



Columbia Center on Sustainable Investment

A JOINT CENTER OF COLUMBIA LAW SCHOOL
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A Framework to Approach Shared Use of Mining-Related Infrastructure

Case Study: Sierra Leone

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List of Abbreviations and Acronyms

ACE cable	Africa Coast to Europe (ACE) submarine cable
AfDB	African Development Bank
AIM	Alternative Investment Market
AMD	Acid mine drainage
AICD	Africa Infrastructure Country Diagnostic
AMD	Acid Mine Drainage
African Minerals	African Minerals Limited
ARPS	African Rail & Port Services (SL) Limited
BHPP	Bumbuna Hydroelectric Power Plant
Btu	British thermal unit
CCSI	Columbia Center on Sustainable Investment
CLSG	Côte d'Ivoire –Liberia - Sierra Leone – Guinea
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessment
HFO	Heavy fuel oil
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoSL	Government of Sierra Leone
GVWC	Guma Valley Water Company, Sierra Leone
IPP	Independent Power Producer
kWh	Kilowatt hour
London Mining	London Mining Company Limited
MDA	Mine Development Agreement
MFO	Medium fuel oil
Mtpa	Million tons per annum
MW	Megawatt
NWSP	National Water and Sanitation Policy
NEPAD	New Partnership for Africa's Development
NPA	National Power Authority

PPP	Public-Private Partnership
SALCAB	Sierra Leone Cable Ltd
SALWACO	Sierra Leone Water Company
SISG	Shandong Iron and Steel Group
SLMA	Sierra Leone Maritime Administration
SLNC	Sierra Leone National Carrier
SPLA	Sierra Leone Ports Authority
SPU	Strategy & Policy Unit at Statehouse, Freetown
Tewoo	Tianjin Materials and Equipment Group Corporation
TPP	Thermal Power Plant
VSAT	Very Small Aperture Terminal
WAPP	West African Power Pool

Glossary

AIM	A sub-market of the London Stock Exchange, allowing smaller companies to float shares with a more flexible regulatory system than is applicable to the main market. ¹
CLSG Interconnection Project	The high-voltage transmission line along the coast that will connect Sierra Leone to Guinea, Liberia, and ultimately Côte d’Ivoire and is envisaged to provide a backbone from which to expand the domestic grid ² Commissioning of this line is expected by 2015. ³
Dewatering	The process of draining the water that collects in the open pits during the mining process. Water collects in the open pits when ore or coal is excavated below the water table, or from rainfall.
Hematite	The mineral form of iron (III) oxide (Fe ₂ O ₃) which is found in the mineral waste of iron ore mines.
Overburden	The waste rock and soil that is excavated in open pit mining.
Rutile	One of a group of titanium dioxide minerals (TiO ₂) predominantly used in the manufacture of white pigment for global paint, plastic and paper.
Tailings	The waste stream of ground rock and process effluents (including unrecoverable and uneconomic metals, minerals, chemicals, organics and process water) that are generated in a mine processing plant during beneficiation. Tailings are usually discharged, normally as slurry, to a final storage area commonly known as a Tailings Management Facility (TMF) or Tailings Storage Facility (TSF). ⁴

¹ AIM website, available at: <http://www.londonstockexchange.com>.

² African Development Bank, “Infrastructure and growth in Sierra Leone,” (2011).

³ “West African Power Pool: Priority Projects and Implementation Strategy,” available at http://www.encharter.org/fileadmin/user_upload/Conferences/2012_March/West_African_Power_Pool.pdf

⁴ “What are Tailings – Their nature and production,” *Tailings.info*, available at: <http://www.tailings.info/basics/tailings.htm>.

Introduction

1. Overview of Sierra Leone

Table 1: Key facts

Capital City	Freetown (capital city)
Administrative divisions	Sierra Leone is divided into three provinces (the Northern Province, Southern Province and Eastern Province) and one Western Area, in which Freetown is located. The Provinces are further divided up into 12 districts, and each of these is further segmented into several chiefdoms.
Population size	5,978,727. ⁵ Freetown is the largest city in Sierra Leone, followed by Bo in Southern Province (149,957), Kenema in Eastern Province (128,402) and Makeni in Northern Province (112,489). ⁶
GDP	US\$3.796 billion (2012) ⁷
GDP per capita	US\$612 ⁸

Sierra Leone emerged from a brutal 11-year civil war in 2002 with most of its infrastructure either destroyed, or in a state of utter disrepair, already having been in decline in the decade preceding the war. A little over 12 years of relative peace and stability later, Sierra Leone’s infrastructure is still in a dire state, notwithstanding the recently high recorded economic growth rates driven by iron ore exports. Power has been restored to Freetown and to a lesser extent the provincial capitals, but is erratic and unreliable at best. With a current combined generation capacity of just 96MW,⁹ it is also inadequate to meet the growing power demands of Sierra Leone’s population, let alone the mining sector.¹⁰ In turn, the transport sector continues to pose major challenges, with roads still in a poor state and airport and port infrastructure lacking the capacity to keep up with private sector demands for imports and export capacity.¹¹ Finally, access to water supply systems remains limited and unreliable and is even declining in urban areas, while ICT coverage is low, with a very low internet penetration throughout the country.¹²

To meet the country’s infrastructure goals, the World Bank has estimated that Sierra Leone should be spending between US\$254 and US\$478 million per year depending on the technologies and implementation methods chosen.¹³ Yet, in recent years Sierra Leone has

⁵ World Bank (2012).

⁶ Population figures are taken from the 2004 census.

⁷ World Bank.

⁸ IMF (2012).

⁹ National Energy Profile of Sierra Leone, 2012, available at

http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf.

¹⁰ Strategy & Policy Unit of the Office of the President, “Interim Report: Working Group Sessions for the Energy Sector,” Public-Private Roundtable Discussion on Energy and Infrastructure, (January 2012).

¹¹ Strategy & Policy Unit, Office of the President, “Interim Report: Breakout session for Ports and Airports,” Energy and Infrastructure Roundtable (January 2012).

¹² Nataliya Pushak and Vivien Foster, “Sierra Leone’s Infrastructure: A Continental Perspective,” World Bank Working Paper No. 5713, (June 2011), p. 2.

¹³ Ibid.

only been in a position to spend around US\$134 million annually on infrastructure (from public, private and donor sources).¹⁴ Most of this spend has been on investment, with the largest share (more than half) going to the transport sector.¹⁵ Comparing those spending needs against current levels of expenditure on infrastructure (plus potential efficiency gains) leaves an annual funding gap of \$59 to \$278 million per year, most of it associated with water, power and transport infrastructure.¹⁶

While public resources are severely constrained, the Government of Sierra Leone (GoSL) is looking to private sources of financing – and is prioritizing the promotion of public private partnerships (PPPs) in infrastructure as a means of narrowing the funding gap to meet its objectives.¹⁷

With the increasing foreign direct investments in the minerals sector in recent years (all large-scale mining activity in the country is foreign-owned),¹⁸ including the associated investments in infrastructure to operate the mines and export the minerals, there may be scope to align such investments to contribute to the infrastructure needs of the country. This study assesses the scope for such synergies in the context of Sierra Leone’s large-scale mining sector given the substantial investments that mining companies need to make in all types of infrastructure to develop such ore productions.

2. Economic and political significance of minerals to growth and the economy

Sierra Leone is rich in minerals including iron ore, rutile, diamonds, bauxite, gold, platinum, tantalite, zircon, ilmenite, chromite and colombite.¹⁹ The mining sector has been active since bauxite, rutile, diamonds and gold deposits were first discovered in the 1920’s and contributed as much as 20% of Sierra Leone’s GDP, particularly from diamond revenues, prior to the civil war.²⁰ However, formal mining activities came to a complete halt during the civil war when trade in “conflict diamonds” was considered to be a contributing factor fuelling the hostilities.

There are three types of mining operations in Sierra Leone: large-scale mining of non-precious metals such as iron ore and bauxite, all operations being foreign-owned, mechanized small scale mining of precious metals such as gold and diamonds, and artisanal mining by individuals. At present, there are four large-scale mining companies, seventeen small-scale mining companies and up to 200,000 artisanal miners operating in Sierra Leone.²¹ In addition, there are an estimated 180 mining companies with exploration licenses covering 70% of the country.²²

Figure 1 below gives an indication of the mineral deposit distribution in Sierra Leone.

Since 2002, with the assistance of international donors, the GoSL has sought to reform and update its mining agencies and minerals legislation in an attempt to both attract investment

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ Ibid.

¹⁷ “Agenda for Prosperity: Road to Middle Income Status - Sierra Leone’s Third Generation Poverty Reduction Strategy Paper (2013 – 2018)” Government of Sierra Leone, 2011.

¹⁸ Ibid.

¹⁹ Ibid.

²⁰ Website of Ministry of Mining and Mineral Resources, available at: <http://www.slminerals.org/index.php/country-information/mineral-sector-overview>

²¹ Agenda for Prosperity, p. 43, op cit.

²² Ibid.

into the sector and to try to avoid the resource curse.²³ The recommencement of mining operations in Sierra Leone has also contributed to Sierra Leone’s fragile economic recovery and growth. With the Chinese thirst for steel and other non-precious metals, mining heavy weights such as Rio Tinto and Vale and juniors alike initially scrambled to invest in underdeveloped ore reserves across [West] Africa, although to date, lesser-known AIM-listed companies such as London Mining and African Minerals are operating in Sierra Leone.

Foreign direct investment into Sierra Leone and economic growth is primarily driven by mining. The mining sector’s contribution to GDP is also projected to increase substantially in the coming years from 4% in 2011 to as much as 30% in 2017²⁴ due for the most part, to the expansion of iron ore operations and the impending commencement of Cape Lambert’s iron ore operations. In 2012, the mining sector contributed nearly 10% of the 15.2% of real GDP growth, up from 11% after the commencement of iron ore production.²⁵

Figure 1: Distribution of Minerals in Sierra Leone



Source: Infrastructure and growth in Sierra Leone, African Development Bank, 2011

²³ African Development Bank, “Infrastructure and Growth in Sierra Leone” (2011), p 32.

²⁴ African Development Bank Group, “Sierra Leone Country Strategy Paper: 2013-2017” (August 2013), available at: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2013-2017%20-%20Sierra%20Leone%20Country%20Strategy%20Paper_01.pdf

²⁵ “Sierra Leone overview,” World Bank, available at: <http://www.worldbank.org/en/country/sierraleone/overview>.

2.1. Large-scale mining operations in Sierra Leone

There are currently four mining companies carrying out large-scale mining operations of non-precious metals in Sierra Leone as set out in Table 2. A further iron ore project, that of Cape Lambert, is anticipated to become operational in 2014. Each mine currently operates in an enclave model, sourcing its own power, water and ICT infrastructure, and providing its own logistics for export of the relevant mineral/ ore.

Table 2: Operational bulk mining companies in Sierra Leone

Company	Commodity	Region	Commencement of production
African Minerals	Iron Ore	Tonkolili	2011
London Mining	Iron Ore	Marampa	2011
Sierra Rutile	Rutile, ilmenite and zircon	Moyamba/Bonthe	2006
Sierra Minerals (Vimetco)	Bauxite	Moyamba/Bonthe	2005
Cape Lambert Resources	Iron ore	Marampa	2014 (expected) ²⁶

African Minerals Limited

African Minerals has a license to mine the Tonkolili iron ore deposit in Tonkolili district.²⁷ Its two subsidiaries, African Rail & Port Services (SL) Limited (ARPS) and African Power (SL) own its rail/port and power infrastructure assets, respectively. African Minerals also has long-term offtake agreements with two Chinese companies, the iron and steel company, Shandong Iron and Steel Group (SISG) for up to 10mtpa and the iron ore trading company Tianjin Materials and Equipment Group Corporation (Tewoo), following a strategic investment of each company respectively in the Tonkolili project in 2012 and 2013 respectively.²⁸

African Minerals began production from the Tonkolili deposit in 2011 and ramped up to 20mtpa of direct shipping ore during 2013. The next stage of the project aims to produce up

²⁶Cape Lambert recently applied for an exploration license. Source: "Cape Lambert applies for Marampa licence," *Engineering News*, November 2013, available at <http://www.engineeringnews.co.za/article/cape-lambert-applies-for-marampa-licence-2013-11-22> 'Cape Lambert expects Marampa mining licence approval in Q2 2014', *Steel First*, November 2013, available at <http://www.steelfirst.com/Article/3282066/Cape-Lambert-expects-Marampa-mining-licence-approval-in-Q2-2014.html>

²⁷ "Railways in Sierra Leone," available at <http://www.sinfin.net/railways/world/sleone.html>

²⁸ "African Minerals, Shandong sign \$1.5 bln deal," *Reuters*, August 2011, available at <http://www.reuters.com/article/2011/08/01/africanminerals-brief-idUSL3E7J10XM20110801> ; African Minerals press release, "Major US\$990m proposed Strategic Investment by Tianjin Materials and Equipment Group Corporation ("Tewoo") confirms US\$6Bn valuation of Tonkolili Project," September 26, 2013, available at: <http://www.african-minerals.com/media/press-releases/proposed-strategic-investment>.

to 35mtpa of high grade hematite concentrate from 2016.²⁹ All mining operations are open-pit mining.

London Mining

London operates an iron ore mine in Marampa, 120km by rail to African Mineral’s Tonkolili operations and by road to Freetown.³⁰ The Sierra Leone Development Company (DELCO) and William Baird previously operated the mine from 1926 and 1975, following which it ceased to operate. London Mining acquired an option for the mine in 2005 and, after securing the financing to develop operations, it commenced production in December 2011 by processing old iron ore tailings. London Mining is currently expanding production capacity to 6.5mtpa with an open pit mining operation, which it hopes to achieve in 2016.³¹

Figure 2 gives an indication of the location of the iron ore mining operations in Sierra Leone.

Figure 2: Iron-ore mining concessions in Sierra Leone (London Mining, African Minerals and Cape Lambert)



Source: Cape Lambert³²

Sierra Rutile Limited

Sierra Rutile’s mining operations are located in Moyamba and Bomthe districts about 15km from the coast. It first began production in 1971, although the mine ceased to operate due to

²⁹ African Minerals Expansion Update, December 2012, available at <http://www.african-minerals.com/media/press-releases/expansion-update>

³⁰ London Mining website, available at: <http://www.londonmining.com/operations/sierra-leone/operations/>.

³¹ Ibid.

the civil war from 1995 to 2006, when it listed on the AIM. The Sierra Rutile mine is the largest primary rutile mine in the world, producing at a rate of 120,349tps of rutile per year in 2013.³³ Sierra Rutile currently mines rutile by means of a one 1,000 tonnes per hour dredge and processes the ore through an existing floating treatment plant and land processing plant.³⁴ It is in the process of expanding its operations by constructing a further dredge to mine tailings and a dry mining plant.

Sierra Mining Limited

Sierra Minerals, a bauxite mining operation, is a subsidiary of Vimetco N.V., a globally integrated aluminium group.³⁵ It is located adjacent to the Sierra Rutile operations. Vimetco purchased the license from Sierra Rutile in 2008. The mine had previously been owned by Sierra Mineral Holdings, which operated from 1963 to 1995. All bauxite is exported to Romania. The mine has a resource base of approximately 31 million tonnes of bauxite. All annual production is exported to Romania for processing at Vimetco's alumina refinery.

3. Institutional and legal Framework for mining and infrastructure development

3.1. Institutions

Mining

The Ministry of Mines and Mineral Resources, under the direction of the President, is responsible for formulation of policy and regulation in the mining sector.³⁶ In turn, the National Minerals Agency, which was established in 2012, is responsible for the implementation of minerals sector policy, legislation and regulation with the aim of ensuring that Sierra Leone benefits from exploitation, minimizing negative impacts.³⁷

Infrastructure

A Public-Private Partnership (PPP) Unit at State House in the Office of the President is responsible for infrastructure policy in Sierra Leone and facilitating PPPs in Sierra Leone. As stated by a representative in a recent interview, "Public Private Partnerships will remain a key approach of the Government of Sierra Leone to investments in infrastructural development and is committed to ensure that the private party is able to recoup its investment with returns. This is important both for economic recovery and long-term sustainable development in the country."³⁸ The power, water and transport sectors are the identified GoSL priorities for PPPs; however, while senior representatives at State House expressed a strong interest in the scope for leveraging mining-related infrastructure investments, no official policy has been espoused in this regard.³⁹

³³ Sierra Rutile Limited presentation delivered at the TZMI Congress (November 2013), available at: http://www.sierra-rutile.com/uploads/presentation_november2013.pdf; "Sierra Rutile provides Q4 2014 operational update and 2014 guidance," January 9, 2014, available at: <http://www.sierra-rutile.com/uploads/q42013tradingupdatefinal.pdf>.

³⁴ Sierra Rutile Overview, available at: <http://www.sierra-rutile.com/overview.aspx>.

³⁵ Sierra Minerals website, available at: <http://www.bauxite.vimetco.com>; Vimetco Annual Report 2012, available at: http://www.vimetco.com/sites/default/files/vimetco/2012_YEAR%20REPORT1.pdf.

³⁶ National Minerals Agency, "Transforming Sierra Leone's Minerals Sector," Presentation given at the Sierra Leone Indaba, (July 2013).

³⁷ Ministry of Mines and Mineral Resources website, available at: <http://www.slminerals.org/>.

³⁸ "Public Private Partnerships to Ensure Improved Sierra Leone" *Awareness News*, November 29, 2013.

³⁹ Interviews at State House, Office of the President, June 2013.

3.2. Legislation

The Mineral and Mines Act (the “Act”) was adopted in 2009, replacing the 1994 regime, and brought in major changes to the way the mining sector is governed in Sierra Leone. The Act gives the holder of a large-scale mining license the right “to erect the necessary equipment, **plant**, machinery and buildings for the purpose of mining, **transporting**, dressing, treating, smelting and refining the minerals or mineral products recovered by the holder during his mining operations.”⁴⁰ However, there are no detailed provisions as to ownership and operation of mining-related infrastructure, nor is there any requirement for third-party access to these facilities in the Act.

The Operational Minerals Regulations adopted in 2011 provide a bit more guidance in this regard, but leave all infrastructure arrangements up for separate negotiation in a piecemeal fashion.

Box 1: Operational Regulations Number 92

(5) The Director may require that a particular facility or piece of infrastructure such as haulage roads or other facilities, owned and operated by a Right Holder shall be used by the general public.

(7) All requests for shared usage of facility or infrastructure shall be subject to a separate agreement between the Government and the relevant Right Holder.

Source: Operational Regulations for the Minerals Sector, 2011

A Public Private Partnership Act (the “PPP Act”) was also adopted in 2010 to promote the GoSL’s policy of promoting PPPs. However, the PPA expressly states that it does not apply to the granting of any mineral rights under the Mines and Minerals Act, 2009. To date, no mining companies have otherwise been directly involved in any PPPs (other than as a potential offtaker for power), with PPPs being limited to ports and power as is set out in the forthcoming sections.

⁴⁰ Provision 114 (b), Sierra Leone Mines and Minerals Act 2009.

A. Scope for shared use in the context of rail and ports

1. Background

African Minerals is the only mining company in Sierra Leone that uses rail transportation to move its minerals from mine to port. The remaining operational bulk commodity mining companies - London Mining, Sierra Rutile and Vimetco - rely on road and/ or barge transportation. Each of these mining companies has its own port facilities. The logistics arrangements of these mining companies' current operations are set out in Table 3 below.

Table 3: Logistics arrangements of operational bulk mineral exporters

Company	Commodity	Region	Transportation	Port
African Minerals	Iron Ore	Tonkolili	Rail road	Pepel
London Mining	Iron Ore	Marampa	Road and Barge Transportation	River Port Tholeifym Terminal
Sierra Rutile	Rutile	Moyamba/Bonthe	Road Transportation	Nitti Port, Sherbro ⁴¹
Vimetco	Bauxite	Moyamba/Bonthe	Road Transportation	Nitti Port, Sherbro

All of the other mining companies in Sierra Leone are either still at the exploration stage, or are engaged in precious mineral mining (gold, diamonds) and therefore do not require bulk commodity transportation infrastructure to get their product to market.

The ARPS-operated single track railway line is also currently the only operational railway line in Sierra Leone. It runs from Tonkolili in Port Loko through Marampa to the port of Pepel, 30km North of Freetown.

There are currently four main port terminals in Sierra Leone: The Queen Elizabeth II Quay in Freetown, Pepel port on Pepel Island, Nitti ports I and II on Sherbro Island and Kissy Oil Jetty.⁴²

The **Queen Elizabeth II Quay** at the mouth of the Rokel River in Freetown is a natural harbor and is the largest port in Sierra Leone. It currently has 6 berths with drafts ranging from 7m to 9m.⁴³ The average annual container traffic is 3,400 TEUs, although 90% of the traffic at the port relates to imports. In 2011, Bolloré Africa Logistics was awarded a 25-year

⁴² Sierra Leone Ports Authority, "Proposed Development Plan: 2010-2015," (2011).

