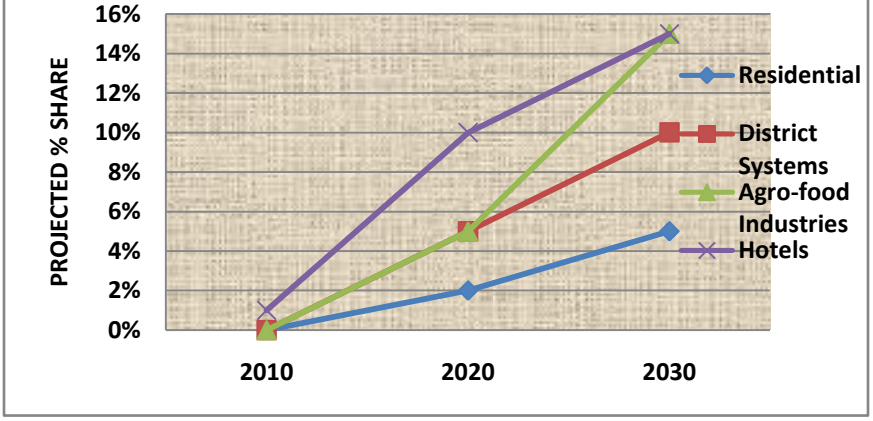
Table 16 below presents the targets for solar water heaters as a perscnt of the number of the respective facilities, namely residentisl households, health facilities, schools and agro-food industrial facilities heating systems and hotels. Figure 4 below shows that the solar water heating systems are projected to be more

prevalent in hotels than the other facilities and are ecpected to kick into the use of the technology earlier than all the other potential users. From thable 16 the highest share of facilities using solar water heating systems is 15%, with the service institutions reaching 10% by 2030.

TABLE 16: TARGETS FOR SOLAR WATER HEATERS

	2010	2020	2030
No. of residential houses with solar thermal systems (000)	0	17.4	52.9
Share of district health centers, maternities, school kitchens and boarding schools with solar thermal systems in %	0%	5%	10%
Share of agro-food industries (preheating of process water) with solar thermal systems in %	0%	5%	15%
Share of hotels with solar thermal systems in %	1%	10%	15%

Figure 4: TARGETS FOR SOLAR THERMAL SYSTEMS



2.9 BIOFUELS ENERGY TARGETS

The table 17 below presents the targets for biofuels, which mainly refers to the use of modern liquid biomas fuels in Liberia. Presently biofuels are not in use but Liberia has vast potentials for biofuels such as ethanol from cane sugar and other ethanol or methanol producing crops. Additionally, oil palm production which is in in relatively large scale commercial production in has enormous potentials in Liberia for conversion to biodiesel.

TABLE 17: TARGETS FOR BIOFUELS

	2010	2020	2030
Biofuels (1st generation) - Ethanol as share of gasoline consumption - Biodiesel as share of diesel and fuel oil consumption	0%	2%	5%

2.10 ENERGY EFFICIENCY TARGET UNTIL 2030

Energy efficiency provides several benefits including but not limited to: more profitable business operations, cheaper and more plentiful energy for households, economic growth, cost reduction, cleaner environment and reduced carbon emissions.

The energy efficiency targets should provide ambitious, yet realistic targests for the rate of improvements in energy efficiency at the national level until 2030.

a. Electricity access is defined as availability of an electricity connection at home or the use of electricity as the primary source for lighting.

b. Access to modern cooking solutions is defined as relying primarily on non-solid fuels for cooking. An important limitation of these binary measures is that they do not capture improvements in cook-stoves that burn solid fuels, nor are they able to register progress in electrification through off-grid lighting products.

Energy efficiency gains are targeted to be derived from grid loss prevention measures, domestic and public lighting, buildings sector, and industry. From table 18 below, the targeted efficiency savings from grid losses reduction, savings from domestic and public lighting, from building sector, and from industry sector total to 236GWh in 2020, 737GWh in 2020 and up to 1,605GWh in 2030.

The efficiency savings along with the RE generation together will rise fron 9% share in 2015 to 50% each in 2020 and 2025 and account for 40% share of total generation in 2030. In another point of view, comparing the baseline FF generation verses other generation sources, the replacement of FF based generation of 9% in 2015 increased to 99% replacement in 2020 and 100% replacement in 2025 and 79% FF replacement in 2030.

2.10.1 Target Sources for Energy Efficiency in Liberia

TABLE 18: PROJECTED TOTAL GENERATION ALL SOURCES (GWh)

Year	2010	2015	2020	2025	2030
Baseline Fossil Fuel (FF) Generation (GWh)	150.49	378.48	880.05	1,983.48	4,410.98
Baseline RE (Small Hydro Projects, SHP) Generation (GWh)	39.51	39.51	39.51	39.51	39.51
SUB-TOTAL BASELINE GENERATION (GWh)	**190**	**417.99**	**919.56**	**2022.99**	**4450.49**
Hydro Generation (M-LHP) (GWh)	0	0	394.2	788.4	788.4
Wind Generation (GWh)	0	0	0.235	0.47	0.47
Solar (PV) Generation (GWh)	0	0	227.7	455.4	455.4
SUB-TOTAL ADDITIONAL RE GENERATION (GWh)	**0**	**0**	**622.135**	**1,244.27**	**1,244.27**
SUB-TOTAL RE GENERATION (GWh)	**39.51**	**39.51**	**661.65**	**1,283.78**	**1,283.78**
ENERGY EFFICIENCY GAINS					
Grid Loss Reduction (GWh)	0	0	92	364	801
domestic and public lighting (GWh)	0	0	117	254	420
building sector (GWh)	0	0	17	76	250

TABLE 18: PROJECTED TOTAL GENERATION ALL SOURCES (GWh)					
Year	**2010**	**2015**	**2020**	**2025**	**2030**
industry sector (GWh)	0	0	10	43	134
SUB-TOTAL EE SAVINGS	**0**	**0**	**236**	**737**	**1,605**
TOTAL ENERGY AVAILABLE (BASELINE+RE GENERATION+EE SAVINGS)	**190**	**417.99**	**1,777.70**	**4,004.26**	**7,299.76**
SHARE OF FOSSIL FUEL GENERATION IN THE NREAP-NEEAP (%)	79%	91%	50%	50%	60%
BASELINE REMAINING AFTER REPLACEMENT BY GENERATION FROM NREAP-NEEAP GENERATION	150.49	378.48	21.92	2.21	1,561.71
DISPLACEMENT OF FF BY RE AND EE SAVINGS	**21%**	**9%**	**99%**	**100%**	**79%**
SHARE OF NREAP-NEEAP-SE4ALL GENERATION (%)	**21%**	**9%**	**50%**	**50%**	**40%**

The average residential electricity consumption per annum per capita in kWh/Capita/year is targeted to increase from 52 kWh/Capita in 2010 to 104 kWh/Capita in 2015, 348 kWh/Capita in 2020 and 669 kWh/Capita and 1,056 kWh/Capita in 2025 and 2030 respectively. It is noted however, that these are average household electricity consumption rates but the figures vary considerably for various homes. A periodic survey to quantify the per-capita consumption will be a component of the monitoring program over the planning period.

