



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: Liberia

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Abbreviations and acronyms

ACE	African coast to Europe submarine communications cable
AICD	Africa Infrastructure Country Diagnostic
AMD	Acid Mine Drainage
BMC	Bong Mines Community
BOC	Bureau of Concessions
Btu	British thermal unit
CCL	Cable Consortium of Liberia
CLSG	The WAPP segment covering Cote d’Ivoire, Liberia, Sierra Leone, and Guinea
CCSI	Columbia Center on Sustainable Investment
CLTS	Community-led Total Sanitation
EIA	Environmental Impact Assessment
HFO	Heavy fuel oil
GoL	Government of Liberia
IPP	Independent Power Producer
JSPL	Jindal Steel & Power
kWh	Kilowatt hour
LAMCO	Liberian-American-Swedish Minerals Company , the now defunct Liberian corporation that mined for iron ore in the Nimba range where ArcelorMittal now has its iron ore operations.
LTA	Liberia Telecommunications Authority
MDA	Mineral Development Agreement/ Mining concession
mtpa	Millions of tons per annum
MoPEA	Ministry of Planning and Economic Affairs
MW	Megawatt
NIOC	National Iron Ore Company
NBC	National Bureau of Concessions
NIC	National Investment Commission
NPA	National Port Authority
PPP	Public-Private Partnership

TPP	Thermal Power Plant
VSAT	Very Small Aperture Terminal
WAPP	West African Power Pool
WASH	Water Supply, Sanitation and Hygiene
WARCIP	West African Regional Communications Infrastructure Program

Introduction

1. Overview of Liberia

Table 1: Key Facts

Capital City	Monrovia
Main administrative divisions	Liberia is divided into 15 counties, which are further subdivided into districts and clans. Nimba is the largest county geographically, whereas Montserrado, in which Monrovia is located, is the smallest.
Population	4,190,435. ¹ While it is estimated that about half of Liberia’s population lives in Montserrado County, the urban and rural areas in the rest of the country remain relatively sparsely populated ²
GDP	US\$1,733,823,553 (2012)
GDP growth	10% (2012)
GDP per capita	US\$414 ³

Liberia emerged from a brutal 14-year civil war in 2003 with most of its infrastructure either decimated, or in a state of utter disrepair. The country’s entire power generation capacity was destroyed during the war, the Freeport of Monrovia was unusable and blocked by sunken vessels and the transportation network of roads and railway lines was in a ruinous state.⁴

Since the signing of the peace accords in 2003, great strides have been made by the Government of Liberia (GoL) to rehabilitate defunct infrastructure and channel investment into new infrastructure as a means to facilitate economic growth. An emergency power plan was implemented in Monrovia within 18 months of the incumbent President Johnson Sirleaf first taking office as President, the Freeport of Monrovia has been privatized and restored to its original capacity, the mobile phone network was liberalized and African coast to Europe (ACE) submarine communications cable brought to Liberia, and extensive road networks have been rehabilitated, as has the Yekepa to Buchanan railway line operated by ArcelorMittal. However, Liberia still faces huge challenges in meeting the increasing needs for infrastructure from its population and foreign investors alike. As is shown in Section B, the power generation capacity is still severely limited, while the LEC tariff is one of the highest in Sub-Saharan Africa. Port capacity is also insufficient to meet increasing demands and requires further investment for expansion. ICT coverage is still limited with much room

¹ World Bank (2012).

² The second largest town after Monrovia is Ganta in Nimba county, which had an estimated population of 41,106 inhabitants in 2008: Source: 2008 National Population and Housing Census, GoL, available at: http://www.emansion.gov.lr/doc/census_2008provisionalresults.pdf.

³ World Bank (2012).

⁴ Zachary A. Kaplan, Peter Kyle, Chris Shugart, and Alan Moody, “Developing Public-Private Partnerships in Liberia,” PPIAF, 2012.

for improvement and expansion throughout the country. Finally, access to an improved water source for most of the Liberian population is still dismally low.