⁴³ Ibid.

concession to renovate and operate the container berth.⁴⁴ However, the port is struggling with capacity constraints for cargo storage and essential port activities and is also heavily congested.⁴⁵ The SLPA nevertheless considers the port to have “huge potential for expansion and development as a transshipment hub”⁴⁶ and is currently seeking private investment to extend the quay westwards for the handling of transshipment cargo, as well as the construction of a dry bulk terminal east of the quay for the purposes of handling general dry bulk cargo.⁴⁷

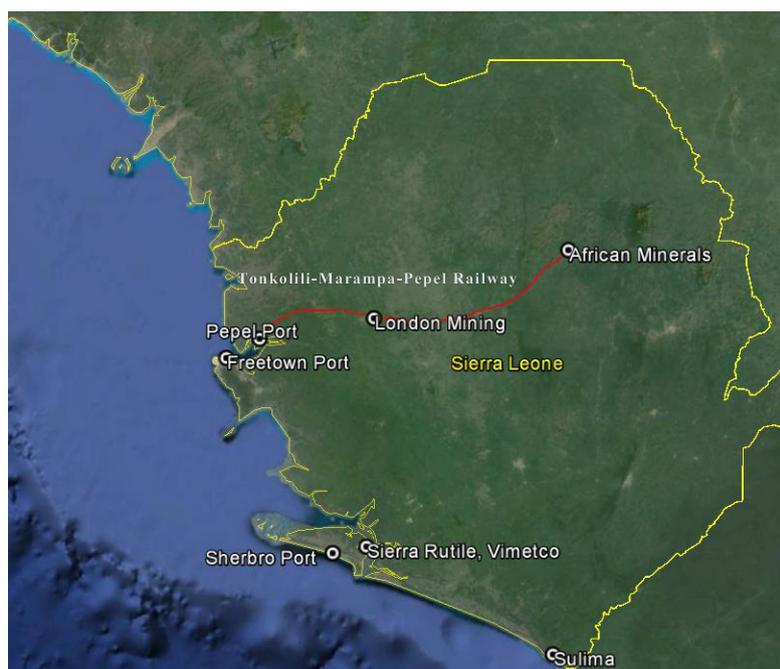
The **port of Pepel** is an iron ore port facility located on Pepel Island, near the mouth of the Sierra Leone River and is operated by African Minerals. It is reported that the pre-war annual turnover of Pepel port was 2–3 million tons of ore.⁴⁸

Nitti port comprises two jetties (Nitti 1 and 2) operated a stone’s throw apart from one another by Sierra Rutile and Sierra Minerals for their respective exports rutile and bauxite.⁴⁹ Given the shallow water depth at the jetties, the rutile and bauxite are loaded onto barges, which then travel 3km along the Sherbro River to where the ore concentrates are then loaded on to larger vessels. There are no expansion plans for the Nitti port.

Finally, the **Kissy Oil Jetty** is currently the only terminal for the supply of fuel to Sierra Leone.

Figure 3 shows the location of the existing rail route and port facilities.

Figure 3: Map of Rail, Ports and Mineral Deposits in Sierra Leone



⁴⁴ Bolloré Africa Logistics website, available at: <http://www.bollore-africa-logistics.com/en/ports-and-terminals/our-container-terminals/port-of-freetown-sierra-leone.html>.

⁴⁵ Office of the President: Strategy and Policy Unit, “Interim Report: Break Out Session for Ports and Airports,” Infrastructure and Energy roundtable, (2012).

⁴⁶ Sierra Leone Ports Authority, “Proposed Development Plan (2010-2025),” op cit.

⁴⁷ Ibid.

⁴⁸ Encyclopedia Britannica entry for “Pepel,” available at <http://www.britannica.com/EBchecked/topic/450725/Pepel>

⁴⁹ Interviews with Sierra Rutile, July 2013.

In terms of future possibilities for new rail and port infrastructure, recent reports suggest the development of a rail-port corridor from mineral deposits in Tonkolili down to a new port site in the South West of the country at Sulima, by the Chinese energy company China Kingho Group.⁵⁰ The possibility of regional rail-port corridors in the West African region has also been noted by a number of regional initiatives.⁵¹

2. Regulation of the rail and port sectors

There is currently no dedicated rail-focused government institution in Sierra Leone. The Ministry of Transport and Aviation is deals with road transportation and airport infrastructure.⁵² In turn, port activities are managed and controlled by the Sierra Leone Ports Authority (SLPA), a semi-autonomous, statutory organization established by the Sierra Leone Ports Authority Act 1964 (amended in 1991). Regulatory authority over maritime activities lies with Sierra Leone Maritime Administration (SLMA), which was created in 2000.⁵³

2.1 Third-Party Access of rail and port infrastructure in Sierra Leone

2.1.1. Rail

The model Mine Development Agreement 2012 (MDA) for Sierra Leone provides for the use of railways by third parties for the transportation of freight or passengers. However, it is unclear whether this model MDA has been officially endorsed by the GoSL. Moreover, this model MDA was developed after concession agreements were signed with African Minerals and the other mining companies currently operating in Sierra Leone.

Box 2: Sierra Leone Model Mining Development Agreement

14.5 Railway

- (a) The Company may construct a standard gauge railway connecting the Mining Area to a port, terminal or other public facility and operate the railway for the purposes of the Company's activities under this Agreement.
- (c) The Company shall, if and when reasonably requested by GoSL, transport passengers and carry the freight of GoSL and third parties over the railway where it can do so without unduly prejudicing or interfering with its activities under this Agreement and subject to the payment to it of commercially reasonable rates in respect of the transporting of passengers and the carriage of freight over the railway.

Source: Sierra Leone Model Mining Development Agreement, July 2012

It should be noted that the condition that shared use must be implemented “without unduly prejudicing or interfering with its activities” is difficult to enforce after the investment has been made and operations have begun. Inevitably, third party use will almost certainly affect the mining company's use of the railway, and the definition of ‘undue’ interference could quickly become a point of contention between government and the company.

⁵⁰ “Sierra Leone economy: Quick View - Investments worth US\$8bn announced following China visit”, *Economist Intelligence Unit*, July 2013, available at:

<https://globalconnections.hsbc.com/global/en/articles/sierra-leone-economy-quick-view-investments-worth-us8bn-announced-following-china-visit>

⁵¹ African Development Bank, “Infrastructure and growth in Sierra Leone,” op cit.

⁵² Based on in-country interviews, June-July 2013.

⁵³ Sierra Leone Ports Authority, “Proposed Development Plan (2010-2025),” op cit.

2.1.2. Ports

With regards to ports, there is no general obligation in law for private port facilities to allow for third-party access. However, the GoSL recently passed the National Carrier Act which may have an impact on use of private port facilities going forward.

Box 3: National Carrier Act

The Sierra Leone National Carrier (SLNC) is a joint venture shipping company, 51% owned by Sierra Leone National Shipping Company, a state owned company of the Government of Sierra Leone, and 49% owned by Four Handy, a UK-based subsidiary of Premuda, an Italian shipping group which is listed on the Italian stock exchange.⁵⁴

The Sierra Leone National Carrier Act was passed into law in November 2012 granting SLNC the right to ship 40% of all inbound and outbound cargoes at a premium above market rates. The Act also gives them the right to have a 40% stake in all Floating Production Offshore Storage (FPOS) projects.⁵⁵

How the SLNC's operations will play out in practice remains to be seen. However, these developments, while increasing investors' risk perception of Sierra Leone, may provide additional mechanisms through which the GoSL could implement a shared use policy.

Interviews with the SPU suggest that there is some intention to open up access to third parties of Sierra Leone's mining railways, primarily for the transportation of agricultural goods. However it appears that this option has not been seriously explored and that the focus of government efforts in the transport sector remains on improving the condition of road infrastructure. The Agenda for Prosperity, Sierra Leone's Poverty Reduction Strategy Paper for 2013-18 emphasizes the need to improve the road network, and mentions only peripherally an intention to explore and commence the reconstruction of a national rail network,⁵⁶ suggesting that public use of railroads may not be at the top of government priorities at present.

In addition, the GoSL recognizes the current capacity shortage with regards to the country's ports. The Agenda for Prosperity sets out plans for investments in port infrastructure, stating an intention for coordination with ministries overseeing mining and agricultural activity, as well as for such investments to sustainably enhance Sierra Leone's economic competitiveness.⁵⁷ These are all positive signs for possible future shared use of port infrastructure.

3. Rail-Port Corridors

⁵⁴ GoSL Press Release, "Sierra Leone National Shipping Company and Premuda to form the Sierra Leone Carrier," November 2012, available at <http://news.sl/drwebsite/exec/view.cgi?archive=8&num=21496>, and Premuda website: <http://www.premuda.net/EN/Area01/Elemento21/index.html>

⁵⁵ Sierra Leone national carrier to ride high, *Awoko News*, April 2013, available at <http://awoko.org/2013/04/11/sierra-leone-national-carrier-to-ride-high/>

⁵⁶ GoSL, "Agenda for Prosperity, Road to Middle Income Status, Sierra Leone's Third Generation Poverty Reduction Strategy Paper (2013-18)," (2012).

⁵⁷ *Ibid.*

3.1. Corridor 1: Tonkolili-Marampa-Pepel

3.1.1. Background

The Tonkolili-Marampa-Pepel corridor extends from Tonkolili to Pepel port and includes the iron ore mining operations of African Minerals in Tonkolili, the London mining iron ore operations around Marampa 120 km away, and the railway line running from Tonkolili through Marampa to Pepel port.⁵⁸ It also includes Cape Lambert's Marampa iron ore project, which is expected to become operational in 2014, a number of bauxite exploration license holders in the Port Loko area adjacent to the African Minerals rail route and the renewable energy and agriculture project which Addax Bioenergy is developing in Makeni.⁵⁹

Figure 1 above shows the distribution of mineral deposits in Sierra Leone, and one can see their proximity to the Tonkolili-Marampa-Pepel corridor. Rights to one of these deposits are held by SLEMCO Resources, a bauxite mining company situated 52-78 km from Pepel port.⁶⁰

African Minerals currently operates both the railway line and Pepel port. The scope for shared use of its rail and port infrastructure is considered in relation to this corridor.

3.1.2. African Minerals infrastructure

Railway Infrastructure

The railway line was originally constructed from Marampa to Pepel port in the 1930s by the Sierra Leone Development Company, a privately owned mining company which mined iron ore at Marampa from 1933 to 1975.⁶¹ After the civil war, it was held as a GoSL state-owned asset, although, at this point it was non-operational and had little worth beyond its scrap value.⁶² In 2008, after African Minerals had commenced exploration and discovered the Tonkolili deposit, its subsidiary, African Rail and Port Services (SL) Limited (ARPS), was granted a 99 year lease in relation to both the Marampa-Pepel railway and Pepel port facility for an annual rental fee of US\$250,000 to the GoSL.⁶³ The GoSL also received a 10% free carried interest in ARPS.⁶⁴ African Minerals subsequently extended the single track railway line by 120km from Marampa to Tonkolili in 2012.⁶⁵

There are currently seven trains in operation on the railway line, each comprising four locomotives and 112 wagons, with rolling stock capacity to add an additional train if required.⁶⁶ Average tonnage per wagon is currently 75 tons and the train cycle time in each direction was under 6 hours on average in 2012.⁶⁷ This allowed African Minerals to transport

⁵⁸ "Railways in Sierra Leone," available at <http://www.sinfin.net/railways/world/sleone.html>.

⁵⁹ Addax Bioenergy Factsheet, available at http://www.addaxbioenergy.com/uploads/PDF/ABSA_July_2013_Factsheet_V1.pdf

⁶⁰ SLEMCO Resources Website, available at: http://www.slemcoresources.com/index.php?option=com_content&view=article&id=4&Itemid=20

⁶¹ Encyclopedia Britannica entry for 'Sierra Leone Development Company, available at

<http://www.britannica.com/EBchecked/topic/543397/Sierra-Leone-Development-Company>

⁶² Scott Wilson, "Reinstatement of Pepel – Marampa Rail Line, Interim Report For The Ministry of Mineral Resources, Government of Sierra Leone (Final Report – 1st Draft for comment)," (August 2008).

⁶³ "African Minerals Limited: Infrastructure Lease," *FE Investigate*, November 12, 2008, available at:

⁶⁴ African Minerals Corporate Presentation, Sierra Leone Mining Indaba, July 2013. SIGS and Tewoo now also have a 25 percent and a 10 percent stake in the Tonkolili project companies, including ARPS.

⁶⁵ "Railways in Sierra Leone," available at <http://www.sinfin.net/railways/world/sleone.html>

⁶⁶ African Minerals Annual Report 2012.

⁶⁷ Ibid

a total of 4.6 million tons of direct shipping ore by rail from the mine to the port in 2012,⁶⁸ a rate which ramped up to 20mtpa during 2013.⁶⁹

To accommodate the expansion to 35mtpa, African Minerals stated that it would construct a partial double track and put in place an enhanced signaling and communication system for increased operational efficiency.⁷⁰ However, in September 2013, African Minerals reported that due to changed circumstances it would now slow down the second phase of Tonkolili and would try to raise output capacity more gradually with cheaper improvements to the existing railway and port infrastructure.⁷¹

Port Infrastructure

Pepel port is a single commodity, single user port operated exclusively by African Minerals for the export of iron ore. The port facilities at Pepel consist of two stockyard facilities (with total laydown capacity of 1mt), each with stackers, reclaimers and ship loading conveyors to allow direct loading from the wagon dumpers.⁷² The Pepel port is only deep enough to allow Panamax (70,000 ton vessels) to dock.⁷³ The African Minerals export operations involve transshipments from the port via three transshipment vessels to larger vessels which are loaded in deeper waters. These facilities were designed to achieve the targeted 20mtpa rate in 2013.⁷⁴ However in mid-2013 African Minerals revised export projections downward to 11-13mtpa (with a final end year result of 12.1mtpa) citing difficulties with handling transshipments in wet weather during the rainy season in Sierra Leone.⁷⁵

3.1.3. Potential for multi-user access

There are a number of mining companies operating or undertaking exploration activities in or near to this corridor that may benefit from use of the African Minerals rail and port infrastructure. Indeed in 2008, a feasibility study considering different options for the reinstatement of the Marampa-Pepel line (still disused at that point) stated:

"The Government of Sierra Leone (GOSL) has received applications from a number of mining companies who are interested in using the disused mineral railway between Marampa and Pepel to transport iron ore and bauxite. GOSL is also keen to provide a passenger service on this line and, in due course, the line could be extended further west to allow iron ore to be exported from Tonkolili and potentially from mines in Guinea. London Mining PLC has put forward proposals to adopt and refurbish the railway as part of its project to reinstate the iron ore mine workings at Marampa, African Minerals wish to explore options for moving iron ore from both Marampa and Tonkolili and Sierra Alumina, who have

⁶⁸ Ibid

⁶⁹ African Minerals Website, available at: <http://www.african-minerals.com//operations/tonkolili-project-highlights>

⁷⁰ African Minerals Corporate Presentation, Sierra Leone Mining Indaba, July 2013

⁷¹ "African Minerals disappoints by scaling back Sierra Leone mine," *Financial Times*, September 11 2013, available at: <http://www.ft.com/intl/cms/s/0/323774c4-1adb-11e3-87da-00144feab7de.html?siteedition=intl#axzz2eIPSfa9Q>

⁷² African Minerals Annual Report 2012.

⁷³ African Development Bank, "Infrastructure and growth in Sierra Leone," op cit.

⁷⁴ African Minerals Annual Report 2012

⁷⁵ James Wilson, "African Minerals disappoints by scaling back Sierra Leone mine," *Financial Times*, September 11 2013, available at: <http://www.ft.com/intl/cms/s/0/323774c4-1adb-11e3-87da-00144feab7de.html?siteedition=intl#axzz2eIPSfa9Q>.

recently acquired Gondwana's mining interests, wish to export either bauxite or alumina from the Port Loko area"⁷⁶

Despite the lack of strong general legal obligations for shared use of mining infrastructure, press releases also suggest that the lease agreement for the existing iron ore rail and port infrastructure between African Minerals' subsidiary, ARPS, and the GoSL does contain a provision for third-party access. From an African Minerals press release about the lease we understand that African Minerals must make the rail and port "available at commercial rates to other users including mining companies and general cargo and passenger transporters."⁷⁷

To date, only Cape Lambert has secured access to the African Minerals rail and port infrastructure.⁷⁸ In December 2013 Cape Lambert announced that it had concluded a much anticipated infrastructure agreement with African Minerals for shared use of its railway and port infrastructure for the export of ore concentrate from Cape Lambert's iron ore project in Marampa.⁷⁹ The infrastructure agreement provides Cape Lambert with access to the ARPS-operated railway as well as provision of train sets to transport up to 2 (wet) mtpa (equivalent to 1.8mtpa dry) of concentrate to the Pepel port, along with the necessary infrastructure for the unloading, stockpiling and transshipment of concentrate at Pepel port.⁸⁰ The agreement also provides African Minerals with an option to purchase 2mtpa (wet) of ore from Cape Lambert at the Marampa deposit mine gate for the first three years of operation.⁸¹

While African Minerals announced in early December 2013 that it would not be building a port at Tagrin as originally planned, Cape Lambert retains the right to expand production at Marampa to 16.5mtpa (wet) and to export the concentrate through the construction of a pipeline to Tagrin Point on terms to be agreed with African Minerals. It has further been agreed that Cape Lambert will now construct a port at Tagrin for the expansion of the Marampa operations.⁸² The commercial terms for the calculation of the charges for the transport and export of concentrate have not been made publicly available. However, it was previously reported that the infrastructure access charge is at a cost plus 20% basis and Cape Lambert must design and construct its own 3km rail spur line to African Minerals rail line.⁸³

It appears that this agreement was reached bilaterally by the two mining companies without intervention from the GoSL. It should be noted that the Marampa iron ore deposit currently owned by Cape Lambert was 100% owned by African Minerals in 2008 and gradually purchased by Cape Lambert to reach its 100% ownership today (30% in 2008 and the remaining 70% in 2009).⁸⁴ In addition, African Minerals is an 18% shareholder in Cape Lambert Resources, which is listed on the Australian Securities Exchange.⁸⁵

⁷⁸ ASX Announcement: "Cape Lambert finalizes Infrastructure Agreement," Cape Lambert Resources, December 24, 2013.

⁷⁹ Ibid.

⁸⁰ Cape Lambert Annual Report 2012, "Principal Activities and Review of Operations," available at <http://cfe2.live.irmau.com/irm/content/annualreport/split/4.PrincipalActivitiesandReviewofOperations.pdf>

⁸¹ ASX Announcement: "Cape Lambert finalizes Infrastructure Agreement," Cape Lambert Resources, December 24, 2013.

⁸² Ibid

⁸³ Cape Lambert Resources Marampa Update April 2012, Fat Prophets, available at <http://www.fatprophets.com/Member%20Area/Product%20Landing/Report%20List/Report%20Page/Article%20Page.aspx?id=b07f54d5-1731-4f39-a008-0943c98926a7&product=Australasian%20Mining&pt=paid>

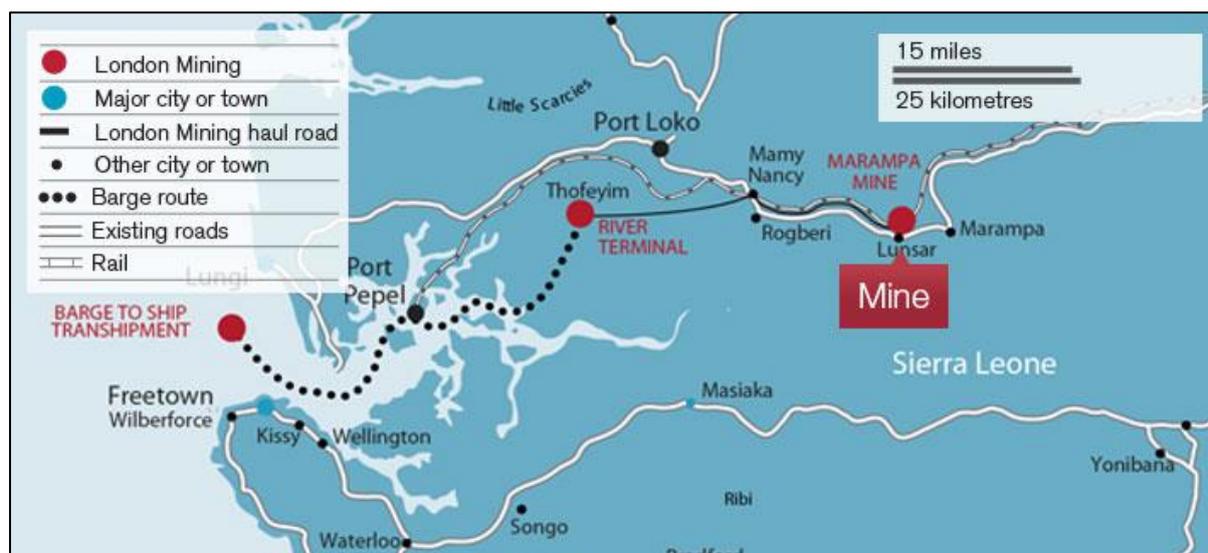
⁸⁴ Cape Lambert website: <http://www.capelam.com.au/irm/content/marampa-iron-ore.aspx?RID=210>

⁸⁵ Cape Lambert Resources, "Top 20 Shareholders", available at: <http://www.capelam.com.au>
<http://www.capelam.com.au/IRM/Company/ShowPage.aspx?CPID=2199&EID=48474253>

While **London Mining** is also located along the rail route in Marampa, it is unlikely to consider shared use of any railway or port infrastructure with African Minerals. London Mining had originally competed against African Minerals for rights to the Marampa-Pepel rail line and the Pepel port facilities, but looked to find other options when these rights were awarded by the GoSL to African Minerals in 2008.⁸⁶ Instead, London Mining currently transports the iron ore concentrate by road (40km to the Thofeyim River Terminal), and then barges for a 50km to the Freetown harbor.⁸⁷ At this point, transshipments take place, with iron ore transferred from barges to ocean going vessels using either the vessel's own loading equipment, or one of London Mining's transshipment vessels.⁸⁸

In most cases, the capital expenditure associated with logistics costs is high, but the operating costs are low. However, with the road and barge transportation London Mining now uses the opposite situation, with low capital expenditure but high operating costs.⁸⁹ Since it is selling a lower volume, higher quality product,⁹⁰ it is perhaps in a better position than African Minerals to withstand the higher costs, but London Mining states that it faces a major difficulty in barging and transshipping, due to the tidal movements and rainfall which pose constraints on the speed and efficiency of exports.⁹¹ As noted above, the Pepel facilities allow African Minerals to use panamax vessels, which would be cheaper for London Mining than their current arrangement. Indeed, London Mining stated in response to questions that “gaining access to the African Minerals rail or port may reduce operating cost.”⁹²

Figure 4: London Mining Logistics Arrangement



Source: London Mining website: <http://www.londonmining.com/operations/sierra-leone/>

Once some of the bauxite deposits in the vicinity of the corridor, such as those of SLEMCO Resources, are actively mined, there may be scope for such minerals to be transported along the railway line, or exported via Pepel or the port of Tagrin. In addition to the deposits in

⁸⁶ Interview with London Mining, Freetown, July 2, 2013.

⁸⁷ London Mining website: <http://www.londonmining.com/operations/sierra-leone/>

⁸⁸ Ibid.

⁸⁹ Interview with London Mining, Freetown, July 2, 2013.

⁹⁰ Ibid.

⁹¹ E-mail exchange with London Mining, September 24, 2013 and interview with London Mining, Freetown, July 2, 2013.