2.11 RELEVANT NEXUS TARGETS UNTIL 2030

In order to accomplish the three SE4ALL targets (universal access, doubling energy efficiency by 2030 and doubling the share of RE in the total energy mix) a number of additional important complimentary targets must be addressed. These are considered to be very important energy nexus issues for Liberia and therefore require understanding the nexus between renewable energy, energy efficiency and energy access. The targets shall include the following measures:

The GOL shall set up a capacity building program for the training of trainers especially for the staff of the DOE, MLME and the RREA as the initial target who will in turn undertake public awareness and the training of other stakeholder institutions on energy efficiency in households, industry and public lighting, etc. The DOE shall develop a cook-stoves equipment performance testing program especially in connection to standards enforcements. For example, cook-stoves are rated on four performances factors: fuel use (fuel efficiency combustion), total emissions, indoor emissions, and safety based on the evidence from research on health and environmental impacts.

2.11.1 Stove Quality and Performance Standards

The following stove quality and performance standards shall constitute a component of the cooking technology standards for Liberia to be used for evaluation and monitoring of the market and targeted homes and institutions.

- Cooking Power: time to boil water, thermal efficiency
- Fuel Consumption: quantity of fuel consumed for a given task
- Emissions: presence of health endangering toxic emissions and quantity/type of climate relevant GHG emissions?
- Durability: expected lifetime

- Stove Security: sharp edges and points, stability, cook-stove tipping possibility, surface temperature and heat transmission to surroundings
- Convenience: appropriateness of stove for the usual tasks in the household. Is the stove appropriate to the usual tasks in an average household?

2.12 PLANNING THE ROAD MAP AND ACCESS STRATEGY

1. Rural Electrification Plan – the RREA is in the process of developing a national rural electrification plan.
2. Sub-Sector Strategy- capacity training and resources assessments
3. The Needs to Drop or Update the Existing Plans – there is the need to update our energy policy, and develop plans that are currently not existing
4. Follow-Up Complementary Plans To Be Developed
5. Funding Requirements For The Additional Plans/Studies it is expected that a budget will be developed for these actions

2.12.1 Facilitating the Mini-grid and Off-grid Power Solutions

The GOL has resolved to accelerate the development of the electricity sector by facilitating and promoting a service-based rather than supply-based approach to energy definition and delivery. The GOL will finance decentralized solutions for power development as a priority. For this purpose the development of mini-grids and off-grid power schemes will be encouraged throughout the country.

In developing these power schemes, the GOL shall encourage the players to undertake protection of the ecosystems with understanding of the energy landscape and the engagement with the civil society in SE4ALL AA. The access to energy for the poor will be prioritized from the point of view of poor people who need energy access for:

- Cooking and mechanical power alongside electricity
- Community services and earning a living equally important as household access
- Establishes minimum standards for energy services that people use (e.g. lighting, space heating, cooling and cooking)

2.13 MEASURES FOR SOME NEXUS AREAS IN THE LIBERIAN ENERGY SECTOR

The GOL shall support, develop and facilitate measures to be undertaken, including appropriate programs, incentives, capacity development and inclusion as well as development and enforcement of standards, legal and regulatory regeim and policies and dissemination of information and provition of various new and emerging renewable energy technologies for the public to address the following nexus areas:

a. Energy and health;
b. Gender mainstreaming in the energy sector;
c. Agriculture and energy;
d. Water and energy;
e. Rural development, etc

3.0 PRIORITY MEASURES AND ACTION AREAS

This chapter of the SE4ALL Action Agenda describes how Liberia foresees achieving the objectives defined in the forgoing chapters and sets out the SE4ALL Priority National Action Areas to be pursued. Priority areas are identified based on the guidance provided by the UN SE4ALL Action Agenda. This includes taking into consideration what resources options are available in a reliable and sustainable manner, and identifying the risks to implementation and the mitigation measures. These include taking into consideration the physical accessibility and assessment of alternative supply options, i.e. availability of energy resources and reliable supply; affordability and cost-effectiveness; magnitude and speed of environmental and social impacts; financial resource requirements; and sustainability. Both regional and local contents are considered. All relevant priority actions with their respective priorities for public, private and civil society actions to meet the common goals are considered. All stakeholders are urged to take concrete action toward three critical objectives: (1) Ensuring universal access to modern energy services; (2) Doubling the share of renewable energy in Liberia's energy mix; and (3) Doubling the national rate of improvement in energy efficiency. See table 19 below which provides the identified relevant action areas planned for so as to meet the three critical objectives.

To make the vision of Sustainable Energy for All actionable, the three core objectives have been disaggregated into **Action Areas.** These are intended to provide:

a. A framework for identifying **high-impact opportunities** and cataloguing existing and potential initiatives that can further the three objectives;
b. A way to organize multi-stakeholder actions across all relevant sectors of the economy toward the objectives;
c. A tangible entry point for stakeholders interested in taking action in specific areas of interest.

The GOL shall develop programs and measures for the following priority action areas considered to be relevant to creating the enabling environment for Liberia at this time in the SE4ALL process.

