Liberia Energy Evaluation

Evaluation of the Liberia Power Compact: Interim Findings

November 2020

“Electricity is Life”.
Investing in the energy sector in a challenging context: Liberia as a case study

- Only small-scale thermal generation
- Destitute utility company
- Dilapidated T&D infrastructure
- Regulatory environment: undeveloped, unfamiliar

- Post-conflict and pandemic (Ebola) affected
- Uncertain political economy
  - Weak governance, institutional capacity, and public sector management
  - Loss of a generation of personnel with energy sector skills and experience
  - New administration lacking experience
  - Worsening financial crisis and unfavorable macroeconomic outlook

Rapidly growing demand for energy
Liberia Compact (2016-2021)

MCC’s Energy Project ($202 million):
- Aims to improve access to reliable and affordable electricity by
  o Increasing production and distribution of lower cost, quality electricity
  o Reducing tariffs and user costs

Activities
- Rehabilitate the Mount Coffee Hydropower Plant (MCHPP) to generate low-cost power
- Build capacity in the Liberian Electricity Corporation (LEC)
- Establish an independent regulator
Reduced poverty through economic growth

**Problem**

Insufficient quantity and quality of electricity and poor electricity infrastructure are binding constraints to economic growth in Liberia.

**Outputs**

- Rehabilitate MCHPP
- Construct and rehabilitate transmission infrastructure from MCHPP to electricity grid

**Activities**

1. Mt. Coffee Rehabilitation
2. Capacity Building and Sector Reform

**Outputs**

- Increased generation, T&D capacity
  - Increased production of low-cost, renewable electricity (hydropower)
  - Improved distribution of low-cost electricity through rehabilitated substations
  - Hydropower accounts for an increased share of Liberia’s energy consumption

- LEC demonstrates improved ability to manage, operate, and expand generation and distribution infrastructure
  - Improved ability to use data for problem solving and decision making
  - Reduced frequency and duration of outages
  - Improved customer service and trust in utility
  - Decreased time between application and connections for new customers

- LERC improves the legal, economic, and technical regulations
  - Transparent registration processes, reduced electricity theft, improved predictability of sector, and environment inviting to private investors
  - Improved tariff structure that balances lowering customer costs, meeting LEC’s operational costs, and generating revenue
  - Improved technical regulations and oversight of providers

**Intermediate outcomes**

- Improved overall functionality of energy sector

**Long-term outcomes**

- Increased business productivity
- Greater economic opportunities for households
- Improved capacity for public service provision

**Outputs**

- Increased consumption of quality electricity
- Reduced user costs

**Outputs**

- Increased number of firms, institutions, and households connected to the grid electricity
Evaluation design, questions, and approach

Performance evaluation to answer evaluation questions

1. What implementation lessons can be drawn (MCHPP and LEC)?
2. What new energy policies, laws, and regulations have been enacted?
3. To what extent has the MSC improved LEC’s management?
4. How have MCC’s investments affected grid performance and new connections?
5. How have customers changed behaviors?

- Pre-post evaluation using mixed methods approaches
- Analysis of implementation and early outcomes
## Liberia Evaluation Timeline

<table>
<thead>
<tr>
<th>Name of round</th>
<th>Data collection</th>
<th>Data cleaning &amp; analysis</th>
<th>First draft report expected</th>
<th>Final draft report submitted/expected</th>
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Key outcomes and data sources

**Document review, site visits**
A thorough analysis of documents: contracts, project implementation agreements, inception and work plans, monthly, quarterly, and annual reports, schedules, commissioned studies, RFPs, TORs, SOWs, spreadsheets, financial statements, presentations, memos, laws, policies, news, maps, issue trackers, timelines from all relevant agencies. **Also,** Multiple rounds of site visits.

**Administrative data**
We collected, analyzed, and plotted five years of administrative data (2015-2019) from the Liberia Electricity Corporation; Subcontract Tetra Tech.

**Quantitative surveys (5 samples)**
- **Monrovia Connected study:** Baseline (2016 recall data) outcomes (2018)
  1) Connected households (n=1,174);
  2) Connected small businesses (n=322); and
  3) Medium and large end users (n=175).
- **Kakata Corridor:** Unconnected study (to follow over time as they connect)
  4) Unconnected households (n=867); and
  5) Unconnected small businesses (n=400).