⁹² E-mail exchange with London Mining, September 24, 2013.

Sierra Leone, it has also been observed that the railroad could eventually be extended to serve mines in Guinea.⁹³

3.1.4. Technical constraints for multi-use

Railway line

The current maximum capacity for the single track railway should be assessed. Although Cape Lambert has been granted access to the infrastructure, this is for very small volumes. Cape Lambert's plan for its mining operations considers transporting volumes of 1.8 (dry) mtpa utilizing the African Mineral rail and port facilities during its initial phase. However, the total first phase production could be up to 3.4mtpa,⁹⁴ and moreover, its second phase ramps up to 10mtpa utilizing a concentrate slurry pipeline,⁹⁵ indicating that further capacity on the rail line was perhaps not available.

African Minerals plans at its peak to transport 35mtpa of iron ore on its railway. A study undertaken by the World Bank in relation to the 250 km rail infrastructure in Liberia states that moving 3 million tons per month, or 36 million tons per year on a single rail track involves a large degree of careful coordination. With a possible 15 daily train rotations, which would involve 30 train crossings on a single track, this would need accurate planning and monitoring.⁹⁶ To accommodate the peak production, as noted above, African Minerals is planning an upgrade of the railroad to a partial double track, with an enhanced signaling system for increased efficiency and coordination of its trains.

Therefore, it seems likely that the capacity of the current single track railway will not be sufficient to handle traffic from many other mining companies. Shared use would demand further investments in the infrastructure, with upgrades to the railroad, perhaps to a double track system. A scenario with no shared use would see mining companies develop their own railroads running close to or even parallel with the existing African Minerals line. However, analysis undertaken by the World Bank notes the benefits of shared use in this context, stating that there are operational and financial benefits of a double track system over development of two parallel lines, with capital costs savings as well as efficiency savings from the use of longer trains at higher speeds.⁹⁷

Port Expansion

African Minerals notes that while well-equipped to handle iron ore, the Pepel port faces capacity constraints. The Pepel port channel is only navigable one vessel at a time, meaning that the company has to anchor additional trans-shipment vessels near Freetown, allowing them into the Pepel jetty once the outgoing transshipment vessel has left the channel.⁹⁸ In addition, the company faces space constraints at the port site.⁹⁹

⁹³ Scott Wilson, op cit.

⁹⁴ Cape Lambert Annual Report 2013, "Principal Activities and Review of Operations," available at <http://www.capelam.com.au/irm/content/ar2013/4.PrincipalActivitiesandReviewofOperations.pdf>

⁹⁵ Cape Lambert Resources Limited Research Report, Resource Capital Research, July 2012, available at <http://www.capelam.com.au/IRM/Company/ShowPage.aspx/PDFs/2373-42410170/ResearchReportRCR13July2012>

⁹⁶ World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," (2011). While the study looks at Liberia, the general principles are useful when considering the railroad in Sierra Leone.

⁹⁷ Infrastructure policy notes: Leveraging investments by natural resource concessionaires, World Bank, 2011

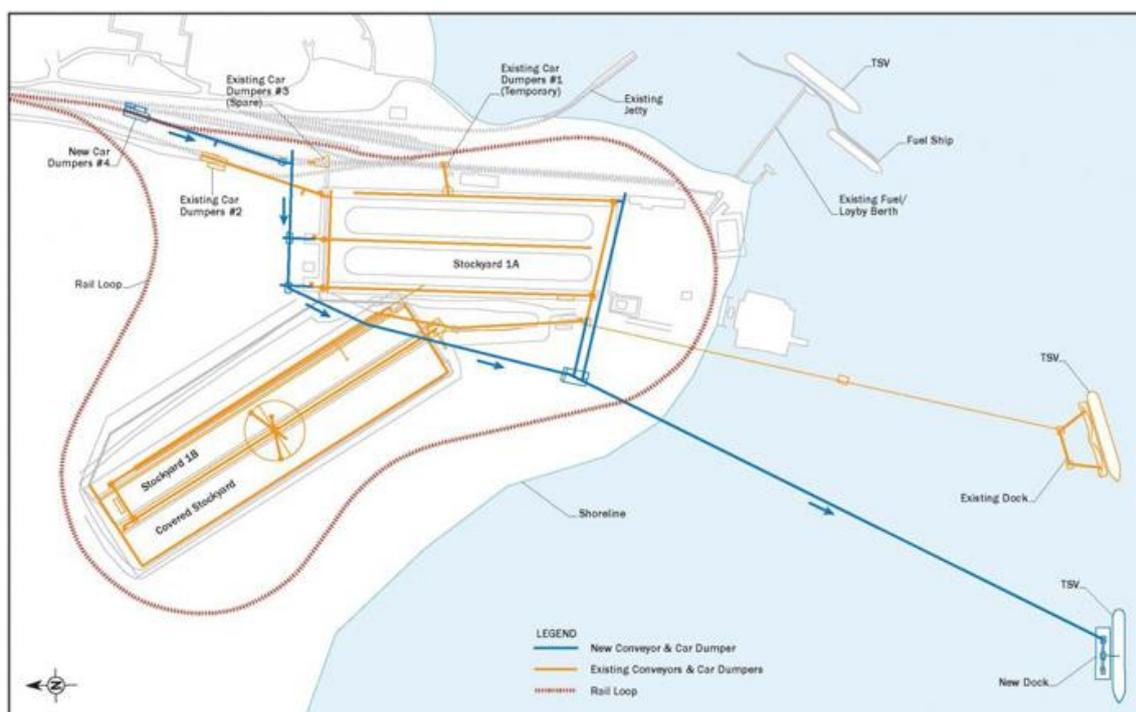
⁹⁸ African Minerals Annual Report 2012.

⁹⁹ Based on in-country interviews, June-July 2013.

In order to accommodate 35 mtpa of iron ore exports, African Minerals is planning further expansion of the port facilities at Pepel. This involves the installation of an additional conveyor and car dumper out to a new dock, with an additional shiploader as well as new transshipment vessels. There will also be an additional rail loop to allow the unloading of 12 trains per day.¹⁰⁰ These expansion plans are shown in Figure 5 below.

However, even London Mining acknowledges that at this level of production, the expanded facility would struggle to accommodate any additional volumes.¹⁰¹

Figure 5: Plans for Expansion of Pepel port



Source: African Minerals¹⁰²

As with the rail infrastructure, although Cape Lambert’s initial production phase will use the African Minerals Pepel port to export 1.8mtpa (dry) of concentrate, the fact that it has agreed with African Minerals to construct a port at Tagrin suggests that excess capacity at the Pepel port is not anticipated, and that further expansion may not be economically feasible.

For a mining company looking to secure shared access, the scope for expansion of the port would have to be explored.

Scope for shared use of both the rail and port infrastructure may also be impacted by the recent African Minerals decision to pursue a more modest expansion strategy,¹⁰³ which would involve cheaper improvements to the existing rail and port infrastructure.¹⁰⁴ With

¹⁰⁰ African Minerals Corporate Presentation, Sierra Leone Mining Indaba, July 2013.

¹⁰¹ Interview with London Mining, Freetown, July 2, 2013.

¹⁰² African Minerals Corporate Presentation, Sierra Leone Mining Indaba, July 2013.

¹⁰³ This is reportedly due to the recent market downturn, along with logistical problems due to wet weather and a reduced cash position from failure to meet sales targets.

¹⁰⁴ “African Minerals disappoints by scaling back Sierra Leone mine,” *Financial Times*, September 2013, available at at: <http://www.ft.com/intl/cms/s/0/323774c4-1adb-11e3-87da-00144feab7de.html?siteedition=intl#axzz2e1PSfa9Q>.

limited additional capital expenditure, there will be less room for other parties to use the existing facilities.

3.1.5. Multi-use of the Port of Tagrin

London Mining stated in response to questions from CCSI that there are many other suitable deep water port locations which provide active solutions to their logistics needs, and they are exploring these options to find a superior alternative to the current river terminal and transshipment arrangement which they are currently using.¹⁰⁵ Given that Cape Lambert may not proceed with the construction of a deep water port at Tagrin, there may potentially be scope for Cape Lambert and London Mining to collaborate in the construction of this port rather than each pursuing new and separate port operations, which would just contribute to the proliferation of further private single-user mining jetties along the coast, with iron-ore specific infrastructure that has limited scope for the export or import other cargo.

Cape Lambert envisages that the Marampa operations will expand to a peak production level of 15mtpa,¹⁰⁶ whereas London Mining's operations are of a smaller scale, targeting volumes of 6.5m wet metric tons per year from 2016.¹⁰⁷ Therefore the combined volumes of these two projects could certainly be accommodated in a single port facility. While it may not be possible to share the transport infrastructure (slurry pipeline, road, barge), a coordinated investment between the two companies into a deep water iron ore port may provide a mutually beneficial shared use arrangement which reduces the capital expenditure incurred by each company.

3.1.6. Potential for multi-purpose access

The model MDA 2012 and the third-party access obligations contained in the African Minerals infrastructure lease agreement suggests GoSL's intention for non-mineral freight and passengers on the existing as well as any future railways.

The World Bank also identifies part of the Tonkolili-Marampa-Pepel corridor as a 'growth pole' for agricultural activity.¹⁰⁸ Figure 6 shows the projected agricultural activity in Sierra Leone over the medium term.

Scope for agricultural freight on mineral railways

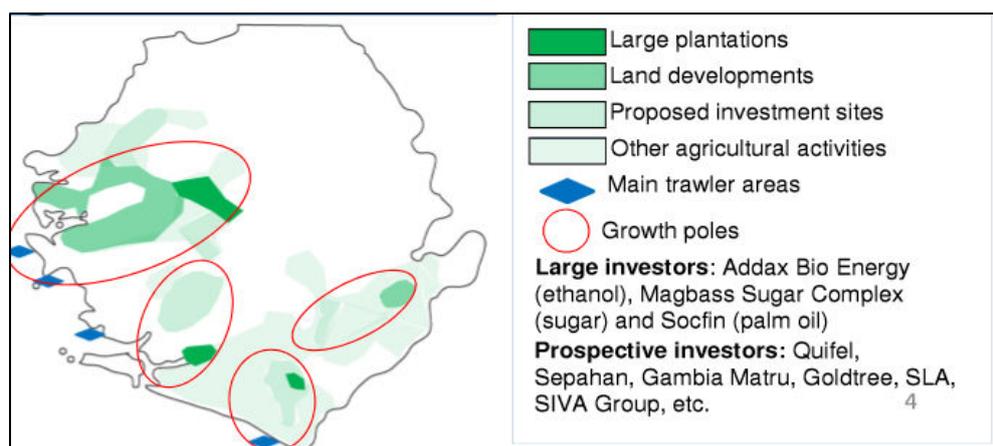
Figure 6: Medium Term Outlook: Agricultural Activity in Sierra Leone

¹⁰⁵ E-mail exchange with London Mining, September 24, 2013.

¹⁰⁶ Cape Lambert Resources Limited, "Marampa Presentation," May 2013, available at http://www.capelam.com.au/irm/content/CFE_Pres_May.pdf

¹⁰⁷ London Mining Website, available at: <http://www.londonmining.com/operations/sierra-leone/staged-development-plan/>

¹⁰⁸ World Bank Group, "Growth poles diagnostic in Sierra Leone, consultative meeting for discussion," (February 2013).



Source: World Bank Group¹⁰⁹

The World Bank assessment acknowledges that there are very few current agricultural investments in the region, but suggests that more activity may be anticipated. In relation to forestry, the locus of logging activity has been in the South and South-Western areas of the country and therefore the forestry sector is not so relevant for the corridor under consideration.¹¹⁰ Moreover, forestry's contribution to Sierra Leone's economic activity is declining as forest resources are now under threat from over-exploitation and therefore increasingly a focus of conservation efforts.¹¹¹

In terms of current medium to large-scale agricultural activity along the corridor, Addax Bioenergy is developing a renewable energy and agriculture project in Makeni that will produce bio-ethanol for export as well as for domestic use, and electricity for the national grid.¹¹² The total processing capacity of the plant is 1 million tons of sugarcane per year,¹¹³ suggesting that the eventual export volumes are unlikely to justify use of the railway line. In addition, Addax Bioenergy stated that it had recently completed the creation/rehabilitation of 344 km of road in the area,¹¹⁴ suggesting that this is their primary and preferred mode of transportation. The Magbass Sugar Complex is also located along this corridor within the Tonkolili district. However, it is reported that the company produces only 6,000 tons of sugar per annum,¹¹⁵ volumes which are a tiny fraction of the iron ore volumes to be transported by African Minerals. Goods that are most suitable for rail transportation tend to be high-volume and low-cost.¹¹⁶ For other goods, particularly where distances are not particularly large, road transportation may be a more favorable option.

¹⁰⁹ Ibid.

¹¹⁰ The Domestic Trade in Timber and Fuelwood Products in Sierra Leone: Current Dynamics and Issues, Energy for Opportunity, available at: http://www.energyforopportunity.org/site_media/media/files/documents/final_report_-_fuelwood_and_timber_trade_in_sierra_leone.pdf.

¹¹¹ African Development Bank, "Infrastructure and growth in Sierra Leone," op cit.

¹¹² Addax Bioenergy Factsheet, available at http://www.addaxbioenergy.com/uploads/PDF/ABSA_July_2013_Factsheet_V1.pdf

¹¹³ Ibid.

¹¹⁴ Interview with Addax Bioenergy, September 13, 2013.

¹¹⁵ "President Koroma Visits Magbass, ADDAX," *The Patriotic Vanguard*, June 2013, available at: <http://www.thepatrioticvanguard.com/spip.php?article7150>.

¹¹⁶ Perrine Toledano, Sophie Thomashausen, Alpa Shah, and Nicolas Maennling "A framework to approach shared use of mining-related infrastructure," (2014) Columbia Center on Sustainable Investment, Columbia University, available at: http://ccsi.columbia.edu/files/2014/05/A-Framework-for-Shared-use_March-2014-2.pdf

In relation to the transportation of agricultural produce by rail more generally in Sierra Leone, the AfDB notes that export crop output could not by itself justify investment in rail infrastructure. Annual tonnages exported from Sierra Leone are very low, totaling less than 100,000 metric tons per year.¹¹⁷ Moreover, while cocoa production is now the country's second most important export after mineral resources,¹¹⁸ production of both coffee and cocoa has traditionally been under smallholder farming on plots of 1 to 6 hectares.¹¹⁹ Additionally, it is reported that urban demand from the cities of Conakry and Monrovia has led to increased cross-border flows of agricultural products.¹²⁰ Due consideration should therefore be given to whether the final destinations or end markets for agricultural produce are actually along the existing rail route, or towards other ports.

If agricultural production is geographically dispersed, there will also be the added cost of coordinating the collection of production to load onto the rail at loading points. Depending on the agricultural investment that is expected over the coming years, a detailed cost benefit analysis should be carried out to determine the economic rationale for transportation of agricultural goods by rail. It may be the case that agriculture companies would benefit more from access to the service roads running parallel to rail tracks used by mining companies for maintenance purposes. African Minerals has reportedly constructed 25km of roads for its operations, including 10km of extra wide roads able to allow access for large trucks.¹²¹ Exclusive rights over new roads are not allocated to African Minerals under its mining lease agreement.¹²² Under the operational regulations listed in Box 1 above, the GoSL would therefore have the authority to mandate open access for use of these roads by the general public.

Aside from the roads constructed by mining companies, public road infrastructure does exist along the corridor, with roads stretching from Tonkolili to Makeni and through to Lunsar, as well as a road from Port Loko-Lungi (near Freetown).¹²³ Further investment in strengthening this network may be more beneficial to agricultural users than access to the rail network.

Scope for a passenger rail service

We can also assess the scope for a possible passenger rail service along the corridor. As the AICD notes, Sierra Leone has a small population of only 5.7 million which is very sparsely distributed across the country, particularly outside of the urban areas.¹²⁴ Although the rail-route does pass through the more populated towns of Lunsar and Makeni, the populations of these areas still only amount to around 36,000¹²⁵ and 82,000¹²⁶ respectively. It may be unrealistic for small populations to generate enough passenger demand to justify a dedicated passenger train service. The insufficient guaranteed demand for passenger rail, along with likely need for subsidization of a passenger rail system by an already severely budget-

¹¹⁷ African Development Bank, "Infrastructure and growth in Sierra Leone," op cit.

¹¹⁸ Ibid.

¹¹⁹ Sierra Invest Website, available at: <http://www.sierra-invest.com/15.0.html>.

¹²⁰ African Development Bank, "Infrastructure and growth in Sierra Leone," op cit.

¹²¹ Dawnus Website, available at: <http://www.dawnus.co.uk/en/content/cms/inter-projects/tonkolili-iron-ore-4/>

¹²² Mining Lease agreement between The Government of the Republic of Sierra Leone (GoSL) and African Minerals Limited Group of Companies, 2010

¹²³ "African Minerals Tonkolili Iron Ore Project making way for Sierra Leone's development,"

Sierra Express Media, August 2010, <http://www.sierraexpressmedia.com/archives/12091>

¹²⁴ Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective," World Bank, op cit.

¹²⁵ "Pictorial Display of London Mining Company's social responsibility projects in Lunsar, Northern Sierra Leone," *The Patriotic Vanguard*, August 2013, <http://www.thepatrioticvanguard.com/spip.php?article7287>

¹²⁶ Encyclopedia Britannica entry for "Makeni," available at: <http://www.britannica.com/EBchecked/topic/359204/Makeni>

constrained government may suggest that the GoSL should continue to focus its attention on roads.

Scope for back-haulage

The return journey wagons of the iron ore trains are currently empty and there may be scope to use this capacity for imports. However, back-haulage opportunities are limited to goods that can be carried in bulk cargo vessels and in open top hopper or gondola car wagons.¹²⁷ As companies in the interior will be powering their operations using HFO or diesel generator plants, imports of fuel from the port using the railroad might be economical, although transporting the fuel, or any other product on back-haulage may require different wagons to those used to transport iron ore. Imported equipment needed by companies along the corridor, or fertilizers and seeds required by agricultural companies and smallholder farmers along the corridor might also be transported along the rail-route. Additionally, as mentioned in section B on Power in Sierra Leone, there are reports that a 350MW coal-fired plant may be built by India's Jindal Steel and Power Limited. Coal would be shipped from Southern Africa to Sierra Leone, and it may be the case that the plant is located near mining corridors with mines as possible offtakers. If the plant is located near to or along the Tonkolili-Marampa-Pepel corridor, the company may benefit from use of empty wagons returning from the port to transport coal to its plant site.¹²⁸

3.1.7. Technical Constraints for multi-purpose use

Tonkolili-Pepel railway line

The specification and the capacity of the rail will determine the scope for multi-purpose use. Carrying non-mining loads, such as Addax's bio-ethanol will require additional investment in rolling stock specific to each type of good and loading facilities at appropriate intervals along the railway line. As the IFC notes, technically it is possible for passenger and general freight services to use the same rail infrastructure as bulk mining companies, and many well-known lines currently do so.¹²⁹ If well-managed, occasional passenger and general cargo trains could run in between the larger mineral trains without disrupting the schedule or service.¹³⁰

However, particularly in single track rail systems, mixed use of the line can be challenging. Intensive use of a single track system will already require careful coordination, and an already tight running schedule may not leave much scope for the transportation of non-mining loads. Efficiency losses are likely if multi-purpose goods are granted access to the railway line, given that such trains would travel at different speeds and may need to stop at particular intervals.¹³¹ A double track system has a much larger capacity, and in this case it would be more realistic to allow the transportation of non-mining goods.¹³² Another consideration is that if the rail were used for non-iron ore goods, extending the line to Freetown may be required both because Freetown is likely to be the major end market for

¹²⁷ Toledano, Thomashausen, Shah, and Maennling, "A Framework to Approach Shared Use of Mining-Related Infrastructure," op cit.

¹²⁸ "Sierra Leone needs \$3.5bn investment to restore power sector," *Mail & Guardian*, July 2013, available at <http://mg.co.za/article/2013-07-20-sierra-leone-needs-35bn-investment-to-restore-power-sector>, Interviews with Strategy and Policy Unit, Statehouse, Freetown, July 1, 2013.

¹²⁹ International Finance Corporation (IFC), "Fostering the Development of Greenfield Mining-Related Transport Infrastructure through Project Financing," (2013).

¹³⁰ Toledano, Thomashausen, Shah, and Maennling, "A Framework to Approach Shared Use of Mining-Related Infrastructure," op cit.

¹³¹ Ibid.

¹³² World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," op cit.

other users and the Freetown port is the only currently operating multi-user port in Sierra Leone.

At present, it would seem that given the uncertain and likely low level of demand from non-iron ore users, African Minerals has little commercial incentive to provide access for passenger, cargo or freight services. For African Minerals there is a high risk that the investment required will not make economic returns, the users may be perceived as unlikely to be able to pay, and moreover, any return that is realized is likely to be viewed as immaterial for African Minerals and a distraction from core operations. Thus, overcoming these commercial considerations would likely require the intervention by the GoSL.

Port Facilities

The current handling and loading facilities at the port of Pepel are designed specifically for the movement and loading of iron ore. It is not designed for the loading of containers and general cargo. Health and safety issues are also raised by using the existing facilities for other commodities. Therefore, use of the Pepel port for non-iron ore freight would necessitate the creation of a separate pier for non-iron ore use. However, it would seem that the space constraints may significantly limit the scope for designing an additional pier separated from the iron ore operations. An assessment of the additional investment needed for an extra pier, relative to the anticipated benefit, would need to be undertaken.

Moreover, as mentioned above, in close proximity (30km¹³³) to Pepel is the port of Queen Elizabeth II Quay in Freetown, a multi-user port which is designed to handle containers and general cargo. While the port is currently capacity constrained, it may make more sense for expansion plans to be undertaken at this port, and for non-mining users of the rail facility to route their exports through Freetown.

3.1.8. Possible shared use scenarios

Table 4 below considers possible shared use scenarios which might be envisaged for the Tonkolili-Marampa-Pepel corridor. Three options are set out. The first sees nominal access for small volumes of third party mineral cargo, as per the current arrangement between African Minerals and Cape Lambert. The second scenario would involve additional investment from a second mining company to a double track system, in order to create additional capacity for shared use at higher volumes. The third scenario contemplates the possibility of a shared investment in a new port by Cape Lambert and London Mining.