To meet the infrastructure challenges in the country, the World Bank's Africa Infrastructure Country Diagnostic (AICD) estimates that Liberia should be spending between US\$350 and US\$600 million per year to meet its infrastructure goals depending on the technologies and implementation methods chosen.⁵ In the mid-2000s, an annual estimated amount of US\$90 million was being spent on infrastructure in Liberia, most of which (80%) was being channeled into new infrastructure investments, largely in the power and transport sectors. This leaves a funding gap of between US\$250 and US\$500 million each year.

To boost investment in its economy, the GoL has been granting natural resource concessions in mining, petroleum, forestry, and agriculture, and is also promoting public-private partnerships (PPPs) in the infrastructure sector as a means of meeting its infrastructure objectives.⁶ Given the huge infrastructure requirements of iron ore mining operations, mining investments into power and transport infrastructure have been estimated to be as much as US\$5 billion in the coming years,⁷ which eclipses the annual GoL spend on infrastructure.⁸ The World Bank further estimates that by 2030, mines could easily represent more than 80% of national power demand, 90% of national demand for port capacity, and close to 100% of national demand for rail freight.⁹

This study assesses the scope for aligning mining companies' investments in infrastructure with the national infrastructure needs of Liberia to see how, and to what extent such investments can best be leveraged for national development. The study focuses primarily on iron ore mining, given that iron ore mines are generally large enough to necessitate the development of vertically integrated infrastructure to meet the mines' pit-to-port logistics and infrastructure needs. It should, however, be noted that there may additionally be scope for leveraging the investments in power, water and ICT infrastructure of medium-scale gold mining operations (Hummingbird Resources, Amlib, Aureus) in Liberia.

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

Mining plays a significant role in the Liberian economy, accounting for a significant portion of the GDP¹⁰ and averaging 68% of foreign exchange earnings.¹¹ The major minerals found in Liberia include iron ore, bauxite, gold and diamonds. Before the civil war, the mining sector contributed to 25% of Liberia's exports, and from 1970 to 1980 Liberia was ranked as the world's 5th largest exporter of iron ore.¹² However, large-scale mining operations altogether ceased in the late 1980s during the civil war, and it is only since 2006 that the GoL

⁵ Vivien Foster and Nataliya Pushak, "Liberia's Infrastructure: A Continental Perspective," Africa Infrastructure Country Diagnostic (AICD), (2010).

⁶ Ibid.

⁷ World Bank, "Infrastructure Policy Notes: Leveraging investments by natural resource concessionaires" (June 2011).

⁸ Foster, V and Pushak, N., "Liberia's Infrastructure: A Continental Perspective," AICD, op cit.

⁹ World Bank, "Infrastructure Policy Notes: Leveraging investments by natural resource concessionaires" (June 2011).

¹⁰ ArcelorMittal's operations alone accounted for 35% of exports in 2012: Government of Liberia, "Budget Framework Paper: FY 2013/14," available at: mof.gov.lr/doc/Budget%20Framework%20Paper%20FY13%20-14.pdf.

¹¹ Liberia Page of African Mining website, available at: http://www.africanmining.com/country_info.php?id=25.

¹² Ibid.

began an extensive program to grant mining concessions to foreign investors to stimulate economic growth.¹³ In 2012, iron ore exports from ArcelorMittal’s operations accounted for 35% of all exports.

There are currently 8 mining concessions that have been signed in Liberia, 5 of which are iron ore concessions. The concessions are set out in Table 2 below.