**Qualitative data**
Key informant interviews with respondents from MCC, MCA, other donors, ESBI and LEC staff and board members, LERC, ministry officials, the contract monitoring consultant, and a range of contractors (n=64); also FGDs with household members, interviews with business owners, local officials, public sector staff, women’s groups.

**Implementation outcomes**

**Energy sector outcomes**

**Utility and grid level outcomes**

**End users outcomes**

**Triangulate findings, identify trends and relationships, confirm patterns or findings, and detect discrepancies or disparate experiences**

**Use the implementation analysis findings to contextualize the performance evaluation findings**
Overview of timeline and major events throughout the Liberia Energy Sector

Liberia ranks behind most of the world (175th of 187 countries) WB’s Getting Electricity index 2019, Measures the ease, time, and cost of connecting; reliability of supply; and transparency of the tariff.
Liberian Energy Sector

National Energy Stakeholders Forum

National Energy Policy (NEP) 2009

Preparation of a Government of Liberia Least Cost Power Development Plan (LCPDP) by Norplantech

Liberia Electricity Law (NEL) signed

MCC Compact Signed, which funded Liberian Electricity Regulatory Commission (LERC) $33.35M

300 stakeholders across Liberia came together to discuss Liberia’s energy situation.

“The principal objective of the National Energy Policy is to ensure universal access to modern energy services in an affordable, sustainable.”

Key features of NEP:
* Good governance
* Financial transparency
* Private sector investment in energy supply
* Development of an independent regulatory commission
* Improved institutional and legal framework

The Ministry of Lands Mines and Energy ordered a study to develop a technically and economically beneficial plan for the power sector. (It is unclear what happened following the plan submission.)

§ Law objectives:
* Regulate and promote the development of the electricity sector
* Review the mandate of LEC in line with the National Energy Policy
* Create the successor company to LEC
* Establish the independent regulatory body (LERC)
* Facilitate private sector investment
* Enable independent power producers (IPPs) to generate electricity to help meet consumer demand.

Liberian IPPs tend to be unregulated small-scale owners of generators or large industrial agogenerators/ concessionaires who sell power directly to customers “behind the fence” or illegally (micro-grid). With no framework for private sector participation, larger IPPs are not incentivized to join the energy market.

NS LERC makes little progress given the lack of Senate approval for appointees.

S President Weah continued to delay appointments and Senate delayed confirmation of commissioners. Delays due to competing priorities and politics around commissioner selection.

EU threatened to withdraw $50M in energy sector funds if commissioners were not appointed. Commissioners were confirmed in late 2018.

Progress delayed given LERC Commissioners and MCA-L’s learning curve

Power Theft Law passes

Outbreak subsidies Liberia declared Ebola free

PresidentWeah sworn into office

Deputy Minister of Energy appointed and confirmed

Chair of LERC resigns once confirmed to lead the Central Bank

LERC begins drafting “documents” in earnest, including administrative procedures and bylaws

§ LERC will be looking for donor support given MCA-L funding ends Jan 2021

Micro Utility Licensing Regulations for Off-Grid Service Providers in the Electricity Supply Industry

Electricity Licensing Handbook for Service Providers in the Electricity Supply Industry

LERC holds “workshop” hosting Liberian energy stakeholders, businesses to introduce LERC and documents

Critical economy

Prewar        War

1988  1989    ...  2003  ...  2006  ...  2009  ...  2014  ...  2015  2016  2017  2018  2019  2020

COVID-19

Electricity Licensing Regulations for Service Providers in Electricity Sector Industry

1988  1989    ...  2003  ...  2006  ...  2009  ...  2014  ...  2015  2016  2017  2018  2019  2020

COVID-19
LEC

Management responsibility

- Public utility
  - LEC served Greater Monrovia
  - The 14-year conflict resulted in damage, looting, and vandalism to Liberia's power plants, substations, transmission lines, and fuel storage tanks.
  - LEC operations ceased completely