Under Scenarios 2 and 3, a haulage regime managed by an independent rail operator is recommended. Current use of the rail and port infrastructure by Cape Lambert sees African Minerals as the rail and port operator under a haulage regime. Cape Lambert is likely to have come to an agreement with African Minerals, based on previous joint ownership of the project, the current shareholding in the Cape Lambert resource by African Minerals and thus good relations between the two companies. Given the historic hostilities between African Minerals and London Mining,¹³⁴ this might not be realistic if, for example, London Mining were to be involved.

Indeed, London Mining stated in response to CCSI questions that it saw a shared use scenario with another mining company having control of rail and infrastructure as unworkable. It noted that shared use would raise issues of priority and allocation in ore/product

¹³³ World Cities Encyclopaedia “Distance from Freetown to Pepel,” available at: http://www.worldcities.us/distance_from_Freetown-SL_to_Pepel/.

¹³⁴ Based on in-country interviews, June-July 2013.

scheduling.¹³⁵ To address these concerns, either a third party running the haulage regime or an access regime would be appropriate. A haulage regime would provide the more efficient scenario. London Mining has in fact suggested that the GoSL should facilitate independent implementation and operation for infrastructure and make competitive tariff arrangements with mining companies.¹³⁶ Recommendations made in 2008 regarding the rehabilitation of the railroad also suggested the creation of an independent railway operating company, which initially would be completely financed by the first user of the line who would also be its principal shareholder. Subsequent users would then also be expected to become shareholders.¹³⁷

¹³⁵ E-mail exchange with London Mining, September 24, 2013.

¹³⁶ Ibid.

¹³⁷ Scott Wilson, "Reinstatement of Pepel – Marampa Rail Line," op cit.

Table 4: Multi-User Situation

Scenario	Potential Users	Shared Use Model	Regulation
<p>Scenario One:</p> <p>Limited additional investment, African Minerals allows low levels of excess capacity</p>	<ul style="list-style-type: none"> • Cape Lambert, or bauxite/alumina mining companies looking to secure access for their initial production levels. • Back haulage access by companies looking to transport fuel, equipment, agricultural inputs to interior , although this would require different wagons. Coal could possibly be transported by back-haulage. 	<ul style="list-style-type: none"> • Haulage regime would be the most efficient model. • Access fees would be charged under long-term ‘take or pay’ agreement. • Existing arrangement with Cape Lambert takes this form. 	<ul style="list-style-type: none"> • Shared use would be negotiated bilaterally between mining companies. • GoSL would need to have sufficient regulatory authority to ensure non-discriminatory access and oversee the setting of tariffs. • This model is seen as a light-touch regulatory model
<p>Scenario Two:</p> <p>Additional Investment by Large-Scale Mining Company</p>	<ul style="list-style-type: none"> • Mining companies with large operations near to the corridor, such as London Mining, Cape Lambert, or Bauxite/Alumina Miners. • Large investment into a double track as well as additional facilities at Pepel. 	<ul style="list-style-type: none"> • Separation of ownership of the infrastructure (both rail and port) from African Minerals. A special purpose vehicle (SPV) could be setup, which owns and operates the rail and port infrastructure. Alternatively, the government could award the upgrade and operation of rail and port infrastructure concession to a third party. • African Minerals would have to be compensated for its investment into the initial rehabilitation of the railroad and port, most likely through an equivalent equity share in the infrastructure company in the case of the SPV or through priority access 	<ul style="list-style-type: none"> • The GoSL would have to monitor and ensure non-discriminatory access, as well as oversee the setting of tariffs. <p>Stronger government intervention may be necessary for more price sensitive cargo such as agricultural products, or passenger rail services when cross-subsidization may be necessary.</p> <p>In this case, potential shared use is likely to only be taken advantage of by other mining companies.</p>

		<p>rights in the case of a third party operator.</p> <ul style="list-style-type: none"> • Other mining companies would be responsible for funding any additional infrastructure required to support forecast operation, either by paying the capital cost of those works (likely to be the preferred option) or through higher track access charges under a long-term take or pay agreement which can be used by operator to obtain financing. • To maximize efficiency, haulage regime should be the preferred operational model. Under the SPV arrangement, an access regime is also possible, although in this case the SPV would need to coordinate the train movements of the mining companies. 	
<p>Scenario Three: Joint Investment of new Port at Tagrin</p>	<p>Companies with small-medium sized mining operations such as Cape Lambert and London Mining. Possibly also African Minerals.</p>	<ul style="list-style-type: none"> • Separation of ownership of port infrastructure from mining companies. A special purpose vehicle (SPV) could be setup, which owns and operates port infrastructure. Alternatively, the government could award the upgrade and operation of port infrastructure concession to a third party. To finance the investment, the SPV would have to be backed by long-term take-or-pay agreements by future users. 	<ul style="list-style-type: none"> • The GoSL would need to monitor and ensure non-discriminatory access, particularly to London Mining and other potential users given the African Minerals – Cape Lambert arrangement, as well as oversee the setting of tariffs.

3.2. Corridor 2: China-Kingho: Tonkolili – Sulima

In July 2013, the GoSL entered into a \$6.5 billion agreement with China Kingho Group, a privately-owned Chinese energy company. China Kingho holds two iron ore exploration licenses in the northern Tonkolili district.¹³⁸ In addition to its investment into mining operations, it is reported that the company will build a 250-km railway line from Tonkolili to the coastal town of Sulima in the south where a port will be developed.¹³⁹ Plans for a smelting facility powered by a 350MW hydroelectric plant have also been reported.¹⁴⁰ Further details regarding this agreement remain scarce at the time of writing this report, and therefore this project is only considered briefly here. Should the project proceed it opens up potential for another transport corridor, with the rail infrastructure connecting the East and the South of Sierra Leone, and the creation of port infrastructure in the south.

3.2.1. Scope for multi-user/multi-purpose access

In terms of shared use, further analysis needs to be undertaken on the level of demand by other users, especially in the agriculture sector, along the newly proposed route. The first step toward this would involve engaging all the stakeholders in dialogue and proceeding with feasibility studies that incorporate shared use scenarios to analyse the cost and impact. Based upon these studies, the GoSL should be able to determine the costs and benefits of shared use and if found desirable proceed with developing the requisite technical, commercial and funding framework to enable such an arrangement.

In terms of the shared use model, the agreement has been made with a single group for an integrated project. Should the project proceed on this basis, then any shared use model would not involve an independent rail or port operator. To enable shared use, the GoSL would need to ensure that third-party access is mandated under any infrastructure development agreement with China Kingho group. It should determine a shared use framework (haulage/access regime) and develop its own capacity to carry out the appropriate regulatory functions.

3.3. Corridor 3: Regional Railways

There may be scope for future regional corridors to open up as a result of planning at the ECOWAS level for rail links across national borders. The AfDB reports that Sierra Leone is an interested participant under ECOWAS plans to refurbish and extend rail services in the region.¹⁴¹ It reports that a West Africa Mineral Sector Strategic Assessment (WAMSSA) analysis identified mineral-infrastructure clusters that would benefit from regional approaches. Those involving Sierra Leone include:

- “Iron ore and gold deposits in or near trans-border watersheds and forests spanning Eastern Sierra Leone and North-Western Liberia; and
- Central Guinea and Northern Sierra Leone bauxite deposits which could plausibly be developed separately or together.”¹⁴²

¹³⁸ “Sierra Leone economy: Quick View - Investments worth US\$8bn announced following China visit,” Economist Intelligence Unit, July 2013, available at:

<https://globalconnections.hsbc.com/global/en/articles/sierra-leone-economy-quick-view-investments-worth-us8bn-announced-following-china-visit>

¹³⁹ Ibid.

¹⁴⁰ Ibid.

¹⁴¹ Infrastructure and growth in Sierra Leone, African Development Bank, 2011.

¹⁴² Ibid.

However the AfDB does note that there are currently no formal plans by NEPAD or ECOWAS to develop rail infrastructure that would penetrate Sierra Leone’s interior.¹⁴³ A detailed analysis of these corridors is not undertaken here. However, it should be noted that when these rail corridors are being planned, a number of elements will need to be considered. These include deciding upon the most appropriate model for shared use of the rail-routes as well as making regional agreements regarding the type of goods that will be transported on the line, transit cargo fees, along with rules for open access and non-discriminatory access to the port. Such an arrangement would also require formulation of a mechanism for regulation in a cross-border context. Many of these issues are set out in the CCSI Rail and Port Framework.

4. Findings and Conclusions

As this study has noted, there are potential benefits from shared use arrangements with respect to both rail and port infrastructure. However, careful planning and strategic negotiation will be necessary to ensure that this becomes a reality.

While the scope for use of the existing railroad by the agriculture sector seems less realistic at this stage, there are a number of mining companies which would clearly benefit from third-party access. In addition, port infrastructure is a major constraint faced by all mining companies currently operating in the corridors suggesting that there are large potential synergies in coordination of infrastructure investment. Going forward, the GoSL also has the opportunity to structure any new rail and port investments in a way that can benefit multiple users.

The possibilities for shared use along the corridors identified in this chapter are summarized in the table below:

Table 5: Summary of findings for shared use possibilities of rail and port infrastructure in Sierra Leone

Corridor	Shared Use Possibilities
Tonkolili-Marampa-Pepel	<ul style="list-style-type: none"> • Small-scale mining bauxite and alumina mining operations, for initial production levels. • Larger operations such as Cape Lambert if double-track can be financed and port expansion undertaken. • Possible shared use of a new iron ore port at Tagrin by small-medium scale users. • Back haulage opportunities.
Tonkolili-Sulima	<ul style="list-style-type: none"> • Shared use possibilities to be determined.
Regional Railways	<ul style="list-style-type: none"> • Future possibilities for shared use with mining deposits located on/near borders with Liberia and Guinea. • Regional trade from Sierra Leone and Guinea.

¹⁴³ African Development Bank, “Infrastructure and growth in Sierra Leone,” op cit.

B. Scope for shared use in the context of power

1. Background

1.1. Key Facts about the power sector in Sierra Leone

Table 6: Key Facts about the power sector in Sierra Leone

Installed capacity	96MW: (Thermal (37 MW), Large Hydro (50MW), Small Hydro (6.75MW) ¹⁴⁴
National Grid/Transmission	<p>Two Grids: Western area powered by Bumbuna I and diesel generation in Freetown. Bo-Kenema has its own grid, powered by thermal plants.</p> <p>Western Area Grid:¹⁴⁵</p> <p>Thermal (Fuel Oil) Plants: Kingston (10 MW) and Blackhall Road (16.5MW).</p> <p>Hydro: Bumbuna HydroElectric Plant (50MW).</p> <p>Mini-hydro: Bankasoka (2.0 MW), Charlotte (3.0 MW) and Makalie (170 kW).</p> <p>In Freetown, power is transferred along low and medium voltage transmission and distribution lines. Bumbuna is connected to Freetown by 200 kilometers of 161 kV transmission line to a substation in Freetown which feeds power into the Western area grid.¹⁴⁶</p> <p>Bo-Makeni Grid:¹⁴⁷</p> <p>Bo Thermal Power Plant: 5MW</p> <p>Dodo Hydro Power Plant: 6MW</p> <p>Power is transmitted in Bo and Kenema via a 33kV sub- transmission line with 11 kV and low voltage local distribution.</p>
Electricity Access	5% overall: 35% (urban), 3.5% (rural). ¹⁴⁸

¹⁴⁴ National Energy Profile of Sierra Leone, 2012, available at

http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf

¹⁴⁵ “Why Sierra Leone’s energy crisis just about got worse,” *Africa Review*, February 2-13, available at <http://www.africareview.com/Business---Finance/Why-Sierra-Leones-energy-crisis-just-got-worse/-/979184/1704108/-/11k5eub/-/index.html>

¹⁴⁶ “Electrical Power in Sierra Leone,” available at <http://www.mbendi.com/indy/powr/af/sl/p0005.htm>

¹⁴⁷ National Energy Profile of Sierra Leone, 2012, available at

http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf

¹⁴⁸ “Pushak and Foster, “Sierra Leone’s Infrastructure: A Continental Perspective”, op cit.

Rate	
Electricity Tariff	Industrial: \$0.30/kWh, Residential: \$0.31 -43/kWh (2011). ¹⁴⁹
Policy Entity	Ministry of Energy
Public Utility	National Power Authority (NPA) vertically integrated state owned enterprise currently responsible for generation, transmission and distribution of electricity.
Regulator	No regulator, although reforms are underway to unbundle the NPA and allow private participation in the sector, necessitating the creation of a regulatory body.

1.2. How do the mines currently source their power?

All mining companies operating in Sierra Leone currently have their own power arrangements. Given that the main projects are in the initial phases of operations, power demand from these mining activities is still relatively low, and can be satisfied using diesel or fuel oil plants. The current mining power demand is estimated to be 60MW in Sierra Leone.¹⁵⁰ Table 7 highlights the power arrangements of the main mining operations in Sierra Leone.

Table 7: Mine Power Arrangements

Company	Production Level	Power Requirement
African Minerals¹⁵¹	Phase 1(2012-3): 20mtpa of Direct Shipping Ore. Phase 2: Expansion to 35mtpa of Direct Shipping Ore and Primary Ore targeted by 2016.	Thermal Plant (HFO/Diesel) Current power demand is met by a 10MW of diesel generated power at the mine site and another 10MW at Pepel port. Phase 2 will require around 150MW of power. African Minerals is exploring sourcing such additional power from government sources, including the possibility of obtaining hydroelectric power from the neighboring Bumbuna and Yiben systems. ¹⁵²

¹⁴⁹ Ibid.

¹⁵⁰ Sudeshna Ghosh Banerjee, Zayra Romo, Gary McMahon, Perrine Toledano, Peter Robinson, Ines Pérez Arroyo, *The Power of the Mine: A Transformative Opportunity for Sub-Saharan Africa*. Washington, DC: World Bank (2015), available at <https://openknowledge.worldbank.org/handle/10986/21402> License: CC BY 3.0 IGO

¹⁵¹ African Minerals Expansion Update, December 2012, available at <http://www.african-minerals.com/media/press-releases/expansion-update>.

¹⁵² "Tonkolili – 3 projects in one," *Mining News*, August 1, 2013, available at: <http://www.miningne.ws/2013/08/01/tonkolili-3-projects-in-one/>.

London Mining ¹⁵³	Current production level of 5 dry metric tons per annum (dmt/a) of tailings and weathered ore. Next phase will see mine progress to 6 dmt/a of tailings, and weathered ore as well as primary ore, necessitating additional processing capacity, primary crusher, and additional mills.	Current power demand of 12MW met by a 15MW MFO power plant (10 x 1.55MW units). Next phase will necessitate expansion of power facility to 50MW, using 4x 8.55MW more units. Total peak demand of 50MW is anticipated, with steady state demand of 31MW.
Cape Lambert ¹⁵⁴	Stage 1 - 2.5mtpa. Stage 2 – 10mtpa Stage 3 – 15mtpa Processing and beneficiation at each stage.	125MW HFO plant (plant site) 26MW HFO plant (port site)
Sierra Rutile	2012 rutile production run-rate of 103,000 tonnes per year. Plans for new dry mining operations.	23MW MFO power plant, although the current utilization is under 9MW ¹⁵⁵ Dry mining will utilize current spare capacity. Sierra Rutile also recently signed an MOU with a developer to offtake hydropower from an 11-14MW run-of-river hydropower plant being constructed nearby (see below).

2. Why do mines self-generate? Generation and Transmission Gaps in Sierra Leone

2.1. Insufficient and unreliable power supply

The installed generation capacity in Sierra Leone is 96MW,¹⁵⁶ amounting to approximately 13MW per million people,¹⁵⁷ which the AICD reports as being lower than for other low-income and fragile states.¹⁵⁸ The AICD further notes that while the existing power infrastructure is concentrated in the Western Area of the country in which Freetown is

¹⁵³ London Mining Presentation, “Analyst workshop – life of mine study results”, September 2013.

¹⁵⁴ Cape Lambert Presentation, “Marampa Project,” May 2013.

¹⁵⁵ Sierra Rutile Annual Report, 2012, available at <http://www.sierra-rutile.com/uploads/annualreport2012.pdf>

¹⁵⁶ National Energy Profile of Sierra Leone, 2012, available at http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf

¹⁵⁷ “Pushak and Foster, “Sierra Leone’s Infrastructure: A Continental Perspective”, op cit.

¹⁵⁸ Ibid.

located, only half of the demand for power in Freetown is currently being met, let alone the power needs of the rest of the country.¹⁵⁹

The power supply in Sierra Leone is also unreliable. Hydropower from Bumbuna is seasonal, and while its wet season production is 50MW, it produces less than 20MW during the dry season.¹⁶⁰ Recent reports suggested that only one of the plant's two turbines was functioning,¹⁶¹ halving the amount of power being generated. In 2009, firms lost as much as 7% of their sales as a result of power outages, which is greater than in other fragile African states.¹⁶² Given such constraints, private companies typically rely on their own diesel generators. When compared to the total national power generation capacity, the capacity of generators installed by private companies is substantial, ranging between 175-250MW.¹⁶³

2.2. High Power Tariffs

In addition to insufficient reliable supply of electricity, power is also very expensive for end users in Sierra Leone. The AICD reports that customers paid between US\$0.22 and US\$0.41/kWh during 2002–2008. Since the availability of cheaper power through Bumbuna in 2009, electricity tariffs decreased to US\$0.31/kWh, which is still on the high side when compared to the average in Sub-Saharan Africa of around US\$0.14/kWh. Thermal generation is estimated to cost between US\$0.30-40/kWh, bringing up the weighted cost of national electricity supply.¹⁶⁴

Demand for electricity supply is growing in the agriculture sector to power irrigation systems and machinery, as well as the industrial and household sectors. The GoSL in its Agenda for Prosperity predicts an increase in power demand from the mining sector to 650MW by 2018.¹⁶⁵ Therefore, addressing generation gaps as well as bringing the cost of power down will be critical for the economic development of Sierra Leone. The GoSL aims to generate an extra 1,200MW by 2017, through a range of new heavy fuel oil (HFO), thermal, hydro and biomass power projects.¹⁶⁶ To meet its targets, it is currently seeking to raise US\$3.5 billion in private investment into the power sector.¹⁶⁷

2.3. Lack of National Transmission Infrastructure

As mentioned, Sierra Leone's grid infrastructure is mainly composed of the Western Area grid centered on Freetown, along with one provincial power system in Bo-Kenema. Moreover, Freetown's low and medium voltage transmission and distribution networks are more than 50 years old, poorly maintained, and are currently not capable of transmitting more

¹⁵⁹ Ibid.

¹⁶⁰ Ibid; GoSL Request for Proposals, "Procurement, Legal Advisory, Monitoring, Administration and Reporting Services in relation to the Bumbuna Hydroelectric Power Plant ("BHPP") Extension ('Bumbuna II') (June 2013).

¹⁶¹ "Why Sierra Leone's energy crisis just about got worse," *Africa Review*, February 2-13, available at <http://www.africareview.com/Business---Finance/Why-Sierra-Leones-energy-crisis-just-got-worse/-/979184/1704108/-/11k5eub/-/index.html>

¹⁶² "Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective", op cit.

¹⁶³ National Energy Profile of Sierra Leone, 2012, available at

http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf

¹⁶⁴ "Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective", op cit.

¹⁶⁵ GoSL, "Agenda for Prosperity, Road to Middle Income Status, Sierra Leone's Third Generation Poverty Reduction Strategy Paper (2013-18)."

¹⁶⁶ Sierra Leone Mining, Energy/Oil & Gas Indaba 2013: Next 5 year Power Roadmap, Minister of Energy

¹⁶⁷ "Sierra Leone needs \$3.5bn investment to restore power sector," *Reuters*, July 20, 2013.

than 36 MW of power.¹⁶⁸ This poses constraints for additional generation capacity to be transmitted to industrial users.

For the mines, the Bumbuna hydro plant lies only 20km from the African Minerals site in Tonkolili district,¹⁶⁹ and the distance between Bumbuna town and Lunsar, the town adjacent to London Mining's Marampa operations is measured to be 97km.¹⁷⁰ However, the transmission infrastructure from the plant does not currently extend to these mining areas. Development of transmission and distribution infrastructure is being planned under donor support from the European Union and AfDB for the nearby towns of Makeni and Lunsar.¹⁷¹

The GoSL recognizes the importance of addressing the transmission gaps and has prioritized the expansion of transmission infrastructure over the short and medium term, aiming to reinforce the Bumbuna line to evacuate more power to Freetown, and to connect provincial towns to the grid via an additional 900km of transmission lines by 2017.¹⁷² In addition, the West African Power Pool (WAPP) is planning to lay a high-voltage transmission line along the coast connecting Sierra Leone to Guinea, Liberia, and ultimately Côte d'Ivoire (the CLSG Interconnection Project), which will provide a backbone from which to expand the domestic grid¹⁷³ (See Box 1). Commissioning of this line is expected by 2015.¹⁷⁴

3. What role can the mining sector play in facilitating new generation and transmission infrastructure investment?

The GoSL recognizes that the power arrangements of the mining sector should be integrated into national development plans. The Ministry of Energy states that one of its key priorities is to “integrate mining companies into the power sector”¹⁷⁵ and the Strategy & Policy Unit (SPU) at Statehouse, which advises the President on infrastructure and energy matters, notes that “modalities should be put in place so that private sector can partner with GoSL for energy generation.”¹⁷⁶

This section sets out how mining companies can play a number of roles in facilitating the construction of power generation and transmission infrastructure, although not without addressing a number of challenges.

3.1. Mines and Supply to Communities: Leveraging Mines for Rural Electrification

Off-Grid Solutions

¹⁶⁸ National Energy Profile of Sierra Leone, 2012, available at

http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf

¹⁶⁹ SRK Consulting, “Technical Review of the Tonkolili Iron Ore Project, Sierra Leone,” (June 2010), available at <http://www.african-minerals.com/system/files/uploads/financialdocs/June2010.pdf>

¹⁷⁰ Distance between Bumbuna and listed at <http://luirig.altervista.org/distances/dist2.php?city1=Bumbuna>

¹⁷¹ African Development Fund, “Bumbuna Hydro-Electric Project, Project Completion Report,” June 2013, available at <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Sierra%20Leone%20-%20Bumbuna%20Hydro-Electric%20Project%20-%20Project%20Completion%20Report.pdf>

¹⁷² Sierra Leone Mining, Energy/Oil & Gas Indaba 2013: “Next 5 year Power Roadmap,” Minister of Energy

¹⁷³ “Infrastructure and growth in Sierra Leone, African Development Bank, 2011.