Table 2: Mining concessionaires in Liberia

Concessionaire	Commodity	Location of Mine	Status
Amlib United Mineral Inc. (Rivercress)	Gold and diamonds	Grand Gedeh and Montserrado	Exploration ¹⁴
Aureus Mining, Inc.	Gold	Liberty Project, Bea Mountain	First gold production expected in 2015. ¹⁵
ArcelorMittal	Iron ore	Mt. Tokadeh, Mt. Gangra and Mt. Yuelliton ranges, Northern Nimba	Commenced production in 2011.
BHP Billiton	Iron ore	Kitoma, Goe Fantro, St John River, Toto Range	MDA signed on September 16, 2010.
China Union China-Union (Hong Kong) Mining Co., Ltd. and China-Union Investment (Liberia) Bong Mines Co., Ltd.	Iron ore	Bong Range deposits	MDA signed on January 19, 2009.
Hummingbird Resources	Gold	Dugbe and Tuzon deposits, Eastern Liberia	First gold production expected in 2016 ¹⁶
Putu Iron Ore Mining	Iron ore	Putu deposit, South-East Liberia	Production scheduled to commence in 2017. ¹⁷
Western Cluster ltd	Iron ore	Western cluster (Bomi Hills, Bea	Shipping of the ore from Liberia is

¹³ Kaplan, Shugart, and Moody, “Developing Public-Private Partnerships in Liberia,” PPIAF, op cit.

¹⁴ Amlib website: <http://amlibgroup.com/pages/projects.php>.

¹⁵ Giles Gwinnet, “Proactive news summary including Aureus Mining, Paragon Diamonds, ANGLE and Iofina,” *Proactive Investors*, December 17, 2013, available at:

http://www.proactiveinvestors.co.uk/companies/market_reports/64260/end-of-day-news-wrap.

¹⁶ Hummingbird Resources website, available at: <http://www.hummingbirdresources.co.uk/>.

¹⁷ “Liberia advocate commends Putu mining,” *AllAfrica*, December 16, 2013, available at: <http://allafrica.com/stories/201312160952.html>.

		Mountain and Mano River deposits)	planned on the first quarter of 2014 ¹⁸
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The ArcelorMittal mine in Yekepa is the most advanced operation in Liberia, and the only company producing and exporting iron ore at present. ArcelorMittal acquired the mining rights for the deposits in Gangra, Tokadeh and Yuelliton in Nimba County, which had once been held by the Liberian American-Swedish Minerals Company (LAMCO). These included rights to rehabilitate and use, but not own, the rail and port assets constructed by LAMCO.

The GoL has a 30 percent equity stake in the project, allocated to it reflect the railroad and Buchanan port assets, valued at \$35,000, that ArcelorMittal has been granted the right to operate. The MDA gives the GoL board representation equivalent to its share in the project. There is the possibility that as the project goes on and additional capital is required, the GoL's equity stake may get diluted. However, the MDA states that the GoL ownership shall never fall below 15%.¹⁹

3. Institutional and legal Framework for mining and infrastructure development

3.1. Institutions

Mining

All natural resource concession agreements, including mining concessions, are negotiated by the Inter-Ministerial Concessions Committee (IMCC), which is composed of the National Investment Commission (chair), Ministers of Justice, Finance, Labor, Planning and Economic Affairs, Internal Affairs and the Minister of Lands Mines and Energy (for a mining project), and possibly with two additional ministers appointed by the President.²⁰ The Ministry of Lands, Mines and Energy (MLME) is responsible for the administration of the mining sector and formulation of mining policy more generally.

Public-private partnerships for the development of infrastructure

There is, at present, no dedicated governmental PPP unit or other single institution with the capacity and expertise to develop, coordinate, negotiate, and monitor private investments in public infrastructure or service provision in Liberia.²¹ The government institution (ministry, district, province or public agency) opting to pursue a PPP is responsible for identifying projects in its particular sector and following the required procurement guidelines, adherence to which is overseen by the Public Procurement and Concessions Commission (PPCC). In turn, the National Investment Commission (NIC) is charged with the promotion of PPPs to investors and the overall administration of the PPP procurement process.²² Like with mining concessions, the IMCC is then responsible for the review and negotiation of PPP concessions, while the National Bureau of Concessions is mandated to monitor and evaluate the compliance with concession agreements, including all PPPs, once they have been approved by parliament.