- Public utility with donor support and TA (2005-2009)
  - With $40 million and TA from USAID, Ghana, Norway, EU, and WB, LEC resumes operations with diesel generators.
  - LEC resumed

MHI as the MSC (2010-2015)
- Contract value $14M over 5 years, 10 staff, $42M through Monrovia Grid Extension for CAPEX
- MHI leaves and LEC poorly managed

Interim Management Team (IMT) 2016-2017
- The IMT entered LEC into unfavorable contracts, sold the customer database, and made illegal promotions.
  - IMT reported revenue but was not transport in reporting expenditures and debt collections
  - LEC operated at a net loss of $1.2M per month

Donor funded infrastructure planned (Monrovia and corridors.)
- Includes T&D network, lines substations, feeders, customer connections.
- Projects suffered prolonged delays.

ESBI becomes new MSC. $11.7M contract for 3 years. 2 optional years for $3.5M, 13 staff, No CAPEX
- 2016/2017 accounts audited until mid 2018.
- LEC switched generators from LFO to HFO to save millions in fuel costs.
- MCHPP turned over to LEC. LEC unprepared to assume operations
- President Weah denounced power theft in State of the Union Speech
- LEC’s financial “crisis is existential” with “chronic illiquidity, inordinate level of electricity theft... LEC cannot fund basic necessities.”
- LEC has “perilous” financial position, with operating deficit, accumulating losses, and high system losses basic necessities (poles, cables, transformers, meters, HFO).
- Power Theft Law passed
- LEC recovers customer database and reduces LEC salaries by 30%.

Asset and Customer Mapping Study critical to geolocating LEC infrastructure and customers to begin

LEC management ends

MCPP events

- 35,000
  - 191 MW
  - 14,000
  - 28,759
  - 33,416
  - 43,976
  - 51,098
  - 53,432
  - 52,680


- Pre-war
- War
- The UN estimated that 200,000 Liberians were killed and 800,000 Liberians became refugees
- Total customers
- Total technical and commercial losses
- Generation (increasing responsibility)
- National emergency
- In neighboring Sierra Leone, 50% of private workforce left the country
- Ebola Liberia declared outbreak
- Ebola free
- Tariff (cost per kWh)

COVID-19
Implementation findings
Implementation: MCHPP  (Most salient findings)

Successes
- Fully rehabilitated and operational
- MCHPP has both emotional and economic value, a symbol of rebirth, modernization, and hope
- Generates high quality, renewable, lower-cost power (~60% less than thermal per kWh)
- Stimulated a high level of donor coordination

Threats and Challenges
- Insufficient resources OMT
- All contractors, LEC, ESBI, hydro facility experts agree OMT insufficient. Risk plant failure, outages, higher rehab costs, emergency situations
- GOL must be a steward of this resource
- “Turbines will go offline as parts are pillaged.”

Opportunities
- Organizations are interested in service contractors or concessions.

Lessons learned
- Donors can successfully collaborate on infrastructure projects, though the consortium structure can improve.
- Plan as systematically and realistically for the operation period as for the rehabilitation works.
Implementation: LEC

January 2018, LEC in a destitute financial situation. ESBI faced:

- Negative operating, profit margin, low liquidity
- Unforeseen and extensive financial liabilities ($21 million debt), lawsuits
- Burned records, accounts in disarray
- Minimal inventory, no asset listing, poorly maintained “decrepit” assets in disrepair
- Shortage of materials, equipment, and tools.
- LV network of “limited standard”, 22 kV network lacked capacity for new connections (inadequate transformers, feeders, meters)
- Suboptimal contracts, no customer listing
- Staffing increased and salaries raised 30%
- Capacity for basic emergency maintenance
- Soon to take over MCHPP, 66 and 22 kilovolt (kV) lines, substations, 230-volt distribution
- No corporate governance
- Widespread corruption throughout LEC

LEC’s financial "crisis is existential" with "chronic illiquidity."
LEC: Successes and stakeholder assessment