¹⁷⁴ “West African Power Pool: Priority Projects and Implementation Strategy,” available at

http://www.encharter.org/fileadmin/user_upload/Conferences/2012_March/West_African_Power_Pool.pdf

¹⁷⁵ Sierra Leone Mining, Energy/Oil & Gas Indaba 2013: “Next 5 year Power Roadmap,” Minister of Energy

¹⁷⁶ “Interim Report: Working Group Sessions for the Energy Sector,” Strategy and Policy Unit, Office of the President, July 2012.

With the mines generating their own electricity in remote areas which are not connected to national grid infrastructure, opportunities may exist for providing self-supply options to near-urban or rural locations. These could utilize off-grid energy solutions. The mines could either work with an NGO to deliver such services, or along with donors, or the government could pursue off-grid technologies that make use of low cost and small scale renewable energy such as mini-hydro schemes or solar technology. For example, in 2010, African Minerals reported that it had provided a generator for non-stop broadcasting of a radio station,¹⁷⁷ and Sierra Rutile has installed solar street lights in the townships of Moriba and Mogbwemo near its site.¹⁷⁸ The Ministry of Energy has also announced that it will work with the NGO Barefoot College for the rollout of solar energy solutions in rural areas.¹⁷⁹ The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, (GIZ), also reported that a number of renewable energy solutions (solar, biomass, waste to energy) had been offered to the GoSL, but that the uptake had been very low to date.¹⁸⁰ The mines potentially have an important role in facilitating these initiatives for faster progress in rural electrification.

Mini-Grid Solutions

There may also be scope for provision of power by the mining companies to surrounding areas through the development of a mini-grid. This may be an optimal solution to electrify remote areas, with the possibility to connect the mini-grids together as the national transmission infrastructure develops. Such an initiative could take on a hybrid model involving the mining companies working together with donors, NGO and small-scale private or public utilities. For example, a mining company could finance the capital investment of a mini-grid, after which a public utility could be in charge of its operation and maintenance, management, tariff collection, and any additional policy initiatives necessary for the success of the project.¹⁸¹

At present, none of the mining companies appear to be involved in significant rural electrification programs, aside from small CSR gestures. Mining companies have little incentive to provide energy solutions unless they form part of their CSR initiatives (Sierra Rutile, African Minerals) or they were contractually required to do so. The concession agreements for African Minerals and London Mining specify no obligation for these companies to generate excess power to surrounding areas.¹⁸²

However, the success of both off-grid and mini-grid rural electrification solutions presuppose a number of initial conditions:

- **Existence of effective demand:** There must be sufficient and sustained effective demand for such energy solutions by end users. Off-grid renewable energy options such as solar streetlights do not rely on a sustained purchasing power from residents of the area beyond the initial investment, which would be made by the mining company. However, when considering the development of mini-grids for rural energy

¹⁷⁷ African Minerals Limited Interim Report 2010 available at http://www.african-minerals.com/system/files/uploads/financialdocs/InterimReport2010_Index.pdf

¹⁷⁸ ‘Sierra Rutile Foundation lights up the streets of Moriba and Mogbwemo, Sierra Express Media, July 2013 available at <http://www.sierraexpressmedia.com/archives/59382>.

¹⁷⁹ Barefoot College website: <http://www.barefootcollege.org/the-women-bringing-solar-power-to-sierra-leone/>

¹⁸⁰ ‘Renewable Energies in West Africa, Country Chapter: Sierra Leone,’ GIZ, available at <http://www.giz.de/fachexpertise/downloads/gtz2009-en-regionalreport-wa-sierraleone.pdf>.

¹⁸¹ Toledano, Thomashausen, Shah, and Maennling, ‘A Framework to Approach Shared Use of Mining-Related Infrastructure,’ op cit.

¹⁸² Based on CCSI interviews in-country.

generation and distribution in mining areas or off-grid solutions with on-going operation and maintenance costs, it is important to carefully assess whether demand from small businesses and households already exists, or is projected to develop in the near term to justify the creation of a mini-electricity grid.

- **Allocation of offtake and distribution responsibilities:** In the case of mini-grid solutions, the arrangement of responsibilities surrounding the distribution of power would have to be determined. While the mining company may be willing to fund the construction of low voltage distribution infrastructure, operation and maintenance, and tariff collection responsibilities fall well outside the scope of its core activities.

Sierra Leonean legislation requires power produced by private parties to be sold to the GoSL or the national electricity company,¹⁸³ which would then sell the power to end-users. Therefore, a mini-grid arrangement would see the NPA play the role of offtaker of the excess power. However, given the current inefficiencies and weak balance sheet of the NPA (see Section 3.3 below), along with concerns over the quality of governance in Sierra Leone, mining companies may question the reliability of such a take or pay arrangement, and require additional credit enhancement (partial risk guarantees, letters of credit) to mitigate the risk, which would, in turn, increase the expense of the arrangement to the government. The NPA is currently not operational outside of Freetown/Bo-Kenema; therefore its capacity would have to be built to oversee the distribution of power elsewhere in Sierra Leone. Decentralized governance in Sierra Leone is weak. A process of decentralization is underway, but it is NGOs and donor-funded programs that currently attempt to fill the service delivery gap at a local level.¹⁸⁴

3.2. Leveraging Mines for Increased Generation: Excess Supply to Grid

As the mining operations progress and they require more power, the mines will expand their power generation facilities, or build new, larger facilities. Certainly African Minerals has been looking for new power arrangements.¹⁸⁵ Due to the level of beneficiation planned in the operations of Cape Lambert in Marampa, the power demands will be high and corporate presentations suggest that it is planning a plant in the order of 125MW.¹⁸⁶ In these situations, mining companies could be incentivized, or required, to build excess power capacity to be sold back to the grid.

3.2.1. Coordinated Mine-Power Investments

Given the proximity of the African Minerals, Cape Lambert and London Mining sites (see figure 2) in theory there could be scope for achieving economies of scale under a joint power investment. With power being such a large operating cost to mines (African Minerals states that fuel alone constitutes 16% of its US\$30/ton operating cost¹⁸⁷), there could be substantial savings made from resource pooling and joint strategy among these mines. The mines could

¹⁸³ National Electricity Act 2011, available at: <http://www.sierralii.org/sl/legislation/act/2011/16>.

¹⁸⁴ Based on CCSI interviews in-country.

¹⁸⁵ African Minerals Press Release, "Memorandum of Understanding with China Communications Construction Company Limited ("CCCC")", May 2011, available at http://www.african-minerals.com/regulatory_news_article/1891

¹⁸⁶ Cape Lambert Marampa Project Presentation, May 2013.

¹⁸⁷ African Minerals Corporate Presentation, Sierra Leone Mining Indaba, July 2013.

jointly form or otherwise contract with an independent IPP to manage the generation and transmission system for such an investment. This may be difficult in reality given the high level of competition over logistics infrastructure among the mines in Sierra Leone and the unaligned timing of each mining company's operations. However, given the cooperation between Cape Lambert and African Minerals on access to the rail, a coordinated power plant, or power strategy, may not be out of the question.

3.2.2. Economies of Scale in Hydropower

The Ministry of Energy has recognized the significant hydropower potential in Sierra Leone and has announced its intentions to reach 750MW of hydropower in the next five years through the expansion of Bumbuna dam (Bumbuna II) and the construction of a further five hydropower plants.¹⁸⁸ Both London Mining and African Minerals have expressed an interest in receiving their power supply from the Bumbuna hydropower plant.¹⁸⁹

Hydropower holds the scope for significant economies of scale and can generally deliver low cost electricity on a levelled cost basis. However, without a reservoir to counter seasonal variability, hydropower cannot be delivered at the same level throughout the year. Current plans for the expansion of the Bumbuna power plant do not appear to include a reservoir.¹⁹⁰ The Bumbuna – Yiben Hydro Expansion Project, which involves the construction of additional turbines at Bumbuna along with the upstream Yiben reservoir to regulate the seasonal variations of the hydropower is mentioned as a future upgrade to the project which would cost an additional \$161m.¹⁹¹ In contrast to donors or an IPP, mining companies may collaboratively not only have the capacity to deliver such a project, but have the commercial motivations to optimize the scope of the power plant. Given mining companies' need for continuous power all year round, they might be motivated to build the reservoir. If sufficient excess capacity cannot be financed by the companies themselves, coordination with the donor community could probably deliver such a project.

3.2.3. Constraints to Excess Power Generation

However, the success of excess power generation to the national grids pre-supposes a number of initial conditions:

- **Initial Design:** The excess power generation must be contractually agreed at the outset, and the initial design must take into account the required amount of excess power generation. The design can rarely be expanded after the event, as generation equipment must be purchased for a given design load. Oversizing the initial design without a guaranteed demand is not desirable as it can be technically damaging or not economically rational to have power plants operating significantly below capacity. However, for existing mining operations, there may be scope for requiring excess power generation if operations expand and require additional power facilities.

¹⁸⁸ Sierra Leone Mining, Energy/Oil & Gas Indaba 2013: Next 5 year Power Roadmap, Minister of Energy.

¹⁸⁹ E-mail exchange with London Mining, September 24, 2013; African Minerals Press Release, "Memorandum of Understanding with China Communications Construction Company Limited ("CCCC")," May 2011, available at http://www.african-minerals.com/regulatory_news_article/1891.

¹⁹⁰ GoSL Request for Proposals, "Procurement, Legal Advisory, Monitoring, Administration and Reporting Services in relation to the Bumbuna Hydroelectric Power Plant ("BHPP") Extension ("Bumbuna II")," (June 2013).

¹⁹¹ WAPP Working Group Exercise, available at:

<http://siteresources.worldbank.org/INTENERGY2/Resources/exercise.pdf>.

- **National Power Authority (NPA) as an Offtaker:** Such an arrangement would see the NPA play the role of offtaker of the excess power being supplied to the grid. Given the current inefficiencies and weak balance sheet of the NPA (see Section 3.3 below), along with concerns over the quality of governance in Sierra Leone, mines might question the security of such a take or pay arrangement, and the additional credit enhancements required (partial risk guarantees, letters of credit) would increase the expense of the arrangement to the government.
- **Transmission Infrastructure:** In order to distribute excess power to the grid, there is a need for adequate transmission infrastructure. In the absence of nationwide grid infrastructure, transmission lines would need to be created. However, the currently operational iron ore mines are located in close proximity to the planned Bumbuna-Makeni transmission lines (see figure 2) and the location of the new WAPP line (See Box 2). Extension of the transmission infrastructure to the mine sites may therefore be less costly to the government, donors, or mining companies than in the complete absence of any infrastructure (see Section 3.4).

3.3. Leveraging Mines for Increased Generation: Mines as anchors for IPP Generation Projects

3.3.1. Background

The SPU held an Energy Working Group meeting in July 2012, attended by government, donors and the private sector, from which it concluded: *“It became evident that the needs of the private sector are similar. In the short term these high demand private sector consumers will self-generate, however, in the medium and long term, as their demand increases, they would prefer to outsource power generation, either to the Government or an Independent Power Provider.”*¹⁹² Indeed both Sierra Rutile and African Minerals in their annual reports note the exposure of their operations to variations in fuel costs.¹⁹³

While many of the smaller installations and additions to the national generation capacity are to be funded by donor grants or concessionary loans, a number of Independent Power Producer (IPP) projects have been proposed, with varying structures, and these are noted in Table 8.

As this section explains, and as we are seeing with the potential Moyambe hydropower project in which Sierra Rutile will be an offtaker, mines can play an important role as anchor customers for IPP generation investments that require outside investment. The National Electricity Act requires power from IPPs to be sold to the national electricity company and/or GoSL directly. It would then be sold on to end-users.¹⁹⁴ However, it is likely that lenders would look to mitigate risk by ensuring that the sale of at least a portion of the power by the NPA was secured under offtake agreements with credible industrial users such as mining companies.

¹⁹² Interim Report: Working Group Sessions for the Energy Sector, Strategy and Policy Unit, Office of The President, July 2012

¹⁹³ Sierra Rutile Annual Report, 2012, available at <http://www.sierra-rutile.com/uploads/annualreport2012.pdf>, African Minerals Annual Report 2012, available at www.african-minerals.com/system/files/.../AfricanMineralsAR2012.pdf

¹⁹⁴ National Electricity Act 2011, available at: <http://www.sierralii.org/sl/legislation/act/2011/16>.

If the proposed generation investment promises cheaper power than its current self-generation arrangements on an equally reliable basis, a mining company could be incentivized to buy power from such projects under such an offtake agreement, which as mentioned, would provide demand guarantees to increase the bankability of the power investment. The structure of such an arrangement can take a number of forms. For example, the mine could be the offtaker of the power produced by an IPP project, or it could play a more active role in the IPP investment as a joint venture partner, or an equity investor. Table 8 notes the possible role of mining companies in the various planned IPP projects in Sierra Leone.

Table 8: Planned IPPs

IPP	Project	Role of Mining Company
Bumbuna II expansion: Joule Africa	<p>IPP with Joule Africa to develop Bumbuna II generating power up to 372MW with a firm capacity of 112MW in the dry season. London Mining and African Minerals reported to be interested offtakers. Recent reports state that Joule Africa has entered into a joint development agreement with Endeavor Energy, a privately owned independent power development and generation company.</p> <p>Source: Procurement, Legal Advisory, Monitoring, Administration and Reporting Services In relation to the Bumbuna Hydroelectric Power Plant (“BHPP”) Extension (‘Bumbuna II’), Joule Africa press release available at http://www.jouleafrica.com/news/press-releases/joule-africa-partners-with-endeavor-energy-to-develop-bumbuna-phase-ii-power-project.html, and interview with Joule Africa, Freetown, July 4, 2013</p>	Offtaker
Moyambe Hydro Project	<p>IPP with Smol Pawa Sierra Leone Ltd to construct an 11-14MW run-of-river hydropower project at the Singima Falls on the Gbanga River, 20km from Sierra Rutile’s current operations. An MoU was signed with Sierra Rutile in December 2013. Project is envisaged to take 36-49 months and provide power to Sierra Rutile, Moyambe community and Njala University.</p> <p>Source: Sierra Rutile, “Sierra Rutile signs MoU with low-cost hydro-power project,” December 9, 2013, available at: http://www.sierra-rutile.com/uploads/srl-pressrelease9december2013.pdf.</p>	Sierra Rutile as Offtaker
Blue Flare/CEC	<p>Public-private-partnership agreement between the GoSL and Blue Flare Power SL Limited (BFP) for the construction of thermal plants with installed capacity of 1,000MW, including their associated distribution and transmission networks on a build-operate-transfer (BOT) basis. Phase I of the project is the construction of a 125MW thermal plant and its associated network for the Western Area. Copperbelt Energy Corporation (CEC) has recently bought a stake in BFP. CEC market a core competence as being the supply of power to mining operations.</p> <p>Source: Sierra Leone Mining, Energy/Oil & Gas Indaba 2013: Outlook for Power Sector, A view from the Private Sector Presented by CEC Africa Sierra Leone Limited, http://www.b2i.us/profiles/investor/ResLibraryView.asp?ResLibraryID=63396&BzID=1935&to=rl&Nav=1&LangID=1&s=0&Category=1565</p>	Offtaker
Addax Bio Energy	<p>Addax Bioenergy to produce fuel ethanol from sugarcane for exports and electricity for injection into the grid, using the residual bagasse. Project will generate 32MW of electricity, of which up to 15MW will be fed into the grid (semi-captive). Transmission lines to be built to feed into Bumbuna-Freetown</p>	N/A

	<p>transmission infrastructure. Recently signed a 20 year power purchase agreement (PPA) with the NPA for offtake of power.</p> <p>Source: Addax Bioenergy Factsheet, available at http://www.addaxbioenergy.com/uploads/PDF/ABSA_July_2013_Factsheet_V1.pdf ; and interview with Addax Bioenergy, September 13, 2013.</p>	
Jindal Steel & Power	<p>A 350MW coal-fired power plant to be built by India’s Jindal Steel and Power. Coal to be shipped from Southern Africa to Sierra Leone. Likely to be located near mining corridors with mines as possible offtakers. Potentially semi-captive plant in the long-run if JSPL secures rights to mine iron ore and/or develops a steel plant.</p> <p>Source: http://mg.co.za/article/2013-07-20-sierra-leone-needs-35bn-investment-to-restore-power-sector; interviews with SPU, Statehouse, Freetown, July 1, 2013.</p>	Investor + Offtaker
Shamshi Steel	<p>Shamshi Steel with First Step to develop Sierra Leone’s steel manufacturing industry and semi-captive power plant in the Northern Port Loko district. Sierra Leone has entered an agreement with First Step & Shamshi Private Ltd. Reports suggest that this might be primarily captive and only supply 5-10MW to the national grid.¹⁹⁵</p> <p>Source: http://www.sierraexpressmedia.com/archives/46881</p>	Investor + Offtaker
HydroChina	<p>The GoSL signed a memorandum with China’s HydroChina to build two hydroelectric power plants totaling 260MW of generating power at a cost of more than US\$800 million.</p> <p>Source: http://www.breakbulk.com/breakbulk-news/industry-sector/government-regulation/sierra-leone-seeks-billions-in-power-investments/</p>	Unknown
Mujimoto	<p>A joint venture of Mujimoto Sierra Leone, China National Electric Engineering Company (CNEEC) and New Generation Energy are planning to develop up to 500MW of CSP Solar plants.</p>	Unknown

Source: http://www.enerdata.net/enerdatauk/press-and-publication/energy-news-001/sierra-leone-needs-35bn-investment-restore-power-sector_21052.html#sthash.A88DNTTrN.dpuf

¹⁹⁵ GoSL Request for Proposals, “Procurement, Legal Advisory, Monitoring, Administration and Reporting Services in relation to the Bumbuna Hydroelectric Power Plant (“BHPP”) Extension (“Bumbuna II”),”(June 2013).

3.3.2. Potential Roles for Mines in IPP projects

Mine as Offtaker (e.g. Joule Africa, Blue Flare Power, Smol Pawa)

Under this scenario, the mines are not involved in the construction of the power plants, but they provide a demand guarantee under a power purchase agreement (PPA) arrangement with the National Power Authority. This indirectly underpins the future cash flows from the power plant and increases the bankability of the project. An advantage of this arrangement is that ultimate control over the plant remains independent of the mining company, but it still plays a key role in facilitating the investment. It may be challenging to coordinate such an agreement, since mining and power investments follow different time horizons as power plants generally take longer to build than a mine. If this can be coordinated, the power demand can significantly help in progressing an investment which might not otherwise take place.

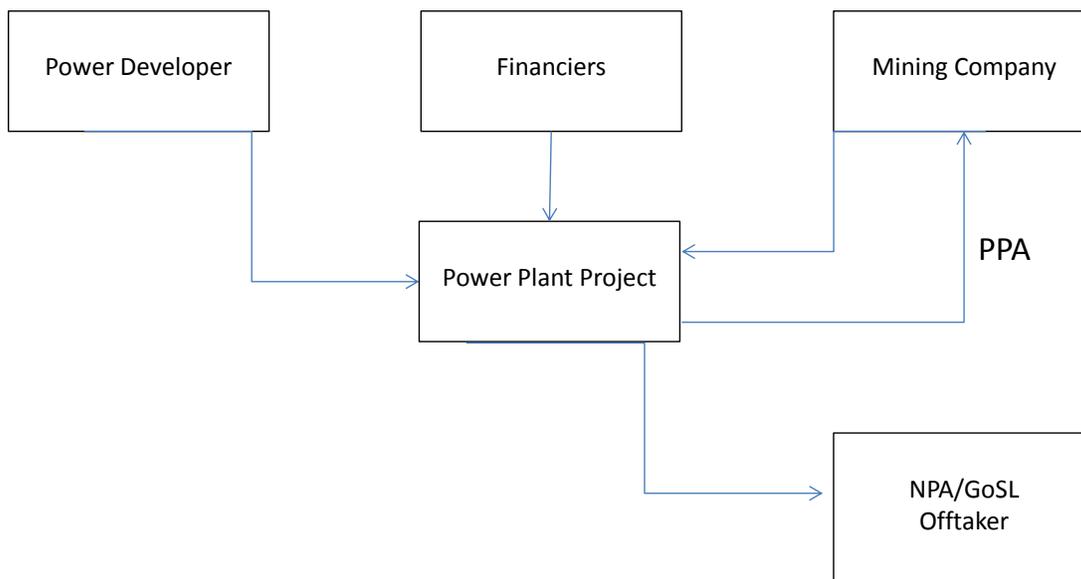
However, the value of the PPA depends on the creditworthiness of the company. The likes of London Mining, Sierra Rutile and African Minerals are small AIM-listed mining companies with limited, or no operations outside of Sierra Leone. This means that the IPP would be inherently taking on some country/project specific risk without the cushion of a multinational balance sheet. African Minerals recently revised their production schedule downwards, as a result of problems with logistics and transportation infrastructure.¹⁹⁶ This highlights how the schedule of operations and the associated power requirements are dependent on a range of factors. Measures such as additional guarantees or letters of credit can enhance the bankability of the PPA in these circumstances, but raise the cost to the offtaking mining company. However, when interviewed, Joule Africa stated that it viewed the mining companies operating in Sierra Leone as sufficiently creditworthy offtakers to obtain financing for the expansion of the Bumbuna plant.¹⁹⁷ Figure 6 below illustrates a simplified structure of a financing for a power plant where a mine is the anchor for the investment.

Figure 6: Structure of a power plant financing with a mine as an anchor offtaker

¹⁹⁶ James Wilson, "African Minerals disappoints by scaling back Sierra Leone mine," *Financial Times*, September 11 2013, available at: <http://www.ft.com/intl/cms/s/0/323774c4-1adb-11e3-87da-00144feab7de.html?siteedition=intl#axzz2eIPSfa9Q>

¹⁹⁷ Interview with Joule Africa, Freetown, July 4, 2013.