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3.1 ACHIEVING THE THREE OBJECTIVES OF SE4ALL

TABLE 19: ACTION AREAS FOR THE THREE SE4ALL OBJECTIVES

Ensuring Universal Energy Access	Doubling the Share of Renewable Energy	Doubling the Rate of Improvement in Energy Efficiency
Improved health; improved agriculture production;	Affordable energy even where grid does not reach	Lighting/appliances that require less power
Empowerment of women;	New opportunities for small entrepreneurs	Fossil fuel resources used more effectively
Businesses and employment creation	Decreased variability in energy costs	Reduced energy costs for consumers
Economic development;	Energy security and reduced import bills	Redistribution of electricity that now is wasted or lost
Achievement of the Millennium Development goals	Reduced environmental impacts	More reliable electricity systems

3.2 THE SE4A AA ACTION AREAS

The SE4ALL Action Areas together address the majority of the key components of productive energy use, and the supporting mechanisms needed to overcome the most common impediments to electricity development. They also aggregate in coherent groups of "high-impact opportunities" (HIOs).

The GOL shall make all efforts to address the electrical energy needs for industry, agriculture and buildings. Although Liberia currently has a small Industrial Sector, when combined with Agriculture, Forestry and Mining it becomes relatively large and has the greatest potentials for energy demand growth. These sectors support the economy and therefore need primary attention for creation of the enabling environment for electricity supply.

3.3 MEASURES AND ACTION AREAS

The GOL as a priority shall support, promote and facilitate the implementation of the following measures and action areas undertaken to insure achieving the objectives and set targets defined in the forgoing chapters of this SE4ALL and its accompanying NREAP and NEEAP as follows:

A. **Modern cooking appliances and fuels:** Providing access to modern energy services for those who lack clean and efficient equipment such as stoves and fuels.

B. **Distributed electricity solutions:** Providing access to electricity through off-grid, micro- and mini-grid solutions, throughout the country including targeted applications for productive uses.

C. **Grid infrastructure and supply efficiency:** Extending the electricity grid in all urban and peri-urban areas where this is cost effectively practicable and increasing the efficiency of energy generation, transmission, and distribution.

D. **Large-scale renewable power:** Accelerating the build-out of grid-connected renewable energy solutions especially hysroelectric and solar PV and wind systems where feasible; and the associated transmission and distribution infrastructure.

E. **Industrial and agricultural, forestry and mining processes:** Improving production efficiency, both directly and in the supply chain and improve the supply of power to the Industry, agriculture and mining sector for increase productivity.

F. **Buildings and appliances:** Improving lighting efficiency and the proper design, insulation, and retrofit of buildings and incorporating renewable self-generation options including solar PV, Solar heaters, and wind systems where feasible, together with more efficient consumer appliances and equipment.

3.4 PLANNED MEASURES FOR ACHIEVING THE SE4ALL TARGETS

1. Support the development of micro-enterprise clusters and cooperations to foster collective energy efficiency and establish vertical linkages between the cluster and the distribution/supply chains for improved cook stoves and efficient lighting devices;

2. Improving the efficiency and sustainability of the energy value chain through participatory and sustainable forest management (PSFM);

3. Ensure that agricultural units make use of solar thermal heating and drying and solar PV systems and their applications in agriculture;

4. Set a required solar thermal contribution for new and renovated buildings in accordance with the ECOWAS Directive on Energy Efficiency in Buildings (EDEEB);

5. Undertake Energy Efficiency Inspections and Energy Management measures in the public health institutions including the options of using mini-grid solar options for large public hospital facilaties;

6. Create an Independent Regulatory Authority - Liberia Electricity Regulatory Commission (Regulator) and give it enforcement powers to improve efficiency of the systems and enforce compliance with established benchmarks, procedures and standards;

7. Carry out resource assessments and feasibility studies on the potentials of technologies to generate energy from renewable sources such as Solar, Hydro, Wind and Biomass. Assessment will be carried out every 5 to 7 years;

8. Develop an inventory of all potential renewable energy resources ranked by their costs and full economical impact;

9. Identify local sites and develop maps for the development of renewable energy (areas with high renewable energy potentials) and reserve these for specific development – Renewable Energy Development Areas;

10. Develop criteria for project selection that are aligned with Government goals and objectives;

11. Analyse Inter-village as well as cross-border connections and the potential utilization of natural resources abundant in neighboring countries;

12. Implement and develop pilot projects for demonstration of technical and economical viability of RE project;

13. Undertake studies on the socio-economic, cultural and institutional factors that can lead to successful RE programs and projects;

14. Prepare Concept plans and implementation of information systems and software solutions to support the implementation of energy efficiency at different levels;

15. Develop legislation that sets up obligation for minimum levels of RE in new and newly refurbished buildings, in accordance with the ECOWAS directive on Energy Efficiency in Buildings (EDEEB);

16. Develop information, advocacy and awareness raising measures for RE project developers; understand the nexus between renewable energy and energy efficiency and energy access;

17. Educate staff and professionals in the process of managing administrative procedures for Renewable Energy Technology;

18. Train industry staff in possible RE measures and RE project financing;

19. Ensure that adequate incentives are instituted and maintained so as to retain a sufficient level of trained staff;

20. Train staff in the fundamentals of renewable energy technology, the principles of energy efficiency, energy policy and carbon markets;

21. Set up a training the trainers program covering all aspects of RE;

22. Provide capacity building opportunities for planning and implementing large off-grid and on-grid programs (operation & management);

23. Develop and implement a training program for energy auditors and managers from the public and private sectors, including energy service providers; and develop and implement a certification scheme for energy auditors and managers;

24. Support the development of micro-enterprise clusters to foster collective energy efficiency and establish vertical linkages between the cluster and the distribution/supply chains for improved cook stoves;

25. Disseminate information about the successful implementation and the economic and environmental benefits of retro-fitting hospitals with energy-efficient or RE-based technologies; this will help increase confidence of local governments and lead to further replication in nearby villages. RE sources could provide alternate sources of energy for emergency services during power shortages;

26. Plan regular training and information sessions to provide system designers and field technicians with the latest know-how and skills;

27. The GOL shall undertake measures through the following policies which will be promulgated into the regulations for the renewable energy sector of Liberia:Policy Measures could include but not be limited to the following:
    - Phasing out fossil fuel subsidies;
    - Pricing energy to fully reflect all the associated environmental costs;
    - Carefully designing targeted subsidies to increase access to electricity and clean cooking fuels.