¹⁸ Elenilto website, available at: <http://www.elenilto.com/press/elenilto-trippled-its-iron-ore-resource-in-liberia-to-3-billion-tonnes/>.

¹⁹ Article XVI (Capital and Corporate Structure of the Concessionaire), Unofficial Restated ArcelorMittal Mineral Development Agreement as Amended with Appendices dated December 28, 2006.

²⁰ Kaplan, Shugart and Moody, "Developing Public-Private Partnerships in Liberia," PPIAF, op cit.

²¹ Ibid.

²² National Investment Commission, "Draft Public-Private Partnership PPP Guidelines," (2012).

3.2. Legislation

The mineral sector is regulated by the Mining and Minerals Law of 2000, which sets out the framework governing large-scale mining operations in Liberia.²³ The Minerals and Mining Law also sets the basis for third party access to infrastructure:

Box 1: Minerals and Mining Law 2000

Section 12.1 Use of Infrastructure: Communication lines and other infrastructure installed or developed by the Holder of Mineral Rights within the area subject of the Mineral Rights may be used by Government or third parties, provided however that fair compensation shall be paid and that such use does not interfere with or hinder the Holders Operations

Source: Minerals and Mine Law, Republic of Liberia 2000

More detailed provisions regarding infrastructure arrangements are negotiated in the mineral development agreements between mining concessionaires and the GoL.

There is no dedicated PPP law. Instead, PPPs are governed primarily by the Public Procurement and Concessions Act 2010. Draft PPP guidelines prepared by the NIC include the consideration that the GoL should seek to leverage the investments of natural resource concessionaires to develop public infrastructure by taking advantage of economies of scale to lower the incremental costs of additional services, or to develop additional infrastructure.²⁴

²³ It is noted that the Minerals and Mining Law is currently being redrafted.

²⁴ Ibid.

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

1. Background

1.1. Existing rail and port infrastructure

There are currently five concessionaires operating in Liberia with mineral development agreements (MDA) which grant them rights to either rehabilitate existing rail and port infrastructure, or construct new railroads to transport their minerals to an existing or new port. The mining rights of these concessionaires are over iron ore deposits, which are geographically dispersed across the country.

Before the war, Liberia had three private mineral railways operated by Bong Mines Company (BMC), Liberian American-Swedish Minerals Company (LAMCO), and National Iron Ore Company (NIOC). The associated port facilities were the NIOC and BMC Piers in Monrovia port, and the Buchanan iron ore port built by LAMCO. The rail links were closed down during the civil war – in many instances rails were removed and after the civil war very little of the original infrastructure remained. Similarly, port infrastructure needed extensive renovation to be utilized again. Three concessionaires have assumed the obligation to rehabilitate these railway lines and ports, and greenfield infrastructure is also planned by two companies. Table 3 below summarizes the plans for rehabilitation or construction of mining infrastructure in Liberia.

Table 3: Iron Ore Concessions and Associated Rail and Port ²⁵

Concessionaire	Location of Mine	Rail route	Port
ArcelorMittal	Mt. Tokadeh, Mt. Gangra and Mt. Yuelliton ranges, northern Nimba	Rehabilitation of LAMCO rail line from Yekepa to Buchanan	Buchanan iron ore port
China Union	Bong Range deposits	Rehabilitation old railroad from Non-Goma mines to Monrovia with rights to extend to Goma Mines	BMC Pier in the Freeport of Monrovia
Western Cluster	Bomi Hills, Bea Mountain and Mano River deposits	Rehabilitation of Monrovia–Tubmanburg–Mano River rail route. ^{26,27}	NIOC and LMC Iron Ore piers at Freeport of Monrovia
Putu Iron Ore Mining	Putu deposit, South-East Liberia	Right to construct new railroad	Port to be constructed in the vicinity of King Williams Town or of Greenville
BHP Billiton	Kitoma, Goe Fantro, St John River, Toto Range	Right to construct new railroad if capacity cannot be secured on existing infrastructure.	Buchanan Port or greenfield facilities adjacent or in close proximity to the railroad and Buchanan port