**SUCCESSES**
A careful review of data, procedures, systems, and management indicates *ESBI has improved*:

- Operations, diagnosing and problem solving
  - Re-creating financial systems, normalizing customer lists, human resource manuals,
  - Re-negotiating/severing contracts, union relationships, salary adjustments
- IMS operational for decision making
- Network performance: reduced outages
- Power Theft Law passed: improved approach
- Donor coordination (still weak, $198 million in T&D projects)

**STAKEHOLDER ASSESSMENT**
Donors and LEC staff agree that LEC is better with ESBI and would “collapse” without an MSC.

- All LEC staff reported that they thought ESBI should stay
- “We know that we can’t turn over the utility to LEC totally.”
- “Liberia is a very difficult country. This is the last opportunity to fix LEC.”
- [We/they] underestimated how difficult the job is."
- “Individually ESBI team members are working hard. But leadership has been lacking”
Utility level outcomes
Total electricity supply, sold, and peak demand

- Total electricity supply
- Total electricity sold
- Peak demand

Energy (MWh/month)

Peak Demand (MW)
Supply, technical and commercial losses

- Total electricity supply
- Technical losses
- Commercial losses

MWh in Millions
Aggregate technical and commercial losses

For LEC: Meter replacement costs
$267 prepaid, $2,139 commercial

CMC Q4 2019
Network performance
System average interruption frequency / duration index (SAIFI, SAIDI)

- Frequency of interruptions
- Hours
- SAIDI
- SAIFI

Mathematica
Trend data on customer numbers

- Total number of households in Liberia
- Total number of households in LEC service area
- Households in LEC service area connected to grid

With illegal connections could be 115,000

Number of households

- 76,263
- 33,144
- 40,274
- 46,495
- 53,432
- 52,680
- 62,274

Total number of households in Liberia
Total number of households in LEC service area
Households in LEC service area connected to grid
Utility level outcomes: Key Performance Indicators

Aggregate technical and commercial losses (percent)
- Baseline: 43-70
- Target: 35
- Result:
  - 2018: 62-80
  - 2019: 69.8
  - 6/2020: 67.6

Network performance (hours per customer)
- Baseline: 500
- Target: 400
- Result:
  - 2018: 187
  - 2019: 261
  - 6/2020: 243 (6 months)

Operating cost per kilowatt (kWh) billed
- Baseline: $0.47-$0.64 per kWh
- Target: $0.45
- Result:
  - 2018: $0.47
  - 2019: $0.77 (missing Oct-Dec)
  - 6/2020: $0.49 driven by $0.71 Feb fuel cost

Number of new connections per month
- Baseline: 6,600
- Target: 25,000
- Result:
  - 2018: 359 per month
  - 2019: 240 per month
  - 2020: 1,772 per month

Total
- Baseline: 35,000
- Target: 94,000
- Result:
  - +37,605 since 2015
  - 2018: 62,000, 115,000 with illegal
  - 76,263 (CMC-2020)
End user level outcomes

- New end user connections were far less than anticipated however, illegal connections proliferated across donor project areas.
- Liberians place high value on electricity and have high demand for electricity.
- Once connected, many respondents report improved quality of life, increased asset ownership, changes in time use, and improved safety.
- Respondents also warn that electricity presents safety risks and communities require education on electricity safety.
Legal and illegal connections in donor project zones

**Meter sharing**
- 37% of households
- 27% of small businesses share a meter
- Those sharing meters include family, friends, neighbors, and businesses

**Average number of users per meter**
- 4.2 among households
- 2 users among small businesses
Main electricity source 2016-2018 connected end users

**Households**
- Direct line from LEC: 56% (2016), 60% (2018)
- Indirect line from LEC: 27% (2016), 39% (2018)
- None: 2.3%

**Small businesses**
- Direct line from LEC: 49% (2016), 50% (2018)
- Indirect line from LEC: 24% (2016), 36% (2018)
- Own generator: 4.1% (2016), 4.0% (2018)
- Local minigrid: 1.6% (2016), 1.8% (2018)
- Other: 0.7% (2016), 1.4% (2018)

**Medium and large end users**
- Direct LEC line: 33% (2016), 34% (2018)
- Own generator: 37% (2016), 37% (2018)
- Indirect LEC line: 6% (2016), 6% (2018)

**Percentage point change in main source of electricity from 2016 to 2018**
- **Households**
  - Direct LEC line: +4**
  - Indirect LEC line: +12***
  - No electricity: -10***
  - ***/*** Indicates statistical significance at the .05/0.001 level with a two-tailed test.