28. Measures to promote the use of solar thermal systems:
    - Conducting awareness campaigns on solar thermal systems to inform all relevant stakeholders and the interested population about the different applications of solar thermal energy and the related benefits.
    - Installing demonstration solar thermal systems for water heating in social institutions (hospitals, orphanages, homes for elderly people, etc.) in order to increase the hygienic standard of the social institutions and to reduce costs for water heating.
    - Establishing a national center of competence on solar thermal technologies.
    - Establishing and implementing a national solar thermal technology platform (STTP), with links to similar platforms in other African countries in order to facilitate information exchange and international cooperation.
    - Setting up technical assistance programmes to local producers of solar thermal collectors

29. Measures to promote energy efficiency and the use of renewable energy in the buildings sector include:
    - National building code tailored to local conditions and construction practices, which requires or encourages minimum energy efficiency standards in buildings, criteria of tropical architecture and a link to urban planning, in line with the requirements of the ECOWAS Directive on Energy Efficiency in Buildings (EDEEB).
    - Measures aiming at reducing energy consumption in public buildings by addressing the building as such, efficient lighting and the building operation (including user behaviour)

- Promotion of the use of local materials in construction
- Qualification, accreditation and certification schemes for installers of energy–related building elements.
- Develop and disseminate a compilation of model designs for sustainable construction of small buildings

30. Renewable energy and energy efficiency will support the adequate functioning of health care facilities among others through the following measures:
    - Vaccine refrigeration and ice pack freezing using solar and wind energy generated on site
    - Lighting from renewable energy sourcesSolar-based radio and radiotelephone communications
    - Enable medical appliances to operate with RES (incorporate inverters that are powered by RES into the system)
    - Sterilization (sterilize with thermal energy rather than electricity due to lower costs)
    - Water treatment (endorse alternatives to chemical disinfection like UV or ozone treatment using RE sources)
    - Water supply (RES-powered manual and large-motor generator driven pumps)
    - Solar thermal technologies (e.g. solar water heating, distillation and pasteurization)
    - Energy storage technologies in combination with RES electricity for medical facilities
    - Equip hospitals with solar energy technologies and efficient light bulbs
    - Make the hospital or health clinic the centerpiece of a village mini-grid

3.5 THE ROAD MAP AND ACCESS STRATEGY

6. Rural Electrification Plan – the RREA shall complete and publish the development of the national rural electrification plan;
7. Undertake Sub-Sector Strategy- capacity training and resources assessments including solar, wind and miny hydro training and resources assessments;
8. Reverse and Update the Existing Plans – including updating the NEPL including cabinet adoption and encorporation of the measures and actions from the NREAP, NEEAP and SE4ALL as well as other relevant polices of the GOL;
9. The GOL shall make available a budget for the required funding for the Additional Plans/Studies needed to put the NREAP-NEEAP-SE4ALL action plans in action.

3.5.1 Grid Infrastructure and Supply Efficiency

The action agenda for expansion of grid infrastructure to areas or people without access to electricity is very much a priority; Transmission lines and distribution infrastructure need to be strengthen and extended to areas not yet supplied. The GOL shall initiate projects and programs with the objectives of reducing technical and non-technical losses in the grid, or put into action the Loss Reduction Studies currently (March 2016) in progress (which currently stand at 25-40% in some cases) and implement the resulting outcoms and recommendations .

The GOL shall support measures on energy efficiency in the Grid, Public and Household lighting, Industry, transport, health and education as planned in the accompanying NEEAP including maeaures which improve reliability and reduce commercial losses, measures that increase the efficiencies of energy generation and supply

3.5.2 Distributed Electricity Solutions

It shall be the policy of the GOL that the electricity distribution network should involve the use of several options including the use of not only grid-power supply but also utilizing mini-grids, micro-grids, beyond the

grid (BTGs) systems and stand alone systems especially for the accelerated supply of electricity to the rural and peri-urban areas of the country.

When assessing existing plans, ownership and implementation structures and track record should be considered.

In terms of the SE4ALL implementation structure, the GOL hereby designates the RREA, being the Focal Point for ECREEE programs in Liberia, to appoint the SE4ALL Coordinator with participating inter-agency coordination committee as described below.

3.5.3 Modern Cooking Appliances And Fuels

The action agenda for modern cooking appliances and fuels is one that holds the first opportunity for the SE4ALL AA to make direct impact to the greatest majority of the population. It is therefore the policy of the GOL to inform, educate and support programs that enable households to shift to cleaner fuels and stoves, to be included, including cook-stoves fuelled by cleaner fuels such as electricity, biogas, solar, ethanol, propane, LPG, and advanced biomass cook-stoves. In the implementation of this AA, actions to consider will include:

- Development of improved and market driven cooking stoves with local manufacturing opportunities;
- Consideration for the needs of consumers and users in the design and implementation of the program
- Insuring that there is available investments with financial & social return
- Involvement of the poor in the creation and engagement of businesses for improved modern cooking technologies, including their involvement in Co-createing the business that engage with the poor.
- Other priorities (including demand side management initiatives), such as efficiency improvements, and use of alternatives will be pursued.

3.6 RELEVANT HIGH-IMPACT OPPORTUNITIES (HIOs)

High-Impact Opportunities (HIOs) are sectors or categories of actions that have been identified as having significant potentials to advance the 3 SE4ALL objectives globally. They serve as a collective forum for stakeholders working on various High Impact Initiatives (i.e. targeted on the ground programs or projects in support of SE4ALL) within the same general sub-sector (such as on mini-grids, or biofuels).

The following are the initial recommended relevant priority high-impact opportunities (HIOs) for Liberia's SE4ALL. More HIO will be identified with the involvement of stakeholders in the development of priority actions in the concerned field, enabling maximum potential for targeted follow-up support and investment.

A. **High-impact opportunities:** Building sustainable local value chains for clean and efficient cooking solutions; building market demand by raising awareness of their health, economic, environmental, and gender benefits; investing in the infrastructure and local distribution supply chains required for cleaner fuels (e.g., ethanol and LPG); developing tiered standards for efficiency, emissions and safety; and designing cooking appliances that meet consumer needs and price points.

B. **High-impact opportunities:** Clean energy mini/micro-grid solutions for rural and targeted industrial applications, using both renewable and conventional sources; locally appropriate regulatory frameworks to incentivize and support commercially viable investments in decentralized electricity solutions; deployment of off-grid renewable and lighting and charging systems, including solar lighting; and self-contained systems that provide uninterrupted power when the grid fails.