Joint Venture (Shamshi Steel, Jindal Steel & Power)



The mining company plays a key role in facilitating the project as:

Investment Initiator: The mining company would initiate/facilitate the investment in the first instance, and can bring in strong developers, EPC (engineering, procurement and construction) contractors, lenders, investors and advisers. It is reported that in the case of the initial rehabilitation of the Bumbuna hydro plant, the lack of competition in the installation of a first generation operating contractor for Bumbuna kept operating costs of this facility higher than necessary,¹⁹⁸ a reflection of the weak governance and oversight of the power sector. The mining companies' commercial incentives to keep costs down would encourage the use of more competitive contractors. They would also want to build the optimal specification of the plant. For example, with the expansion of the Bumbuna plant, the mine's need for a high level of continuous power throughout the year is likely to necessitate building a reservoir to smooth power supply.

Equity Investor: The mining company could contribute to meeting the equity requirements of the project.

Partial offtaker: The mining company will offtake a certain proportion of the power. This may help with the bankability of the deal, to the extent the mining company is considered to be a credible offtaker, and the company's overall balance sheet and creditworthiness can help to underpin the deal.

3.3.3. Challenges to use of mining companies as anchor for IPPs

Power Price

The incentive for mining companies to support a power project will depend on the ultimate cost of the electricity. Mining companies will only buy power from an IPP if it is cheaper than its

¹⁹⁸ "Infrastructure and growth in Sierra Leone," African Development Bank, 2011.

current diesel or fuel oil-based sources, and as reliable. London Mining stated that its current marginal cost of power using its HFO plant is US\$0.18/kWh.¹⁹⁹ Similarly, the World Bank²⁰⁰ has calculated that the power generation costs for using smaller diesel, or HFO plants would be approximately \$0.20/ kW for self-generating mining companies. Ultimately, the IPP's ability to develop alternative power sources more cheaply than the mining company itself depends on the economies of scale that it can take advantage of, and the financing costs of the capital that they are accessing to develop the power plant. Joule Africa has projected that its cost of producing hydro power will be \$0.062/kW, and the cost post-transmission to be between \$0.08-0.14/kWh.²⁰¹ This would provide a cheaper power solution for mining companies than their current arrangements. A biomass plant might yield a higher price. Addax Bioenergy has recently entered into a PPA with the NPA but was unwilling to reveal the negotiated tariff.

As mentioned, the Electricity Act requires a back-to-back PPA in which the NPA would offtake 100% of the power and then distribute to possible users at a range of different prices. This requirement means that the price is reliant on the GoSL's negotiation of the power price as well as any margin charged by the NPA. It is reported that the NPA has a PPA to purchase power at \$0.15/kWh from the current Bumbuna hydropower plant (Bumbuna I), but the long term marginal cost is estimated to be much lower.²⁰² However if part of the electricity purchased by the NPA is to be sold to mining companies, lenders may require that the offtake agreements with these mining companies be finalized early on in the negotiation of the deal, to ensure its bankability, and incentivizing the NPA to negotiate a price that will be attractive to the power offtakers. Then the question is whether mining companies would be willing to commit to a long offtake agreement at this stage or if would they would just sign a letter of intent.

Offtake amount and NPA as a PPA provider

Once the mining company has agreed to be an offtaker for an IPP project, the question becomes how much power should it be permitted to offtake? On the one hand, it is not desirable for the IPP's power to be fully captured by the mining sector. The GoSL notes that "*power produced by Bumbuna could very easily entirely be absorbed by the expanding mining operations of African Minerals and London Mining. GoSL is conscious of the need to not have all emerging power delivered to mining companies and to reserve a portion of power for the population, other local industries and export.*"²⁰³ Moreover, it has been suggested that the level of constant firm power from the Bumbuna expansion is anticipated to only be between 78MW and 112MW.²⁰⁴ London Mining noted that any offtake agreement would need to be provided on the basis of firm power.²⁰⁵

On the other hand, while it is preferable for a significant amount of power to be procured by the government for national distribution to small businesses and households, the offtake of this

¹⁹⁹ E-mail exchange with London Mining, September 24, 2013.

²⁰⁰ World Bank, "Infrastructure Policy Notes: Leveraging investments by natural resource concessionaires," (2011) - used for comparative purposes.

²⁰¹ Interview with Joule Africa, July 4, 2013.

²⁰² African Development Bank, "Infrastructure and growth in Sierra Leone," op cit.

²⁰³ GoSL Request for Proposals, "Procurement, Legal Advisory, Monitoring, Administration and Reporting Services in relation to the Bumbuna Hydroelectric Power Plant ("BHPP") Extension ("Bumbuna II")," (June 2013).

²⁰⁴ Ibid.

²⁰⁵ E-mail exchange with London Mining, September 24, 2013.

power would have to be guaranteed by the NPA, a significantly less credit-worthy partner. As a result, the offtake of power by the NPA could negatively impact the bankability of the deal unless suitable credit support or guarantees are obtained. AICD reports that several factors have constrained the financial health of the NPA. Technical and non-technical losses were as high as 33–45% from 2001-11 due to deteriorated power lines, a large degree of theft and low collection rates. These losses amounted to \$24.2 million in 2010. Collection rates for the decade were on average 86 %, but dipped to 50% in 2008, and inadequate bill collection cost the NPA \$8 million in 2010. Decrepit systems have reduced the fuel efficiency of the generation infrastructure and along with rising labor costs, the NPA has seen operating costs escalate rapidly.²⁰⁶ Addax Bioenergy, which recently entered into a PPA with the NPA, required the PPA to be backed by GoSL as well as additional partial risk guarantees to underpin the agreement.²⁰⁷

The balance of this distribution of the power between the mine and the NPA will determine the bankability of the project, as well as the contribution to broader economic development. If the WAPP regional project is completed, the risks to Sierra Leone will be reduced because excess supply will have an immediate outlet for sale into the regional energy market. This will make the conditions for private investment by independent power producers more attractive.

Regulatory Environment

At present there is no independent regulatory body overseeing private participation in the power sector, with NPA acting as both the vertically-owned utility and the regulator. The lack of clear rules and frameworks for IPP generation and the associated PPAs means that for new entrants, many of the details are not known and must be negotiated, increasing the risk of investment in Sierra Leone's power sector for private sector parties.

However, the Sierra Leonean power sector is currently undergoing significant reform. The National Electricity Act 2011 provides for the unbundling of the NPA, creating an Electricity Generation and Transmission Company as well as the Electricity Distribution and Supply Authority. The 2011 Act also allows for private sector participation in power generation and transmission, and establishes a basis for PPAs among the parties involved²⁰⁸. In addition, the Electricity and Water Regulatory Commission Act 2011 creates a regulator for the electricity and water sectors.²⁰⁹

Transmission Infrastructure

As mentioned in section 2.3 above, the lack of transmission infrastructure poses a bottleneck in Sierra Leone. Soon after the war, the GoSL entered into a take-or-pay contract with an IPP called Income Electrix Limited for 15MW of thermal power generation. However, with the

²⁰⁶ Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective," World Bank, op cit.

²⁰⁷ Bioenergy and Food Security Criteria and Indicators, "Addax Bioenergy", available at: <http://www.fao.org/bioenergy/31526-0f64a59805bd9a5ec0b02e419f54df9e1.pdf> and interview Addax Bioenergy, September 13, 2013.

²⁰⁸ National Electricity Act 2011, available at: <http://www.sierralii.org/sl/legislation/act/2011/16>.

²⁰⁹ National Energy Profile of Sierra Leone, 2012, available at www.undp.org/content/dam/sierraleone/.../undp_sle_energyprofile.pdf

transmission and distribution infrastructure unable to absorb the supply from this planned project, the GoSL eventually had to cancel that contract.²¹⁰

If this transmission infrastructure cannot be delivered by government or by donors, there are a range of ways in which it may be constructed. For example, Addax Bioenergy financed the construction of a 161 kV high voltage line and substation from its operations to the national grid at Bumbuna. Along with the expansion of the Bumbuna hydro plant, reports suggest plans to extend of power lines to African Minerals and London Mining, and to other potential industrial end-users such as Cluff Gold.²¹¹ However, it is unclear at present whether this infrastructure will be built by Joule Africa, the offtakers themselves, or whether it will be commissioned by the government.

Where a mine or an IPP finances some of the investment costs for the transmission line and substations, it is common for the infrastructure to belong to the national utility and a prepayment to be treated as a loan. This is repaid in kind, rather than in cash, through an offset in the invoicing for power purchased or sold by the IPP/mine. This could be made equivalent to an adjusted tariff during the repayment period.²¹² Such an arrangement may be preferable to the IPP and the offtakers than the situation where the GoSL facilitates the transmission infrastructure and the offtaker faces the risk of the GoSL not delivering the transmission infrastructure to adequate time and standard.

3.3.4. Leveraging Mines for a more robust grid

The Côte d'Ivoire –Liberia - Sierra Leone – Guinea (CLSG) transmission line will provide backbone infrastructure from which to expand the grid in Sierra Leone. As Box 2 shows, the CLSG line will pass through the current main mining corridor in the north-west of Sierra Leone. If the power supply generated within Sierra Leone as well as supply from the WAPP is sufficient to meet mining demand, then companies may have an incentive to finance the extension of transmission infrastructure to allow them to tap into the grid supply.

Box 2: WAPP CLSG Line

The West African Power Pool (WAPP) is an effort to integrate the power systems of its members into a unified regional electricity market. This effort aims to provide citizens with a stable, reliable and affordable electricity supply. The Côte d'Ivoire –Liberia - Sierra Leone – Guinea (CLSG) Interconnection Project will involve a 1,411 km of high voltage (225kV) transmission line. 530 km of this transmission line will be in Sierra Leone, along with five new high voltage substations in Kenema, Bikongor, Bumbuna, Yiben and Kamakwie. The European Investment Bank has approved €75 million of funding to the GoSL for its part of the WAPP interconnection.²¹³

²¹⁰ African Development Bank, "Infrastructure and growth in Sierra Leone," (2011), op cit.

²¹¹ GoSL Request for Proposals, "Procurement, Legal Advisory, Monitoring, Administration and Reporting Services in relation to the Bumbuna Hydroelectric Power Plant ("BHPP") Extension ("Bumbuna II")," (June 2013).

²¹² Toledano, Thomashausen, Shah, and Maennling, "A Framework to Approach Shared Use of Mining-Related Infrastructure," op cit.

²¹³ African Energy, "Sierra Leone: EIB funds West African interconnection", *Cross-border Information (CbI)*, Issue 246, 17 January, 2013.



Sources: The Infrastructure Consortium for Africa – Topics and Programmes – West African Power Pool, available at: <http://www.icafrica.org/en/topics-programmes/west-african-power-pool/>

Commissioning of the CLSG line is expected by 2015.²¹⁴ If power generation in Sierra Leone at that time is still limited, measures would be needed to ensure that the grid supply is not captured by mining companies. These could include mandating mines to contribute to investment in emergency power infrastructure, to make available their idle generator capacity as grid back-up to alleviate bottlenecks at times of peak demand, or to pay a margin on their power tariff to allow the utility to make extra investments to increase the capacity of the national power system.

4. Findings and Conclusions

Through improved planning and structuring of new power generation and transmission capacity associated with the mining sector's energy demand, Sierra Leone can aim at building robust power generation facilities and electricity transmission systems as well as accelerating access to electricity in the rural areas where mining companies are operating. Sound regulations and efficient coordination mechanisms will be necessary to realize such synergies between the power and the mining sector, in which mines could benefit from considerable cost-savings.

The potential options for power-mine synergies, along with their associated challenges, are summarized in the table below.

²¹⁴ West African Power Pool: Priority Projects and Implementation Strategy, available at http://www.encharter.org/fileadmin/user_upload/Conferences/2012_March/West_African_Power_Pool.pdf

Figure 7: Summary of Power-Mine Synergies

Option	Description	Challenges
Rural Electrification	Off-grid or Mini-grid electrification solutions to rural areas.	<ul style="list-style-type: none"> - Effective rural demand - Allocation of distribution responsibilities.
Increased Generation: Excess Supply	Excess capacity built into larger power plants to supply additional power to grid.	<ul style="list-style-type: none"> - Initial design - NPA as off taker - Transmission infrastructure - Coordination among mines.
Increased Generation: Anchor for IPPs	Mines act as the offtaker to IPP projects, providing power demand guarantee and increasing bankability of project.	<ul style="list-style-type: none"> - Power price - NPA as off taker - Transmission infrastructure.
More Robust Grid	Mines finance the extension of transmission infrastructure to allow them to tap into the grid supply.	<ul style="list-style-type: none"> - Insufficient grid power supply - Demand management to avoid saturation of the grid by the mines.

C. Sierra Leone - Scope for shared use in the context of Water

1. Introduction

Access to safe, reliable and affordable water and sanitation in Sierra Leone is very low. Water infrastructure is, in large part, old and in disrepair, having been destroyed or neglected during the country's 11-year civil war. With the dire state of Sierra Leone's water infrastructure, a high displacement of the population to urban areas during the civil war and a population growth rate of over 2%, the GoSL is struggling to keep up with demand for drinking water supplies and sanitation in urban areas, let alone expand coverage to rural areas.²¹⁵ As a result, only around 30% of the population has access to safe drinking water in the country and an estimated 7.1% of households have a water connection on their premises.²¹⁶

According to the World Bank, Sierra Leone should have been spending an annual amount of US\$202 million on water supply and sanitation between 2006 and 2015 to meet the Millennium Development Goals in relation to the water supply and sanitation (WSS) sector²¹⁷ by 2015.²¹⁸ However, with an annual public expenditure of US\$16 million on the WSS sector in 2009, this leaves an estimated annual funding gap of around US\$176 million, taking into account the efficiency gains that could be had by improving distributional losses and bill collection.²¹⁹

Given the GoSL's budget constraints, and the already sizable portion of GDP it allocates to infrastructure investments, the required funding gap needs to be addressed by a combination of private sector investment, efficiency gains, and the re-direction of capital investments into low cost water supply and treatment technologies rather than piped water infrastructure. The growth of Sierra Leone's mining sector and associated investments in water infrastructure provide an opportunity to narrow the gap in this regard. Indeed, the 2008 National Water and Sanitation Policy (NWSP) outlines as one of the GoSL's objectives to encourage private sector-led development in the WSS sector with effective community participation, although no partnership with any natural resource concessionaire is contemplated.

This case study provides an overview of (1) Sierra Leone's water resources and the state of its water infrastructure, (2) the policy, institutional and regulatory framework governing Sierra Leone's water sector, (3) water use in Sierra Leone's large-scale mining sector, and (4) the scope for shared use of mining-related water infrastructure in Sierra Leone.

²¹⁵ Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective," World Bank, op cit., p. 7.

²¹⁶ Anthony Bennett, Darrell Thompson and Meike van Ginneken, "Sierra Leone: Public Expenditure Review for Water and Sanitation 2002 to 2009", Water Papers, Water Partnership Program, 64895-SL, July 2011, p. 9.

²¹⁷ The Millennium Development Goals (MDGs) in relation to water and sanitation are to halve, by 2015, the proportion of people without access to a sustainable source of drinking water and basic sanitation from 2000 levels. Section 2.24 of the National Water and Sanitation Policy of Sierra Leone sets the national MDG targets at 74 percent and 65 percent respectively. These targets are uniform across the urban and rural areas. Source: Wateraid, "Financing of the Water, Hygiene and Sanitation Sector in Sierra Leone," (2012).

²¹⁸ This estimate comprises an annual amount of US\$149 million in capital expenditure, of which US\$ 118 million is new investments and US\$31 million is for rehabilitation of existing facilities. Source: Pushak and Foster, "Sierra Leone's Infrastructure: A Continental Perspective," World Bank, op cit., p. 7.

²¹⁹ Ibid.

2. Background

2.1. Overview of Sierra Leone's Water Resources

Sierra Leone is a water abundant country with internally renewable water resources of over 29,000km³ per capita - six times the average for Africa.²²⁰ It has twelve river basins, seven of which it shares with Guinea and Liberia.²²¹ Sierra Leone also has a high annual rainfall averaging around 3,800mm per year, which makes it one of the most humid countries in Africa. However, rainfall is distributed unevenly throughout the country and on a seasonal basis from May to October each year.²²² Given the uneven distribution of water resources during the wet and dry seasons, and limited water storage capacity in the country, as little as 11-17% of surface water is available between December and April of each year, with an estimated 14,500 water points ceasing to function during this time.²²³ This leaves many parts of the country with inadequate water supplies for domestic and agricultural purposes.²²⁴

2.2. State of Sierra Leone's water infrastructure

Only around half of the population currently has access to an improved water source in the country and an estimated 7.1% of households have a water connection on their premises.²²⁵ There is also a wide disparity between access to potable water supply and sanitation in the urban and rural areas. Whereas around 20% of the urban population has access to piped water, only 1% of rural areas have piped water access.²²⁶ Moreover, a 2012 water point mapping of available water points (boreholes and wells) for water withdrawals reported that 18% of existing water points across the country were broken, with an additional 14% being partly damaged and dysfunctional at that time.²²⁷

In terms of sanitation and waste water treatment infrastructure, whereas an estimated 10% of the urban population has access to flush toilets, these are almost non-existent in rural areas. Similarly, while about 11% of the population has access to septic tanks, 76% use pit latrines, with 12% of the urban population having access to improved latrines versus only 6% of the rural population. Waste water treatment infrastructure is also limited in Sierra Leone. Major urban centers such as Freetown discharge effluent directly into the ocean, although the African

²²⁰ "The Agenda for Prosperity: Road to Middle Income Status," Sierra Leone's Third Generation Poverty Reduction Strategy Paper: 2013-2018, Government of Sierra Leone, 2013.

²²¹ The river basins include, from West to East, the Kolente (Great Scarcies), Kaba, Rokel, Pampana (Jong), Sewa, Moa, and Mano.

²²² For example, rainfall ranges from around 5,000mm in Freetown on the coast to 2,500mm in the North East of Sierra Leone each year. **Source:** Anthony Bennett, Darrell Thompson and Meike van Ginneken, "Sierra Leone: Public Expenditure Review for Water and Sanitation 2002 to 2009", Water Papers, Water Partnership Program, 64895-SL, July 2011.

²²³ Adam Smith International, "Sierra Leone water security: monitoring and managing water resources together," 2013, featured in the Guardian Newspaper, available at: <http://www.theguardian.com/global-development-professionals-network/adam-smith-international-partner-zone/sierra-leone-water-security-asi-together>.

²²⁴ USAID Country Profile, "Property Rights and Resource: Sierra Leone," (2011).

²²⁵ Anthony Bennett, Darrell Thompson and Meike van Ginneken, "Sierra Leone: Public Expenditure Review for Water and Sanitation 2002 to 2009", Water Papers, Water Partnership Program, 64895-SL, July 2011, p. 9.

²²⁶ Access figures were calculated by the AICD using data from the 2000 Multiple Indicators Cluster Survey as published by the JMP in March 2010 and the 2008 Demographic and Health Survey.

²²⁷ "Case Study: Financing of the water, sanitation and hygiene sector in Sierra Leone," WaterAid, 2012.

Development Bank is currently financing the targeted rehabilitation of water systems in Bo, Kenema and Makeni, along with the installation of septic tanks to contain sewerage waste in these provincial capitals.²²⁸

3. Legal and Institutional Framework governing water supply and use in Sierra Leone

3.1. Legal framework governing water usage

3.1.1. The general water sector

At present, Sierra Leone has no single, unified legal regime governing water resource management, with water rights depending on whether they are derived from private land ownership, community trusteeship, or statutory title.²²⁹ Water legislation in relation to Freetown in the Western Area is based on English common law principles, pursuant to which water resources other than large streams and underground water flowing in established channels vests in the relevant landowner.²³⁰ Outside of Freetown and in Sierra Leone's three provinces, land and water are communal goods and are held on trust for the community by the local chief. In turn, the near obsolete Water (Control and Supply) Act of 1963, provides that water resources within declared water supply areas vest in the ownership of the GoSL.²³¹

There is also no legal regime for the allocation of water rights to natural resource concessionaires. The 1963 Water (Control and Supply) Act appears to contain a provision requiring concessionaires to obtain a water extraction license from then Ministry of Energy and Water Resources. However, the only company that has done so in recent years, and entirely upon its own initiative, is Addax Bioenergy.²³²

3.1.2. Water usage in the mining sector

In relation to the mining sector, the Minerals and Mines Act 2009 (the "Act") provides that a large-scale mining license holder is entitled to use water as is necessary for its operations subject to the provisions of the Act and any other law or condition that may be applicable.²³³ There are no limits to the quantity of fresh water a mining company may withdraw. The Act just requires a mining company to obtain the prior approval of the Sierra Leone Environmental Protection

²²⁸ "Roadmaps for water management in West Africa: Case Studies from The Gambia, Guinea-Bissau and Sierra Leone Development of IWRM Plans" UNEP-DHI Centre, 2009, p.19; AfDB project portfolio website: "Three towns water supply and sanitation project" (ongoing), available at: <http://www.afdb.org/en/projects-and-operations/project-portfolio/project/p-sl-ea0-001/>.

²²⁹ "Roadmaps for water management in West Africa: Case Studies from The Gambia, Guinea-Bissau and Sierra Leone Development of IWRM Plans," UNEP-DHI Centre, 2009, p. 16.

²³⁰ Ibid.

²³¹ "Roadmaps for water management in West Africa" p. 16.

²³² Following due diligence on Sierra Leone's legal regime, Addax Bioenergy requested and obtained a water extraction license from the then Ministry of Energy and Water Resources in September 2011, allowing it to extract water from the Rokel River for its operations in return for a fee based on water usage. Source: Telephone interview with Addax Bioenergy on September 13, 2013.

²³³ Article 114(e) of the Mineral and Mine Act. There are similar provisions for small-scale mining (Article 102(1) (e)), reconnaissance license holders (Article 64(2) (d)) and exploration license holders (Article 77(2) (e)).

Agency, or EPA, if it wishes to divert a watercourse, and that of the Ministry of Mines and Mineral Resources prior to flooding an area or carrying out any dredging activities.²³⁴

Some individual concession agreements contain provisions in relation to water usage, such as those entered into by the GoSL with African Minerals and Koidu Holdings S.A., but these tend to be very weak.

Example: Mining Lease Agreement between the GoSL and African Minerals Limited dated August 6, 2010

“Article 13: Water and Land right

- a) To facilitate mining operations, in addition to the rights given to the Company under Section 114 of the Act, the Company shall with the approval of the Ministry of Energy [and Water Resources] have the right to use water from any natural watercourse for domestic and or mining operations and return mining spoils to the river or stream provided that the Company shall not discharge any poisonous or noxious matter not present in the intake water.”