- **Small businesses**
  - Direct LEC line: +1
  - Indirect LEC line: +15***
  - No electricity: -12***

- **Medium and large end users**
  - Direct LEC line: +12**
  - Indirect LEC line: +1
  - Generator: -7
  - No electricity: -2/9
Main use of electricity in households (any electricity source)

- This is the 21st century, and you can’t live without current.
- Current is life and it provides comfort.
- Normally you won’t want to be in darkness, that’s why we always need light.
- I don’t think Liberians want to be in darkness. People want to enjoy current (electricity), watch videos, charge our laptops, and entertain ourselves. People don’t want to always find themselves in difficult times.
- “How can we go into quarantine without water and electricity? It means we are going to die. Let the government focus and ensure these basic services are affordable.”

Percentage point change in the “main use” of electricity from 2016 to 2018:

- **Lighting:** -9.9%
- **Fans:** 3.5%
- **Electronics and appliances:** 9.9%

Major findings:

- “Electricity Is Life”. It improves quality of life and feelings of security.
- Percentage point change in main use of energy 2016-2018
  - Lighting: -9.9%
  - Fans: 3.5%
  - Electronics and appliances: 9.9%
Quotes on electricity

“This is the 21st century, and you can’t live without current.”

“Current is life and it provides comfort.”

“Normally you won’t want to be in darkness, that’s why we always need light.”

“I don’t think Liberians want to be in darkness. People want to enjoy current (electricity), watch videos, charge our laptops, and entertain ourselves. People don’t want to always find themselves in difficult times.”
Summary of key findings

• **Successful MCHPP rehabilitation (Liberia’s largest energy asset)**
  - LEC unprepared to assume MCHPP operations, maintenance, training (OMT).
  - Inadequate payments to OMT risks turbine or plant failure, performance losses, extended outages, higher rehab costs and emergency situations.

• **LEC continues to face a grave financial situation**
  - However, the management services contract (MSC) Electricity Supply Board International (ESBI) has achieved some success.
  - LEC requires increased funding for operating and capital expenses, sustained donor and government support to continue operations.
  - LEC management and leadership is critical moving forward.
  - URGE the GOL to use all mechanisms to champion the energy sector, reduce corruption and losses, and ensure LEC becomes a functional, profitable utility company.

• **Liberians value and demand “LEC current”**
  - “Electricity Is Life”. It improves quality of life and feelings of security.
  - Limited education and low quality infrastructure present safety risks.
Future considerations

LEC

• “Keep the patient alive.” Operations improving, functional utility essential to energy goals

• Condition future funding on installing qualified LEC Board members

• Focus on reducing fraud, errors, corruption
  • Identify all drivers and sources of loss at LEC
  • Develop theory- and evidence-based approaches (technical and behavioral)
  • Involve LEC board, donors, GoL, media

LEC continued:

• Adequately fund operating and capital expenditures

• Ongoing professionalization of Senior Resource Training Pool critical

• Add a contracts manager to ESBI to oversee all T&D plans

MCHPP:

• Minimize risks. Maintain oversight.

• Ensure GoL understands preventive maintenance is essential

• LEC, GOL to become the steward

• Other financing models
Lessons learned

• Donor collaboration can be successful
• Establish clear lines of authority for each agency
• Ensure that contracts align with the infrastructure needs
• Plan as systematically for the operations as the rehabilitation
• Estimate cost of completion assuming a catastrophic event to give the program a better chance to succeed
• Conduct a utility- and country-level PEA to understand the context

• Build compact and contracts to account for high likelihood of corruption
• Assume MSC will face immense challenges; apply all lessons from the literature
• Build in preconditions and identify leverage to ensure board and government accountability
• Operate as a donor block in extremely poor, post-conflict countries
“The challenges involved are immense and should not be underestimated.” National Energy Policy 2009