C. **High-impact opportunities:** Traditional grid expansion to unconnected areas; strengthening transmission and distribution networks to reduce losses and improve reliability; regional

interconnections to improve performance; improving the efficiency of existing conventional energy generation and interaction between fossil and non-fossil fuels; smart grid technology solutions and grid-scale storage; and redesign of existing plants and networks to facilitate long-distance transmission in a more volatile supply-and-demand environment.

D. **High-impact opportunities**: Public/residential/commercial buildings, cool roofs, building integrated solar PV, and small-scale renewable rooftop solar and solar hot water; sector efficiency labels and performance standards; well enforced building codes; demand-side management programs and advanced technologies to enable energy-saving behavior and shift demand across time; advanced lighting, space cooling and heating, and refrigerators; and wider adoption and enforcement of regional minimum efficiency standards and comparable test procedures by industry and local governments.

E. **Engaging in policy and planning have high-impact opportunity**: Create opportunities for private and public sector partnerships (PPPs) and independent private partnerships (IPPs) transaction for power development and financing.

Annex 1 contains the current list of formalized HIOs (an updated version of this list can be obtained from the Global Facilitation Team).

4.0 MEASURES TO ACHIEVE THE TARGETS FOR RENEWABLE ENERGY IN LIBERIA

In order for Liberia to achieve the set of targets and the SE4All objectives in the field of renewable energy, various measures and plan of actions are identified below which the GOL consider necessary and hereby highlight them for appropriate GOL implementation. These measures shall include measures to support, encourage, and cerate the enabling environment for the development of the electricity grid, off-grids, mini- and micro grids and stand alone solutions of various kinds and beyond the grids (BTGs). They will be considered as applicable for rural, peri-urban and urban areas with a view to achieve the set targets.

4.2 IMPLEMENTATION OF THE WAPP CROSS-BORDER PROJECT

Liberia is a member of the WAPP through which there are opportunities for the Cross-border electric power supply and the CLSG transmission lines projects. It is recommended that an indicative costing of the activities is provided that should take into account both OPEX and CAPEX considerations, as well as an assessment of the risks (political, economic, social & environmental, financial, and implementation) and their mitigations. This should make use of renewable energy resources and readiness assessments to the extent practical. Efforts are in progress to implement these and other projects which are of very high priority in Liberia.

4.3 RENEWABLE POWER GENERATION

Liberia has several options to accelerate the deployment of all renewable technologies, including mainly solar PV, solar thermal including CSP, hydro, marine power, and biomass; the research and innovations needed to continue pushing down the cost of these technologies; specific policies and business models to support them (e.g. feed-in tariffs and public auctions); and the removal of barriers to large and small-scale renewable. Due considerations need to be given to questions of affordability, availability of base load generation capacity, network stability, cross-border energy flows and energy trading.

4.4 GRID INFRASTRUCTURE AND SUPPLY EFFICIENCY

Grid infrastructure and supply efficiency is mainly focused on the prevention of huge technical and non-technical power losses in electricity generation, transmission and distribution with a focus on the infrastructure and network necessary to enable the target penetration of renewable and exploit domestic renewable energy resources to best effects. Efficient lighting for domestic and public facilities and streets as will as energy effeniency in industry (Small-mesium scale industries, mining, and acriculture) as well as in commercial buildings shall be addressed.

4.5 INDUSTRIAL, AGRICULTURAL AND MINING PROCESSES

The industrial, agriculture and mining as well as forestry operations hold enormous opportunities for energy access, energy efficiency and renewable energy. Some of the notable areas include the capture and recycling of waste heat, waste wood and other agricultural and industrial waste to be used for energy generation purposes; as well as the use of renewable energy sources in industrial, forestry and agricultural processes. Mining, Forestry and Agricultural concessions in Liberia provide housing facilities and camps for their employees where energy efficiency measures can be effectively applied.

4.6 BUILDINGS AND APPLIANCES

This action area includes considerations for design and retrofit of buildings with the objective of incorporating renewable self-generation options (e.g. rooftop solar and solar hot water). This area has high impact potentials for Liberia with other Nexus impacts associated with it – including energy and health, water supply, agriculture applications, educational institutions, residences, tourism resorts, hotels, etc. etc.

4.7 TRANSPORTATION

The application of RE in the Transportation sector is mainly focusing actins needed on increasing the share of renewable sources such as alcohol and biodiesel technologies in the fuel supply. Solar-charged batteries could be applicable to specific transportation needs in Liberia. More importantly for Liberia, energy efficiency can be substancial in the transport sector through efforts to inprove the streets and highways. The GOL shall undertake streets and highway paving programs and improvement measures as part of energy efficiency in Transport.

4.8 OTHER PRIORITIES

Relevant High-Impact Opportunities (HIOs) identified are relevant as stated above for both access and renewable energy targets.

4.9 ENERGY EFFICIENCY

Current Status and Trajectory

Information on the current situation regarding energy efficiency for Liberia was based on the results from Scenario analyzes of the trajectory for the rate of improvements in energy efficiency until 2030. The rapid assessment/gap analysis done for Liberia provided initial basis for the analysis and inputs into the Scenario analysis used for the SE4ALL to the extent possible as baseline.

Existing Plans/Strategies and the Gaps

For the strategy in the area of energy efficiency, there is a serious gap in Liberia including the lack of existing plans and strategies in the sphere of energy efficiency. This is especially lacking in areas such as addressing inter alia residential, industrial & commercial energy efficiency and energy efficiency in transport. This SE4ALL Action Agenda has been prepared to fill that gap and is therefore endorsed by the GOL for implementation.

The NEEAP document accompanying this SE4ALL addressees the overarching objectives in the field of energy efficiency which include but not limited to the following areas:

Buildings and Appliances

Buildings in Liberia have not been built or managed with the conscious design for appliance and operational efficiencies and energy conservation principles in the plan. The GOL Action Area for Buildings and Appliances will be identified to include opportunities and innovative methods of designs and retrofitting of the building envelope to decrease energy consumption; appliance efficiency, including efficient lighting, space cooling, water heating and refrigeration appliances. The GOL shall institute policies for the appropriate use of airconditioners and lighting devices in public buildings and households. Standards will be enforced to protect the environment as well as conserve energy.