In turn, the mining lease agreement with London Mining contains no provision whatsoever on how much water may be withdrawn and from which sources, let alone any mention of water infrastructure.

The current legal regime governing water is set to be rationalized by a new water law to replace the Water (Control and Supply) Act and harmonize the legal regime and framework governing water supply.²³⁵ How it will reconcile competing water user rights and the current system of customary water usage with the rights of private users and especially natural resource concessionaires remains to be seen.

3.2. Institutional Framework governing water usage

While there was previously no single authority responsible for the overall management of Sierra Leone’s water resources and services, the GoSL is in the process of addressing this. A Ministry of Water Resources was established in 2013 with responsibility for water policy formulation and water sector coordination of government agencies, donors and NGOs who play an important role in Sierra Leone’s water sector.²³⁶

The management of water supply has been tasked to two public water utilities, namely the Guma Valley Water Company (GVWC), which supplies water in Freetown²³⁷ and the Sierra Leone Water Company (SALWACO), which is responsible for water supply to the rest in the

²³⁴ Articles 135 and 126 of the Mineral and Mine Act.

²³⁵ “Country Sector Assessments: Governance, Advocacy and Leadership for Water, Sanitation and Hygiene: Sierra Leone”, UNDP Goal WASH Programme, UNDP, July 2009.

²³⁶ Interview with the Ministry of Water Resources, Freetown, Friday, June 28, 2013. Prior to 2013, the a water department was housed in the Ministry of Energy and Water Mineral Resources and had overall responsibility for the policy formulation, regulation and implementation/ management of water and sanitation, which it lacked capacity and the financial resources to carry out.

²³⁷ The Guma Valley Water Act 1961.

country.²³⁸ Both water utilities are severely constrained by a lack of water production capacity, coupled with severe human and financial resource constraints. Their financial woes are compounded by a low cost recovery rate due to high distributional losses of around 40% of production stemming from water pipe leakages and illegal connections, and a low water tariff.²³⁹ At an average effective rate of US\$0.22 per cubic meter in 2008, water tariffs are only around one third of the charge of countries with comparable water resources in Sub-Saharan Africa.²⁴⁰

In 2004, the supply of water in rural areas was decentralized to local councils, although implementation has been slow to date.²⁴¹ Given their limited capacity in service delivery, a number of international organizations, notably UNICEF and the WHO, along with numerous NGO's, have intervened in the rural WSS sector and are particularly active in fostering community participation in the operation and maintenance of the water infrastructure assets.²⁴²

To date, there is no formal private sector participation in the water supply sector, although small-scale providers do provide water that they get from a utility network or a water source, and in the sanitation sector in the construction of latrines or emptying of pits and septic tanks.

The Ministry of Mines and Mineral Resources is responsible for ensuring that mining activities are carried out in an environmentally friendly way. The Minister is advised by a Minerals Advisory Board on matters of the environment as they affect mining, which includes a representative of the EPA, but no representative of the Ministry of Water Resources.²⁴³

4. Water use in the large-scale mining sector in Sierra Leone

4.1. Open pit mining

The iron ore mining by African Minerals is primarily carried out by means of open pit mining. This is because the types of iron ore being mined – hematite and magnetite iron ore - are located no lower than 300m below the ground. The ore mined is low grade iron and is subsequently processed, or beneficiated, to improve the grade, or percentage of iron content in the ore to around 65%.²⁴⁴ Once operational, Cape Lambert will also be carrying out open pit mining. Sierra Minerals similarly mines bauxite by this method.

London Mining has not yet started mining for primary iron ore in the ground, which it plans to commence by 2016. At present, it just extracts a low grade hematite iron ore from old tailings waste left over from pre-civil war mining operations at the Marampa site. Extraction of iron ore

²³⁸ Sierra Leone Water Company Act, 2001. At present, SALWACO supplies water to six urban areas, as well as a small percentage of the population in a number of secondary towns. SALWACO has also started certain projects in rural areas, including in Tonkolili district, but these are limited in scope.

²³⁹ Pushak and Foster, *Sierra Leone's Infrastructure: A Continental Perspective*, World Bank, op cit., p. 43.

²⁴⁰ Ibid.

²⁴¹ Local Government Act 2004, Third Schedule. The authority of local governments is also undermined by the chiefdom structure in Sierra Leone. In accordance with the current land tenure system, a chief holds the land rights on behalf of the community in his chiefdom. The chief is therefore more involved in negotiations and decisions in land allocation than local authorities. Source: Interview with Adam Smith International, Freetown, June 2013.

²⁴² These include Oxfam GB, GOAL/SL, Concern Worldwide, Action Contre la Faim (ACF), and Action Aid. Source: Anthony Bennett, Darrell Thompson and Meike van Ginneken, "Sierra Leone: Public Expenditure Review for Water and Sanitation 2002 to 2009", Water Papers, Water Partnership Program, 64895-SL, July 2011.

²⁴³ Article 12 of the Mineral and Mines Act.

²⁴⁴ London Mining, "Analyst Workshop: Life of a Mine study results," September 23, 2013.

from tailings does not entail any blasting – but simply shoveling and trucking the sludge in the tailings dams, which contains an average of 21% iron ore, to the processing plant.²⁴⁵

4.2. Water use

The iron ore mines in Sierra Leone – African Minerals, Cape Lambert and London Mining, draw water from the Rokel River for dust suppression and ore beneficiation.²⁴⁶ In turn, Sierra Rutile and Sierra Minerals draw their water from neighboring rivers such as the Jong River.

Water is required for dust suppression to reduce the impact on the environment and human health. It is estimated that above 3 kilograms of dust per ton of ore mined is generated during the mining extraction, beneficiation process and transport of the ore.²⁴⁷ Water is distributed by water trucks on haul roads and waste dumps, and by sprays on iron processing equipment such as conveyers and crushers.²⁴⁸

Water is also used in wet processing of ore to increase the quality and concentration of iron. After crushing, the dry ore is mixed with water and wet screened. In addition, Sierra Rutile requires considerable amounts of water for its dredging operations, which involve a floating plant on a man-made lake which excavates material using a buck ladder. Fresh water is not required for dust suppression, dredging, or beneficiation, so dewatered or recycled water can be used for these processes.

4.3. Mine wastewater

Iron ore mining generates considerable volumes of waste, the environmental impact of which is exacerbated in Sierra Leone by the heavy rainfall during the wet season. First, considerable overburden is produced during the open pit mining, which poses a challenge in terms of its proper storage given the high annual rainfall and subsequent reclamation after mine closure. Surface runoff from overburden following rainfall may also contain acid mine drainage (AMD) from the sulphur-containing rock in the overburden, traces of heavy metal, ammonium nitrates and other remnants of explosives used during the blasting of rock, and oil from the trucks and machinery on site. Surface run off from the overburden and the mine site in general also exacerbates soil erosion.

Tailings produced during the processing/ magnetic separation of iron ore from other waste is also a pressing environmental concern. The tailings consist mostly of silicate rock, but can also include other heavy metals and AMD. If tailings are not properly managed, tailings may seep into ground water and also contaminate surface water if tailings ponds flood during the rainy season.

²⁴⁵ Ibid.

²⁴⁶ Also known as the Seli River, this Rokel is Sierra Leone's most important river. It originates in the Guinea Highlands in North Central Sierra Leone and empties into an estuary of the Sierra Leone River on its journey towards the Atlantic Ocean. Bumbuna dam is situated on the Rokel River, which is upstream from the three iron ore mines.

²⁴⁷ "Base Metal and Iron Ore Mining," Pollution Prevention and Abatement Handbook, World Bank Group, July 1998, p. 267.

²⁴⁸ Geraldton Iron Ore Alliance, "The use of water in iron ore mining," available at: www.gioa.com.au/images/gerioa-20--aghii.pdf.

While the EPA and Ministry of Mines and Mineral Resources lack the capacity to monitor the environmental impact of the mining operations, local communities have reported contamination of surrounding water sources, soil erosion and flooding over and above heavy seasonal rainfall. For example, communities downstream of African Minerals' mining operations have complained of deteriorating water quality, reflected in the orange color of the Rokel River water following the commencement of its mining operations.²⁴⁹ Communities around Lunsar have also recently accused London Mining of causing excessive flooding on their land.²⁵⁰

5. Scope for Shared use: challenges, opportunities, pre-requisites

5.1. Scope for shared use in the context of water infrastructure

Given the lack of a regulatory and institutional framework requiring mines to minimize their water footprint, there is currently limited scope to leverage mining-related investments in water infrastructure for development. There are three scenarios in which mines could be involved in the provision of treated water to communities, only the first of which would leverage mining-related investments in water infrastructure for the purpose.

5.1.1. Mines supply excess treated water from dewatering of open pits: leveraging mines for increased drinking water

Supply of dewatered water for re-use, drinking water and/ or irrigation purposes

Given the high seasonal rainfall in Sierra Leone, considerable dewatering is required to be undertaken on the iron ore mine sites. This excess water could be sufficient to both be re-used/ re-cycled in the mining process at each mine site, and to be supplied to surrounding communities for drinking water and irrigation purposes after some treatment. To be sustainable, mining companies would need to partner with the local water service provider in the area- whether it be SALWACO, an NGO, or a small scale water supplier, who could then sell/ supply the treated water to local community members for an agreed water tariff.

Requirements and Negotiation Points

To explore the scope for the provision of dewatered water, an assessment of water needs and the existing infrastructure of an identified community would need to be conducted in consultation with the local community, local government and/or NGOs involved in local service delivery, and the donors, if any, funding water and sanitation programs in the target area.

For an operating model, it would need to be decided whether:

²⁴⁹ Interview with Adam Smith International, Freetown, June 2013.

²⁵⁰ "Open Letter to London Mining – Sierra Leone" *Salone Monitor* (July 13, 2013), available at: <http://www.salonemonitor.net/open-letter-to-london-mining-sierra-leone/>.

- a. there is excess water available to be supplied to communities after the water needs of a mine have been satisfied, and how the minimum deliverable quantity of excess water should be determined;
- b. the water is supplied by the mine to a local government authority, NGO, or small-scale water supplier operating in the target community that would then deliver the water to surrounding communities, or directly to the identified community; and
- c. the water is provided as part of a CSR initiative, or whether the mining company is paid a small water tariff for the provision of water.

Given the low water tariff in Sierra Leone (below cost recovery levels) and the limited capacity of rural families in particular to pay for water, there may not be a business case for such an initiative. However, mines could nevertheless be mandated to do so by regulation, or in the terms of the concession agreement or a CSR plan.

5.1.2. Mines as an anchor for investment in water supply: leveraging mining companies' investments in water infrastructure for increased water

Mines as an anchor for development funds

There may be scope for mines to collaborate with SALWACO and donors such as DfID, the World Bank, or the AfDB, who are active in the WSS sector, to share costs, or attract financing for the construction of the requisite water infrastructure from the water source to various water points serving both the mine site and nearby towns, or communities. This is particularly so where the large-scale mining operations are nearby a town such as Lunsar, in the case of London Mining. The fact that part of the funding could come from donors could reduce the cost of the water supplied to the target towns/ communities and promote cost recovery given that only a smaller portion of the capital investment would need to be reflected in the water tariff charged for the water supplied to consumers.

Requirements and Negotiation Points

To explore the scope for a shared financing arrangement, a mining company would need to collaborate with the donors active in the rehabilitation and construction of water supply infrastructure in Sierra Leone to assess the water needs of nearby communities, and whether there is the requisite critical mass of population to, on a cost-benefit basis, justify the investment into piped water infrastructure. Who operates the water infrastructure and the method for calculating the tariff charged for both residential use and mine use would need to be agreed upfront.

Given the low water tariff in Sierra Leone (below cost recovery levels) and the limited capacity of rural families in particular to pay for water, there may not be a business case for such an initiative at this stage. However, mines could nevertheless undertake to rehabilitate/ upgrade defunct water systems, or provide technical expertise to nearby communities to do so as part of a CSR plan.

5.1.3. Mines provide self-contained, small-scale water supply and treatment solutions as part of a CSR program

Each of the mining companies interviewed and/ or researched provides water in some capacity to communities. For example, London Mining has installed some water wells and filtration plants to provide potable water to Lunsar residents, though there were complaints from residents that these were not being maintained. Similarly, African Minerals announced in its 2011 Annual Report that it has launched a number of drinking water projects for sole use by local communities in Bumbuna Township.²⁵¹

However, not all the water made available to communities is potable. For example, Koidu Holdings, a company mining for diamonds in the Kono district, constructed a borehole for local Koidu Town residents and additionally made available dewatered water, both water sources of which were subsequently found to be toxic.²⁵²

In turn, Sierra Rutile reported providing 63 million gallons of clean water to local communities in its 2012 annual report and also rehabilitates old wells and constructs new ones.²⁵³ However, water from wells is considered an unprotected water sources as it is often found to contain a high presence of harmful bacteria and pathogens, rendering it unfit for human consumption.²⁵⁴ Any provision of wells to communities needs to be accompanied with a filtration and monitoring system to ensure the water meets drinking water quality standards.

Any water supply and treatment schemes provided as part of a CSR plan or otherwise must:

- align with national and local water development goals for a district/ chiefdom;
- be carried out in collaboration with relevant stakeholders to ensure community buy-in and capacity to operate and maintain the water infrastructure; and
- be monitored regularly to ensure that the water being supplied meets acceptable drinking water standards.

Finally, the provision of water needs to take into account the seasonality of water availability to ensure that the water source made available can provide water throughout the year.

5.2. Prerequisites

To overcome the challenges set out above, a number of pre-requisites in terms of Sierra Leone's legal, institutional and regulatory framework would need to be met to require mining companies to minimize their water footprint and thereby facilitate synergies between mining companies' water infrastructure needs and the water needs of surrounding communities. A number of the policies set out by the GoSL in its Agenda for Prosperity and NWSP, if implemented, may address these points:

²⁵¹ African Minerals Annual Report 2011.

²⁵² Interview with Adam Smith International, July 3, 2013.

²⁵³ Sierra Rutile website: <http://www.sierra-rutile.com/community.aspx>

²⁵⁴ "Infrastructure and Growth in Sierra Leone", African Development Bank, 2011. P. 54

5.2.1. Create a system of water rights allocation

The regulatory framework governing water use should be revised and rationalized, with a clear system of allocating water rights among competing users and uses. The Agenda for Prosperity and NWSP recognize this, and it is anticipated that the draft water law will address this. At a minimum, the new legislation will (1) clarify the legal regime applicable to water concessions outside of the Western Area in a manner that is distinct from, but not inconsistent with the accompanying land rights, (2) provide for a system of granting and evaluating water licenses on the basis of the concessionaires actual water needs taking into account their ability to minimize water usage and recycle water, and (3) provide for a mechanism to alter the allocation of water rights over the life of the water concession with a built in review mechanism, or a grant of a water license for no longer than 5 year periods.

In relation to the **mining sector**, water rights for the extraction of fresh water should only be allocated to the extent that dewatered water is insufficient to meet the mine's water requirements, or a mine can otherwise recycle its initial fresh water intake. Given Sierra Leone's high rainfall, ingress water should be sufficient water to meet the water requirements of large-scale mining companies for much of the year.

5.2.1.1. Hydrological data to understand existing water resources and cumulative impact of users over time

To make informed decisions in relation to water usage the following types of data is required:

- Hydrological data on the location, variability, and renewability of existing water resources to properly understand the existing water sources and any seasonal fluctuations in water availability.
- Water use demands in relation to the water resources.
- An analysis of cumulative effects of water users on the water sources during the life of the mining operations.
- Baseline information on the water quality of the water sources from which to monitor changes.

There is presently very little hydrological data available on Sierra Leone's water resources as most data records were destroyed during the civil war. However, Sierra Leone's Ministry of Water Resources is aware of the need to collect data and build up capacity on monitoring water availability and managing water demand and allocation. With the aid of Adam Smith International and DfID, it has begun a pilot program at Bumbuna, a town along the Rokel river downstream from Bumbuna dam (and immediately upstream from African Minerals), which involves community members monitoring rainfall and river levels and feeding the collected information back to the Ministry.²⁵⁵ The EPA is also planning to carry out a strategic environmental impact assessment of the Rokel Seli water basin area, which includes the districts of Port Loko and Tonkolili where the operations of London Mining, Addax Bioenergy, Cape Lambert,

²⁵⁵ Interview with Joel Cutting and Singe Day, Adam Smith International, in Freetown, June 2013.

and African Minerals are located to better understand the *cumulative impact* of water usage in this area.²⁵⁶

5.2.2. Zero tolerance policy for discharge of wastewater and other mine effluents – to protect the environment and require re-use and treatment of waste water

Strict environmental regulations are required that hold mines to best international environmental practices in relation to effluent discharge, tailings storage, ingress water treatment, the use of chemicals in mining processing, and mine closure. At present, the Mines and Minerals Act 2009 only contains limited obligations on a mining company in relation to effluent discharge.²⁵⁷

Some mining concessions also contain provisions in relation to water quality; however these are generally weak and do not require compliance with international environmental standards. For example, in the MDA between the GoSL and African Minerals, the latter undertakes not to “pollute, impair, divert or destroy the normal supply of drinkable water supply of any village” *without* providing an alternative safe and adequate drinking water source to be determined and approved by the Minister of Health.”

Mining companies should be required by law to minimize the discharge of any contaminated water into surrounding water sources and to treat all wastewater, including dewatered water, to an acceptable water quality level prior to discharging it. Mining companies that are unwilling or unable to comply with environmental regulations should be subject to strict penalties.²⁵⁸

5.3. Greater transparency regarding a mining company’s environmental obligations

Each mine is required to submit an Environmental Impact Assessment, or EIA, and an Environment Management Plan, or EMP, to obtain the requisite mining license to begin its mining activities. However, these documents are shrouded in secrecy and appear to be unavailable for public review, even though a copy of each EIA is meant to be kept at the National Minerals Agency. The documents should be readily available for public

²⁵⁶ Interview with the Environmental Protection Agency, June 24, 2013.

²⁵⁷ The Environmental Impact Assessments required to be submitted in order to obtain a large-scale mining license must include (1) a baseline of the environment prior to the commencement of operations, (2) identification of envisaged environmental impacts of the mining process, and (3) the proposed strategy for mitigating such environmental impacts; however no standards are included with which the mining companies must comply: Article 133 of the Mines and Minerals Act 2009. The draft Operational Regulations for the Mining Sector 2012 require mining operations to comply with international standards in relation to, among other things, the discharge of liquid effluents, solid waste disposal (overburden) that could seep into ground water, water quality, and river diversions. However, to date they have not been enacted.

²⁵⁸ Section 23(1) Environmental Protection Act 2008, as amended in 2010, provides for a fine of up to \$10,000 for non-compliance with the environmental regulations by non-Sierra Leone nationals. Considering the size of large-scale mining operations, such a low fine is hardly an incentive to comply with the provisions of the environmental regulations. Similarly, section 34 of the Environmental Protection Act gives the executive director of the EPA the discretion to suspend, limit or cancel the operations of a company that is non-compliant or materially alters its operations in such a way that is disruptive and detrimental to the surrounding environment and communities. This is again very weak. There should be strict liability with immediate consequences for a breach of the environmental regulations. Source: Halima Tejan-Sie, “Review of the status of Sierra Leone’s commitments under regional and global multilateral agreements,” November 2011

scrutiny and monitoring – particularly as the capacity of the relevant Ministries is currently lacking to monitor a mining company’s compliance with its environmental obligations.

5.4. Institutional capacity of local authorities and a stronger presence of EPA and Ministry of Water Resource capability to monitor mining activities

It is fundamental to ensure that an institutional setting that enforces and monitors water rights and environmental obligations is in place. This requires (a) institutional capacity to monitor water usage and compliance with environmental best practices, (b) institutional presence and capacity to supply water, (c) clear information on existing water resources and demands on such resources, and (d) coordination among government ministries and agencies. The presence and efficacy of local councils is currently weak given the pervasive lack of financial and human resources. In addition, there is little or no representation of the relevant Ministries at the district level, which makes the monitoring of water resources and compliance with environmental obligations immensely challenging. At a minimum, there should be representatives from the Ministry of Mines and Mineral Resources, the EPA and the Ministry of Water Resources at the district level in Sierra Leone. Given capacity constraints in this regard, priority should be given to staffing those districts, such as Port Loko, Tonkolili and Kono, in which numerous mining operations are active.

Government representatives from each Ministry/agency should also receive sufficient training and financial resources to be able to properly assess each mining company’s compliance with its environmental and water-related obligations, particularly with its treatment of mining waste (including overburden, tailings, and AMD) in an independent manner.²⁵⁹

5.4.1. Institutional presence and capacity to supply water

SALWACO is responsible for the provision of water supply and water infrastructure in urban and peri-urban areas outside of Freetown. However, its operation is currently limited to certain provincial capitals and secondary towns and its service is largely unreliable. Mining companies are unlikely to consider relying on SALWACO, let alone a local council in rural areas to partner with, or to obtain or treat their water. Mines require certainty of water supply and cost, neither of which can be guaranteed under the current institutional framework.

5.4.2. Greater community involvement in monitoring water and environmental management plans to also increase awareness of the value of water resources

Greater involvement of communities in the management and monitoring of water resources in terms of both water supply and water quality is a key strategy to ensuring the sustainable management of a country’s water resources – even in a country like Sierra Leone, where there is a perception that water availability is plentiful. As the pilot project

²⁵⁹ For example, without an own method of transportation, government representatives are dependent on mining representatives to drive them around the mining operations, which can lead to awkwardness and inadequate rigor when assessing a mining company’s compliance.

of community monitoring at Bumbuna indicates, there is scope for communities to take on a larger role in monitoring and managing water resources. Such community involvement not only helps communities better understand water cycles in their areas, but it also helps the Ministry of Water Resources gather information on the availability, seasonality and quality of water resources.

5.5. Greater sector coordination is required between Ministries and government agencies dealing with the water and mining sectors

To ensure that mining companies are properly regulated in relation to their environmental obligations and water usage, the Ministry of Mineral Resources needs to collaborate more closely with both the EPA and the Ministry of Water Resources. The results of the EIA and the plans for managing mine waste water set out in the EMP need to be aligned with seasonal water availability in the district in which the mine is located.