Industrial and Agricultural Processes

This Action Area shall include opportunities to improve the efficiency of business operations and product design, reduce energy consumption and wasteful practices along the value chain. These will be identified in the SE4ALL AA process for Liberia.

Transportation

The SE4ALL Action Area for the Transport Sector of Liberia shall includes all options that improve the efficiency and reduce fuel consumption per distance travelled, that shift fuel demand to sustainable biofuels or electric power vehicles, that promote modal shifts to less polluting vehicles and more efficient transportation means and that reduce demand for transportation services. For Liberia, the list is in process but this must include as a priority, the following:

- Grid infrastructure and supply efficiency including programs to repair the roads across the country;
- Many other priorities shall be identifiable such as vehicles importation, maintenance system, etc. Relevant High-Impact Opportunities are to be identified including the construction of roads, importation of fuel efficient vehicles, etc.

4.10 ADDITIONAL NEXUS TARGETS

The GOL shall identify additional Nexus targets as a part of the SE4ALL AA for Liberia which shall include but not limited to the following activities:
Review the current status and trajectory;
Review existing plans/strategies and the gaps;
Identify the priorities to be addressed to achieve the overarching objective in the field of energy efficiency.
These should be identified in consideration of the following sub-sector areas and considerations:

4.10.1 Buildings and Appliances

The GOL shall support programs and efforts for improving the construction standards and norms for thermal insulation to reduce the abusive use of air conditioning that is widely spread in Liberia. Public awareness programs on building energy efficiency will be undertaken by the relevant energy agencies.

In the housing and building industry, standards and practices as far as insulation is concerned are very low for the existing constructions, thus resulting in high consumption of electricity for air conditioning. The types of incandisent lighting divices are high consuming. It also appears that the uses of timers or automatic switch-off devices are not developed. The GOL shall develop and enforce standards and undertake tranining and information programs for Building and Appliance efficiency.

4.10.2 Industrial and Agricultural Processes

In line with the international community, and based on the principles of extending energy access to all Liberians through careful consideration of the environmental costs and benefits, and with the goal of maximizing efficiency to minimize costs and any adverse environmental impacts, the Government of Liberia shall encourage the efficient use of energy in industry and agriculture

activities, including the use of energy efficient equipment, reduction of losses in power generation, lighting and operational processes.

4.10.3 Transportation Including Good Roads

Repairs of streets, allays, and highways will substantially, if not the most contribute to the efficient operation of transportation energy, the vast majority of losses can be attributed to bad roads. The GOL shall undertake programs to improve roads streets, allays and drainages.

4.10.4 Grid Infrastructure and Supply Efficiency

Electricity transmission and distribution infrastructure as well as generation facilities are the sources of the greater majority of electric powerlosses. The GOL shall support power loss reduction programs including requirements for utilities to inplement required standards in transmission and distribution infractrutures with energy efficiency as the backdrop.

4.10.5 Other Priorities

Programs and measures will be developed at various levels, organizations and stakeholders for the implementation of the identified relevant High-Impact Opportunities (HIOs). For the additional Nexus targets – see Appendix I of this report.

4.11 ENABLING ACTION AREAS

Below is a summary listing of the enabling action areas for the above outlined priorities and their inter-linkages with the GOL priorities. These enabling environment activities including the establishment of a dedicated institution, standards, regulation and support mechanism of the above priorities are to be acted upon while focusing on cross-cutting enabling environment issues. The required enabling policies, measures and regulations at all levels to facilitate innovation and overcome market and other barriers to the dissemination and commercialization of sustainable energy technologies, products and service delivery approaches shall be developed and detailed to ensure sustainable implementation and enforcement actions.

4.12 ENERGY PLANNING AND POLICIES

The DOE and the Liberia Electricity Regulatory Commission (LERC) shall develop energy planning programs and promulgate policies, regulations and institutional frameworks that are clear, transparent, and predictable to create the right environment for long-term investments incl. national level target setting, appropriate pricing, tax regimes and tariff structures. This will also include institutional and governance environments and utility reform. This also includes strengthening the statistical capacity and data reliability.

4.13 BUSINESS MODEL AND TECHNOLOGY INNOVATION

The GOL shall foster improved business models and technology innovations for private sector market approaches to pursue decentralized access solutions or for small businesses to pursue energy-saving technologies. Due consideration should be given to sustainable operation of utilities/municipalities and co-operatives in providing sustainable and affordable energy solutions to consumers.

4.14 FINANCE AND RISK MANAGEMENT

The Government shall develop approaches and instruments to mobilize the capital required, and to direct that capital to the appropriate priority opportunities, and very importantly to reduce the risk of private investment in sustainable energy through the targeted use of philanthropic and public capital and the engagement of local financial institutions. The GOL shall develop machanisms that will also outline actions required to modernize the country's finance sector, sustainable pricing policies etc. Financing opportunities and mechanisms and financial tools where available, will be pursued and the GOL will make all efforts to meet the requirements.

4.15 CAPACITY BUILDING AND KNOWLEDGE SHARING

The GOL shall launch and implement a diverse array of programs: technical assistance to government cperations, other companies and organizations; efforts to build strong local institutions; the gathering and dissemination of knowledge and best practices; general advocacy and consumer education programs.

4.16 OTHER PRIORITIES

The SE4All shall be related to the broader issues of the rule of law, taxation, fight against corruption etc. and critical areas will be identified by the GOL and measures will be put in place to address these issues.

National SE4ALL Action Agenda Investments

Actual global investment in the areas covered by the three SE4ALL objectives has been estimated at about $400 billion in 2010. For Liberia, the investments required to achieve the three objectives are tentatively estimated to be at least $600–800 million per year over and above existing levels, entailing a doubling or tripling of financial flows over current levels.

The bulk of those investments are associated with the energy efficiency and renewable energy objectives, with access-related expenditures representing a relatively small percentage of the incremental costs (10–20 percent). Achieving such a steep increase in financing for energy is unlikely to be possible without substantial investments from the private sector. The global energy models also help to clarify the kinds of policy measures that would be needed to reach the three sustainable energy objectives.

A variety of data sources—primarily previous studies presented to me from the MLME and RREA and in some ECREEE, the Backstopping Consultants, the Global databases on electricity and another on non-solid fuel, the World Bank and other studies were consulted as references.