6. Findings and Conclusions

There is currently limited scope for leveraging mining-related investments in water in Sierra Leone beyond CSR-type programs to provide treated dewatered water or small-scale water supply and/or treatment technologies. However, the GoSL may wish to start considering the scope for future potential synergies between the mining-related investments in water infrastructure and the water supply needs to nearby towns and communities as opportunities may exist as the institutional and regulatory framework of the water sector is strengthened and mining companies are increasingly required to minimize their water footprint both in terms of the quantity of water and the quality of water they discharge in their mining operations.

Table 9: Summary of options for leveraging mining-related investments in water infrastructure

Option	Description	Challenges	Potential to leverage
Excess supply from dewatered water	A portion of the excess water that collects in the open pits is drained (dewatering), treated and supplied to surrounding communities.	<p>There is currently little incentive for mining companies to minimize their water usage – no regulation requires this as water is perceived to be abundant.</p> <p>There is generally little existing, let alone functioning piped water infrastructure, or water treatment</p>	Moderate-low for mining companies to provide treated dewatered water to surrounding communities because of a lack of regulations requiring mining companies to treat dewatered water, lack of onsite water treatment systems at mine sites and lack of piped

		facilities in the vicinity of the mining operations.	water infrastructure connecting the mines to community water systems.
Mines as a demand anchor for investment in water supply, storage and treatment infrastructure	Mining company provides guaranteed demand for water supply infrastructure in a private financing arrangement, or collaborates with donors, contributing to financing or technical expertise.	<p>There is a limited appetite on the part of the mining company to become a long term service provider of clean water to communities; and</p> <p>There is a limited capacity and/or will of local communities to pay for water provided to them from mines.</p>	Low – Private sector investment in piped water infrastructure in rural areas and for small towns is unlikely given the relatively small populations of towns and communities neighboring mine sites and the GoSL emphasis on small-scale technologies to extend access to water supply rather than piped water infrastructure and cost recovery.

D. Scope for shared use in the context of ICT

1. Background

1.1. Key Facts about the ICT sector in Sierra Leone

Table 10: Key fact about the ICT sector

Policy	Ministry of Information and Communications
Regulator	National Communications Commission (Natcom)
National Operator	Sierratel
Operators	3 operators (Africell, Airtel and Comium)
Access Rate (Mobile Phone)	38% in 2010 ²⁶⁰
Access Rate (Internet)	1.3% in 2012 ²⁶¹

1.2. Mobile Coverage

Fixed line infrastructure was largely destroyed during Sierra Leone’s civil war.²⁶² There are three active licensed mobile operators in Sierra Leone - Airtel, Comium and Africell, along with the national operator Sierratel. The market is liberalized, and is regulated by the National Telecommunications Commission. In terms of access, the African development Bank reports that the total mobile subscriber base had reached 2,254,925 by the end of 2010, a number equivalent to 38% of Sierra Leone’s population.²⁶³ In terms of pricing, liberalization of the sector after the conflict brought in new private sector participants and the introduction of competition led to reduced tariffs.²⁶⁴ The AICD notes, however, that with 12% of households having access to electricity, recharging a mobile handset may present more of a constraint to mobile phone usage than the cost of service.²⁶⁵ Sierratel still has control over the international phone gateway and international callers face very high fixed calling cost. Reforms have reportedly been planned to introduce open access.²⁶⁶

However, mobile networks are still not accessible throughout the country. Figures 8 and 9 show the gaps in mobile coverage of the operators Airtel and Comium. Experts at the National

²⁶⁰ African Development Bank, “Infrastructure and growth in Sierra Leone,” op cit.

²⁶¹ Commonwealth Telecommunications Organisation: Country Page – Sierra Leone, available at: <http://www.cto.int/media/ICT-data/sierra%20leone.pdf>

²⁶² Interview with Natcom, Freetown, July 3, 2013.

²⁶³ “Infrastructure and growth in Sierra Leone,” African Development Bank, 2011.

²⁶⁴ Ibid.

²⁶⁵ “Pushak and Foster, “Sierra Leone’s Infrastructure: A Continental Perspective,” op cit.

²⁶⁶ Sierratel’s monopoly on international gateway set to end, Telegeography, January 2012, available at <http://www.telegeography.com/products/commsupdate/articles/2012/01/11/sierratels-monopoly-on-international-gateway-set-to-end/>.

Telecommunications Commission (Natcom), described the challenges in expanding to rural areas, pointing out that two generators (one for backup) are required, along with 20 gallons of fuel per day to keep a telecoms tower running, and that there is often not a clear business case for operators to construct towers due to insufficient customers in remote areas.²⁶⁷ Natcom started the Universal Access Development Fund last year to increase levels of rural connectivity.²⁶⁸

Figure 8: Airtel Coverage Map



Source: Mobile World Live²⁶⁹

Figure 9: Comium Coverage Map

²⁶⁷ Interview with Natcom, Freetown, July 3, 2013.

²⁶⁸ Audiencescapes, “Connecting Rural Sierra Leone,” available at <http://www.audiencescapes.org/connecting-rural-sierra-leone-internet-natcom-mapaki-cdpeace-bombali-ict-uadf-UN-development-goals-moses-lahai-masapaki-kobombor>

²⁶⁹ Mobile World Live, “Sierra Leone - Coverage and Network Information,” available at http://maps.mobileworldlive.com/network_info.php?nid=313&org_id=4904&cid=81



Source: Mobile World Live²⁷⁰

1.3. Internet

Until late 2012, Sierra Leone did not have a landing station to facilitate access to the Africa Coast-to-Europe (ACE) submarine cable. The main way of connecting to the internet was through satellite telephony which is expensive and beyond the affordable reach of most of the population.

As of 2012, Sierra Leone is now connected to the ACE cable linking it with Europe and has a landing station, acquired through an ECOWAS initiative to bring a new fiber optic landing cable to West Africa, and with funding and technical support from the World Bank.²⁷¹ The GoSL has created a special purpose vehicle, Sierra Leone Cable Ltd (SALCAB), which holds the fiber optic cable equipment and is responsible for facilitating use of the ACE cable by service providers. Regulatory reform is also underway to ensure open access to the ACE cable.²⁷²

While the ACE cable has arrived in Sierra Leone, there is limited infrastructure in place at the moment to distribute the broadband technology. It is possible to more immediately tap into the ACE cable through microwave links from the landing station along telecommunications towers to end users, and internet service providers are developing this capacity. Ultimately, there are plans to lay fiber optic cable in the country to facilitate direct connections. Sierratel, the government telecommunications company is currently facilitating the connection of Freetown to the ACE cable by laying fiber optic cable around the capital city. There are then plans to build a national backbone to supply broadband into the interior.²⁷³

However, while the fiber optic cable might contribute to lowering the cost of internet, high electricity costs have the opposite effect, since network equipment relies on electricity to operate, and companies need to spend a large amount of money to fuelling their masts and internet

²⁷⁰Mobile World Live, “Sierra Leone - Coverage and Network Information,” op cit.

²⁷¹ Interview with Sierra Leone Cable Ltd, Freetown, July 4, 2013.

²⁷² Ibid.

²⁷³ Ibid.

equipment. This then translates into high fees for internet service.²⁷⁴ As a result, internet penetration remains very low, estimated at 1.3% in 2012.²⁷⁵ It is reported in 2011 there were 18 major licensed Internet Service Providers and 64 licensed VSAT operators.²⁷⁶

2. Leveraging mines to extend the national ICT infrastructure

ICT is employed in all phases of a mine's life, increasing efficiency and generating cost savings for the mining company. These benefits can be realized, for example, through better logistics allowing virtual operations, grade optimization and improved exploration analyses. Instantaneous access to video, voice and data communications provides the mining company with the ability to use materials and human resources more efficiently. As a result, delays are reduced and logistical coordination is strengthened. ICT can also help to mitigate security risks and improve the safety of their employees.²⁷⁷

The mining sites in Sierra Leone are dispersed throughout the country suggesting that experience of ICT infrastructure may vary. However, the large-scale iron ore mines of African Minerals in Tonkolili district and London Mining in Port Loko district are located along a populated corridor, near to towns such as Makeni and Lunsar. Figure 10, which shows Airtel's coverage around the Tonkolili-Marampa-Pepel corridor, suggests that there is mobile coverage in this area, from Makeni up to the port in Pepel. However, the reliability of this coverage would also be a significant factor in its usefulness to the mines – London Mining stated that they did not perceive communications from in-country mobile providers to be reliable.²⁷⁸ Some mining companies in Sierra Leone use VHF (very high frequency) bandwidth for reliable, 'walkie-talkie' type internal on-site radio communication.²⁷⁹

Figure 10: Airtel Coverage of Tonkolili-Marampa-Pepel corridor

²⁷⁴ Based on in-country interviews, June -July 2013.

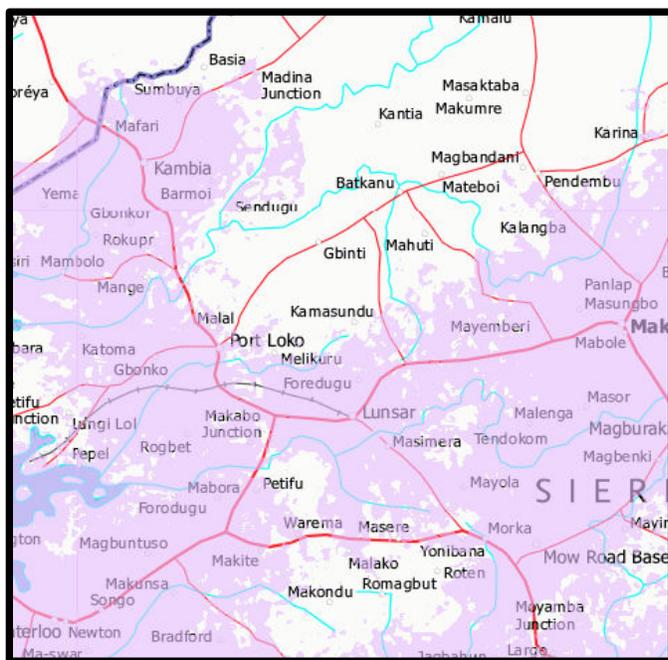
²⁷⁵ Commonwealth Telecommunications Organisation: "Country Page – Sierra Leone," available at: <http://www.cto.int/media/ICT-data/sierra%20leone.pdf>

²⁷⁶ Ibid.

²⁷⁷ Perrine Toledano and Clara Roorda, "Leveraging mining demand and investment in ICT for broader needs." Columbia Center on Sustainable Investment, Columbia University (June 2014) available at: <http://ccsi.columbia.edu/files/2014/05/CCI-Policy-Paper-Leveraging-Mining-Related-ICT-Infrastructure-for-Development-June-20141.pdf>

²⁷⁸ E-mail exchange with London Mining, September 24, 2013.

²⁷⁹ Interview with Natcom, Freetown, July 3, 2013



Source: Mobile World Live²⁸⁰

While companies might use national mobile telephone infrastructure, they are also covered by satellite link through their own private VSAT for internet connection.²⁸¹ VSAT presents the most reliable method of connecting to the internet and companies often use satellite phones for communication if mobile coverage is unreliable or patchy in the more remote areas in which they operate.

London Mining stated that with the advent of the fiber optic cable, it has recently transitioned from satellite to a fiber link out of Freetown, which is likely to involve the use of microwave transmission of the fiber link from Freetown to Lunsar.²⁸² SALCAB stated that African Minerals have also requested a microwave link to the Freetown fiber optic cable. The relatively short distance of the mine site from the capital and the good coverage of this area with sufficient tower infrastructure would make this link possible.

The notion of ICT infrastructure provision by the mines to surrounding areas may not be appropriate in Sierra Leone, because where companies make their own ICT arrangements, they typically use private satellite infrastructure rather than investing in a capital intensive mobile phone or fiber optic network which could be extended to other users. In any case, in the context of ICT, due to the complexities of service provision, it is unrealistic to expect mines to provide both the ICT infrastructure and associated network services as part of a voluntary CSR initiative. While a mining company may fund the capital cost of a satellite antenna for nearby communities,

²⁸⁰Sierra Leone - Coverage and Network Information, Mobile World Live, available at http://maps.mobileworldlive.com/network_info.php?nid=313&org_id=4904&cid=81

²⁸¹ E-mail exchange with London Mining, September 24, 2013; Interview with Sierra Rutile, Sierra Leone, June 26, 2013.

²⁸² Ibid.

for example, it would remain necessary for the telecom providers to provide telecommunication services to the communities.

However, as this section explains, there are ways in which the mines' own infrastructure as well as its demand for ICT services can play a role in increasing access to ICT service in surrounding areas.

2.1. Mines provide anchor demand

Given the distance of the operational mining operations from Freetown where the ICT infrastructure is concentrated, and their location in relatively sparsely populated areas, the costs of extending the required ICT infrastructure to the mines may be substantial and difficult to justify when demand is not significant.²⁸³ However, mining companies such as Sierra Rutile and Sierra Minerals (Vimetco), or London Mining/ Cape Lambert/ African Minerals could potentially constitute an anchor demand for telecommunications services. This is especially so in relation to the Tonkolili-Marampa-Pepel corridor with respect to the provision of fiber links to users along the corridor.

To facilitate such an arrangement, an appropriate offtake agreement must be negotiated between the mining company and the telecommunications company, stating the ownership, responsibilities and obligations of each party under the agreement, the level and timeframe of guaranteed mining demand as well as provisions regarding priority access to the ICT services by the mines. When a guaranteed demand is not enough to make the extension of ICT infrastructure economically feasible, the mining company and the telecommunications company could share the initial capital costs of the arrangement, with the costs split, for example, according to relative magnitudes of the potential additional market for the telecom company in the region and the scope of the services being provided to the mining company.²⁸⁴

If the demand provided by the mines is not sufficient to generate a commercially viable deal, the government could also take measures to create a sufficient demand anchor: providing subsidies to subscribers or coordinating for broadband access for public administration, public safety, local schools, and health care facilities.²⁸⁵

2.2. Telecommunications capacity integrated in the construction of mine service corridor

Since most of the costs of building a fiber optic cable network are related to civil works, joint infrastructure building can result in significant savings for the telecommunications companies by distributing the burden of these costs among infrastructure service providers (power utilities, rail operators, pipeline operators).²⁸⁶ As mentioned, in remote areas where most mining companies are located, it is generally not commercially viable for telecommunication companies to invest in ICT infrastructure, given the high costs of installation and low demand.

²⁸³ Toledano, Thomashausen, Shah, and Maennling, "A Framework to Approach Shared Use of Mining-Related Infrastructure," *op cit*.

²⁸⁴ *Ibid*.

²⁸⁵ *Ibid*.

²⁸⁶ *Ibid*.

There is an existing mining rail route in Sierra Leone between Tonkolili and Pepel used by African Minerals for the transportation of iron ore from their mine in Tonkolili to the port at Pepel.²⁸⁷ Subsequent phases of which will require the upgrade of this rail route.²⁸⁸ There are also possible plans for a new rail route between Tonkolili and Sulima in the South of the country²⁸⁹ and this is likely to require a significant amount of excavation. Since civil works is a major cost when laying the cable, capitalizing on the work that will take place to build the railway by laying fiber optic cable at the same time would allow Sierratel to extend the reach of the network without incurring substantial additional costs. Laying cable underground also provides a more protected route for the cable than hanging the cable overhead alongside power distribution lines. When interviewed, SALCAB recognized these potential synergies, stating that a framework could even be developed where mines could even be compensated, or the costs of the civil works shared.²⁹⁰ Such collaboration may be in the medium term, once the initial phases of laying the fiber optic cable have been completed.

The cost savings resulting from such economies of scope²⁹¹ could be significant enough to make telecommunication services economically viable while bringing fast and efficient telecommunication technology to the mines.

Shared Infrastructure Access – Regulation

The development of a shared infrastructure access regulatory framework would be an essential precursor to facilitate shared infrastructure synergies.

A number of principles might be considered by Natcom:

- Section 9A(f) of the Telecommunications (Amendment) Act 2009 requires Natcom to assist when sharing of ducts, masts and other installations is necessary.²⁹² However, Natcom could increase incentives for additional investment in existing backbone networks by making such resource and rights-of-way of those infrastructures more readily available, especially in public property, limiting the fees charged and simplifying the legal process involved.²⁹³
- It is even possible for regulators to instate formal rights which allow carriers the right to access passive infrastructure that are owned by a non-carrier, i.e. players such as public utility companies that provide passive network elements, but which do not compete for

²⁸⁷ African Minerals website, available at: <http://www.african-minerals.com/operations/operations>

²⁸⁸ African Minerals Corporate Presentation, presented at the Sierra Leone Mining Indaba, July 2013.

²⁸⁹ “Sierra Leone economy: Quick View - Investments worth US\$8bn announced following China visit,” *Economist Intelligence Unit*, July 2013, available at: <https://globalconnections.hsbc.com/global/en/articles/sierra-leone-economy-quick-view-investments-worth-us8bn-announced-following-china-visit>.

²⁹⁰ Interview with Sierra Leone Cable Ltd, Freetown, July 4, 2013.

²⁹¹ Economies of scope exist when a range of products can be produced or services provided together at a cheaper price than each product is produced or service is provided on its own.

²⁹² Sierra Leone Telecommunications (Amendment) Act 2009, available at <http://www.sierralii.org/sl/legislation/act/2009/8>.

²⁹³ Toldeano, Roorda, “Leveraging mining demand and investment in ICT for broader needs,” op.cit.

end users.²⁹⁴ In this sense, if a mining company or the owner of the mining railroad is not a licensed carrier, then a carrier may use their infrastructure to add optical fiber at a lower cost. This might make the realization of synergies between the mining companies and service providers more straightforward. Section 60(2) of the Telecoms Act requires any local authority as well as the Sierra Leone Road Authority to allow any telecoms to be laid under, over, across or along any property owned by them.²⁹⁵ This principle should be extended to include a range of infrastructure types and infrastructure owners to expand the scope of such sharing arrangements.

It is important to note that, while some developing countries have enacted laws that address cross-sector infrastructure sharing, generally neither the telecom operator nor the telecom regulator has actual legal authority to force the infrastructure owner to allow shared use. Such laws have limited effect, and therefore the enforceability of shared use arrangements as well as dispute resolution mechanisms should also be considered carefully.²⁹⁶

- A dedicated institution for infrastructure sharing could facilitate the coordination of civil works among telecommunications companies as well as between telecommunications companies and utilities and mining companies.²⁹⁷ With Sierra Leone currently seeing the development of the mining railroads as well as planning to lay fiber optic cable around the country, the government could play a valuable role in coordinating possible sharing of civil works necessary to build both types of infrastructure.
- With the possibilities for cross-border mining transport routes and regional power lines, cross-border infrastructure sharing in the ICT context could also be an imminent reality. In order to prepare for this, regulators might work together to ensure an appropriate level of regional harmonization. In this situation, regional organizations such as the West African Power Pool will have an important role to ensure that best practice regulatory policies on sharing are observed across the region, since a national regulator alone would not be able to resolve significant cross-border issues.²⁹⁸

3. Findings and Conclusions

If sound regulations and efficient coordination mechanisms are put in place in Sierra Leone, synergies between the ICT and the mining sectors could be realized. The main synergy identified in this case study is that of economies of scope between railroad construction and the laying of the fiber optic cable. This will require cooperation between the mines and telecoms companies as

²⁹⁴ International Telecommunication Union, “Global Symposium for Regulators GSR 2008: Best Practice Guideline on Infrastructure Sharing,” available at “<http://www.ictregulationtoolkit.org/en/toolkit/docs/Document/3463>” (2008).

²⁹⁵ Sierra Leone Telecommunications Act 2006, available at <http://www.sierra-leone.org/Laws/2006-9s.pdf>.

²⁹⁶ Toledano, Thomashausen, Shah, and Maennling, “A Framework to Approach Shared Use of Mining-Related Infrastructure,” *op cit*.

²⁹⁷ Adapted from: International Telecommunication Union “Global Symposium for Regulators GSR 2008: Best Practice Guideline on Infrastructure Sharing,” *op cit*.

²⁹⁸ *Ibid*.

well as the development of an appropriate and enforceable legal and regulatory framework to enable shared access to infrastructure.

The potential options for ICT-mine synergies in Sierra Leone, along with their associated challenges are summarized in the table below.

Option	Description	Challenges
Construction/ utility company builds required infrastructure to serve mines (e.g.: railways) and adds telecommunication capacity	Synergies with mining railroad infrastructure investment when extending optical fiber network.	Insufficient current regulatory framework to mandate shared infrastructure use .
Mines as a demand anchor for telecommunications companies	Mining company provides guaranteed demand for telecommunications company, making investment in remote, otherwise unconnected area economically viable.	Coordination between mining and telecommunications companies.

Summary and Conclusions

The lack of reliably functioning infrastructure in Sierra Leone is recognized as one of the major obstacles to its development efforts.²⁹⁹ While rehabilitating, constructing, expanding access to-, and maintaining all types of infrastructure are vitally important for economic growth and human development, the GoSL has, in particular, prioritized the power and transport (roads, airport and ports) sectors.

In the power sector, there is considerable scope to leverage mining demand to improve and expand power generation and transmission capacity, particularly in relation to hydropower. In the medium-to-long term, sustained mining demand for cheap power could also be leveraged to construct reservoir capacity, which would allow hydropower plants such as Bumbuna to provide a year-round source of reliable energy.

In the transport sector, there may be some potential benefits from shared use arrangements with respect to ports and, to a lesser extent, rail infrastructure. However, investments in road infrastructure are more likely to benefit agricultural producers, businesses and passengers than rail infrastructure, where other mining companies are the most likely benefactors of shared-use arrangements.

There is currently less scope for synergies between mining-related investments in water infrastructure and the water supply and sanitation requirements of surrounding populations. As a priority, mining companies should be required to minimize their water footprints and especially their impact on the surrounding eco-system so that their operations do not monopolize or contaminate existing water resources. In addition to the provision of water through CSR-type arrangements, there may also be scope for providing treated dewatered water to surrounding communities for an affordable water tariff.

Finally, in respect of ICT infrastructure, the main synergy has been identified as the potential economies of scope between railroad construction and the laying of the fiber optic cables.

²⁹⁹ Strategy & Policy Unit, “Interim Report of the Energy Working Group,” *op cit.*, p. 9.