The SE4ALL universal access goal will be achieved only if every person on the planet has access to modern energy services provided through electricity, clean cooking fuels, clean heating fuels, and energy for productive use and community services. Although global tracking of energy sources for heating, community services, and productive uses will not be possible in the immediate future, it is recommended that an approach to track them at the country level be developed in the medium term.

5 FOLLOW-UP, MONITORING, EVALUATION AND PERIODIC ADJUSTMENTS

Chapter 5 of this Action Agenda is intended to outline the national SE4All coordination structures and the follow-up mechanisms in terms of subsequent analysis, reporting and monitoring arrangements. It also highlights the link to the Investment Prospectus as the second pillar of SE4ALL country action.

5.2 NATIONAL SE4ALL COORDINATION STRUCTURE

At the launch of this AA activities, the GOL will as soon as possible nominate the SE4ALL Coordinator and the GOL will appoint the Coordinator for the SE4ALL possibly form the RREA who is currently the Focal Point for ECREEE in Liberia. The following four key actions shall be undertaken by the coordinator in the implementation of action agenda for Liberia:

1. The National SE4ALL Coordinator should be involved throughout the AA development process;
2. The Coordinator shall maintain good stakeholder engagement; and
3. The Coordinator shall along with other stakeholders and the MLME identify Bankable projects identified in the SE4ALL process as input for the Investment Prospectus (es).

In developing the investment prospectus, the Coordinator shall as soon as possible identify and work with a Financing Working Group which brings together Government stakeholders and financing institutions. The mandates, roles and responsibilities of institutions and stakeholders shall be clearly and adequately defined within the institutional framework to implement the SE4ALL Action Agenda. The issue of quality control is an important dimension that will also be addressed.

5.3 FOLLOW-UP ANALYSIS

The Action Agenda already provides the strategic framework that needs to be followed towards achieving the SE4ALL targets, however there will be a need for subsequent in-depth studies and analysis in many cases.(i.e. electrification plan, priority sub-sector market mapping, etc.). It is therefore incorporated into this SE4ALL for measures to be undertaken to mobilize financial resources and technical manpower capacity necessary to provide resources to cover the costs for the subsequent in-depth studies and analysis.

5.4 MONITORING, EVALUATION AND REPORTING

A flexible but robust framework shall be developed for monitoring and evaluation of the national SE4ALL Action Agenda and to support lessons learning, and make necessary adjustments over time. This monitoring and evaluation shall include but not limited to provisions for regular review/update (every five years) of the Action Agenda, which shall be seen as a living document. There shall be a continuous process to build support for the SE4ALL Action Agenda and foster ownership and accountability, a mechanism will be put in place to track progress that should link to the Government's own monitoring and evaluation instruments and where relevant build on existing monitoring exercises by the different partners, facilitate the collaborative participation of stakeholders in monitoring, and make the monitoring information accessible to the public. This work should also be linked to the Global Tracking Framework ensuring the provision of the most accurate data. Provisions will also be made for regular reporting on Action Agenda implementation to the GFT and Regional Hub.

5.5 LINK TO INVESTMENT PROSPECTUS (ES)

The Action Agenda shall be followed by the development of SE4ALL Investment Prospectus (es) with a view to mobilize the required investments to implement the Action Agenda.

The GOL shall undertake progress monitoring using appropriate GOL functionaries including the assessment and provision for enough data to monitor progress indicators towards fulfilling the three SE4ALL targets.

AA Coordination Group

- The SE4ALL Coordinator shall be appointed by the GOL to be based either in the MLME or RREA
- Ministry of Lands, Mines and Energy or RREA shall appoint the: SE4ALL Focal Point
- Representative of the Minister of Lands, Mines and Energy shall be member of the AA Coordination group
- Another one or more members of the AA Coordination Group shall be appointed from the lead development partner(s) – EU, USAID, NORWAY, Australia, Woeld Bank, GIZ, etc.
- SE4ALL GFT and Hubs (Regional Hub + thematic Hubs)
- Development Partners interested to actively support the process shall be represented
- Relevant regional entities shall be represented

National Expert Group(s)

- Ministries and other specialized Government entities, including the utility representative
- Private sector representatives
- Civil society representatives
- Financing institutions
- Academia and other stakeholders (e.g. relevant HIOs)

Validation Stakeholder Group

- Some key Ministries
- Private sector stakeholders
- Civil Society stakeholders
- Development partners

The list of Validation Stakeholder Group will constitute a wide range of stakeholders with the role to validate the AA draft and provide outside expertise and input the appendix to the Validation Report will include National Expert Group(s) set-up for the respective priority areas and will include relevant representatives from Ministries and Government entities (these include but not limited to MLME, DOE, RREA, LEC, EPA, MOA, MOF, MIA, FDA, MPW and NIC), private sector (LIBA, energy NGOs, International partners, and civil society with the role to:

(i) Formulate the priority actions in the respective priority area;
(ii) Define additional information needs;
(iii) Communicate results to the AA Coordination Group.

REFERENCES

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29. TECHNICAL ASSISTANCE FOR SMALL HYDRO POWER DEVELOPMENT Scoping Report Enco Private Limited 92/A, Raththanapitiya, Boralesgamuwa, Sri Lanka | Tel: +94-114-301833 Fax : +94-112-545192 | Email : info@hydropowerinternational.com Web: www. hydropowerinternational.com

ANNEX 1 – ACTIVE HIGH-IMPACT OPPORTUNITIES

One of the primary ways in which Sustainable Energy for All drives action is through the formation of High Impact Opportunities (HIOs). HIOs are categories of actions that have been identified as having significant potentials to advance the three objectives of Sustainable Energy for All (SE4ALL).

HIOs provide a platform for stakeholders from the private sector, public sector, and civil society to work together on specific actions that advance sustainable energy within the framework of the larger global initiative. HIOs enable partners to:

- Collaborate with other organizations on similar objectives;
- Track and mobilize resources and investments;
- Overcome barriers that are difficult to tackle individually;
- Share best practices and coordinate activities;
- Develop and promote international standards;
- Broker new partnerships

These High-Impact Opportunities, which fall within the 11 Action Areas of the Action Agenda, are defined based on their significance and ability to make an immediate impact towards reaching Sustainable Energy for All's three objectives.
Created By:

- Building Strong Partnerships;
- Encouraging Common Actions; and
- Forging Lasting Commitments.
- Ensure universal access to modern energy services.
- Double the global rate of improvement in energy efficiency.
- Double the share of renewable energy in the global energy mix.

Approximately 50 High Impact Opportunities have been identified to date. Some examples include:

1. Advanced Lighting and Appliance Efficiency;
2. Building Energy Efficiency;
3. Energy and Women's Health;
4. Finance;
5. Modern Cooking Appliances and Fuels;
6. Off-Grid Lighting and Charging;
7. Phase out of Gas Flaring;
8. Sustainable Bioenergy;
9. Sustainable Energy for Island Economies; and
10. Vehicle Fuel Efficiency.
11. Water-Energy-Food Nexus
12. Clean Energy Mini-Grids

The Accelerator Platform is established under Sustainable Energy for All to support specific sector-based energy efficiency accelerators. They are:

Governance:

- Performance Metrics;
- Reporting Requirements;
- Commitment Management;
- Policies;
- Resources And Tools;

- Public And Private-Sector Financial Support

The individual accelerators focus on specific energy efficiency sectors and include:

- Buildings,
- Lighting,
- Appliances,
- District Energy Systems,
- Industry, and
- Transportation.

Discussions underway

1. Advanced Lighting & Appliance Efficiency
2. Energy Efficiency in Buildings
3. Off-Grid Lighting & Charging
4. Sustainable Energy for Rural Towns – Beyond the Grid (BTG) Solutions
5. Universal Adoption of Clean Cooking Solutions

APPENDIX II: TABLE OF BASIC ECONOMIC DATA OF LIBERIA FOR 2010 – 2016

BASIC ECONOMIC DATA									
Annual percentage change unless otherwise stated									
	2010 Prel	2011 5th Rev.	2011 Proj.	2012 5th Rev.	2012 Proj.	2013 Proj.	2014 Proj.	2015 Proj.	2016 Proj.
Population (Millions)	3.8	4.0	3.9	4.1	4.0	4.1	4.2	4.3	4.4
Real GDP growth	5.6	8.8	6.8	11.7	9.6	7.8	5.8	9.5	5.1
Nominal GDP (millions of US dollars)	989.1	1,054.1	1'153.9		1,353.0	1,488.1			
Nominal GDP per capita (US dollars)	261.8	265.8	297.7		340.2	364.7			
Consumer Prices – end of period (%)	6.6	4.6	6.1	5.0	5.4	5.0	5.0	5.0	5.0
Foreign direct Investments net (million $)	398	602	431		821	903			
Consumer Prices – average (%)	7.3	4.2	8.1	4.8	5.8	5.2	5.0	5.0	5.0
Consumer Prices – US dollars denominated, year-on-year (%)	1.3	0.8	3.6		3.0	1.1			
Fiscal Balance. Incl. grants (% of GDP)	0.6	-0.5	1.3		-1.1	-3.5	-4.6	-5.4	-5.4
Fiscal Balance. Excl. grants (% of GDP)	-0.8	-6.4	-2.2		-4.2	-7.1	-8.2	-9.0	-9.0
Current Account Balance – Incl. grants (% of GDP)	-43.5	-59.2	-37.8		-62.9	-64.6	-44.8	-7.0	-0.2
Current Account Balance – Excl. grants (% of GDP)	-142.4	-149.3	-121.6		-127.8	-117.7	-90.2	-39.3	-28.6
Broad Money (M2)	33.5	5.4	15.2		16.5	103			
Reserve Money (annual percentage change)	32.0	8.8	7.2		13.4	11.8			
Public External Debt (% of GDP)	11.3	15.6	10.9		11.7	13.7	17.4	19.6	22.4
Central Government Domestic Debt (% of GDP)	31.4	29.7	27.3		24.3	22.3	21.7	20.7	19.8
Gross official reserves (millions of US dollars)	391.4	329.8	425.1		452.0	462.0	483.8	488.2	488.3
Gross official reserves (months of imports	3.4	2.0	2.7		2.1	2.1	2.3	2.5	2.4

BASIC ECONOMIC DATA									
Annual percentage change unless otherwise stated									
	2010 Prel	**2011 5th Rev.**	**2011 Proj.**	**2012 5th Rev.**	**2012 Proj.**	**2013 Proj.**	**2014 Proj.**	**2015 Proj.**	**2016 Proj.**
cover*)									
***Source:** *LIBERIA: Rapid Assessment and Gap Analysis Draft Report - March 2013*									

APPENDIX III SCENARIOS OVERVIEW RESULTS

1 - Overview of scenarios NREAP - NEEAP - SE4ALL (short version)											
For the country Liberia Developed on: 03.23.2015											
Baseline scenario ("Baseline") for the power sector							Value in US$				
	2010	**2015**	**2020**	**2025**	**2030**		**2010**	**2015**	**2020**	**2025**	**2030**
Annual electricity generation (GWh)	190	418	920	2,023	4,450						
of which renewable generation (GWh)	40	40	40	40	40						
Value of electricity generation (000 000 Liberian Dollar)	8,208	18,057	39,725	87,393	192,261		103	226	497	1,092	2,403
Value of fossil fuel consumption (000 000 Liberian Dollar)	3,251	8,175	19,009	42,843	95,277		41	102	238	536	1,191
Rate of access to electricity	1.4%										
Scenario NREAP - NEEAP - SE4ALL											
Additional renewable electricity generation (GWh)	0	0	622	1,244	1,244						
Value of renewable electricity generation (000 000 Liberian Dollar)	0	0	26,876	53,752	53,752		-	-	336	672	672
Savings in electricity consumption (GWh)	0	0	236	737	1,605						
Value of savings (000 000 Liberian Dollar)	0	0	10,176	31,855	69,339		-	-	94	209	335
Efficiency + renewables (GWh)	0	0	858	1982	2849						
Value of EE + RE (000 000 Liberian Dollar)	0	0	37,052	85,607	123,091		-	-	1,295	2,612	2,738
NPV of the set of action plans, in the starting year of implementation (000 000 Liberian Dollar)	290,316										
Improvement in the national balance of payments = value of the reduction in fossil fuel consumption (000 000 Liberian Dollar)	-	-	19,553	45,072	65,302		-	-	661	1,336	1,419
Rate of access to electricity	1%	1%	34%	67%	100%						