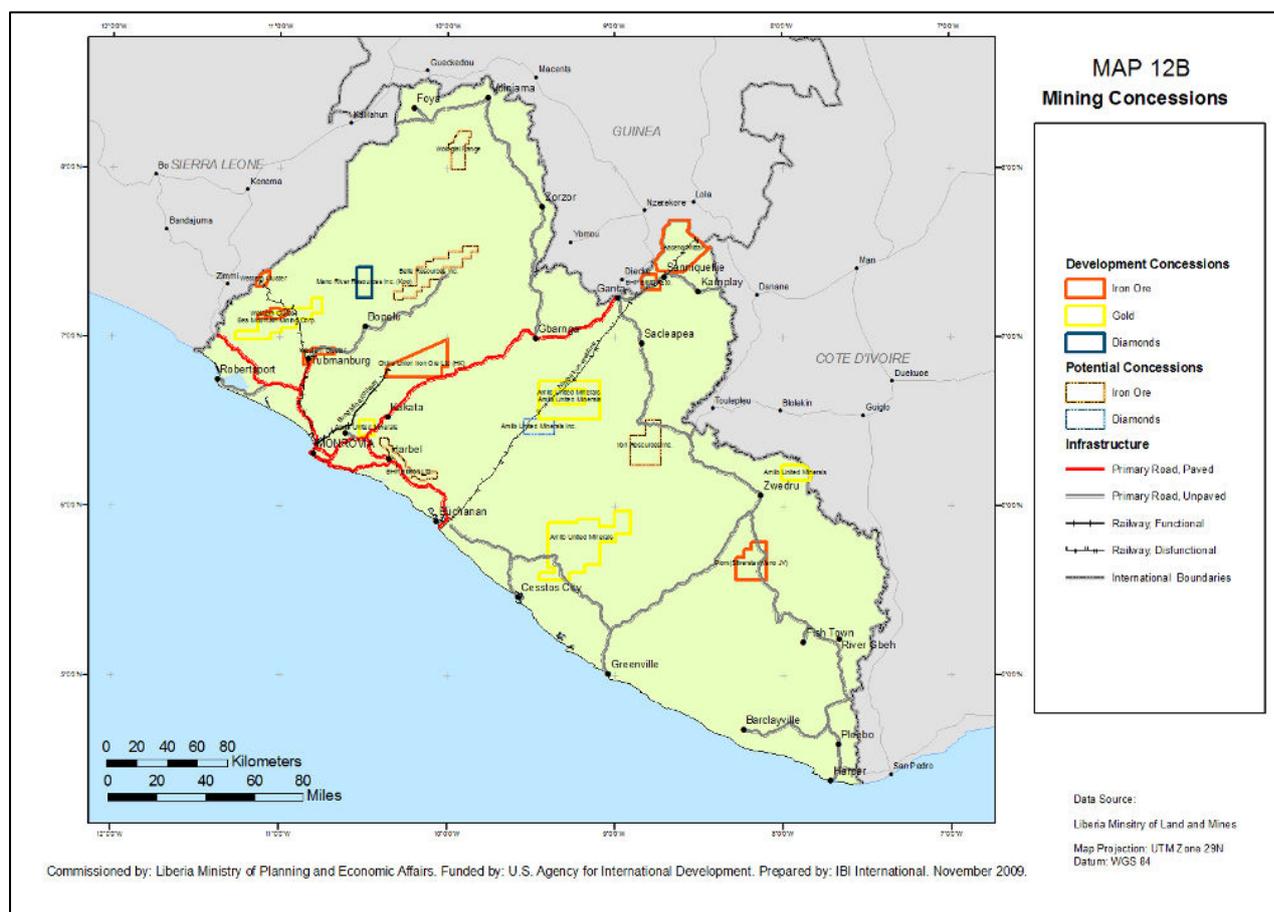
²⁵ Mineral development agreements between the GoL and mining concessionaires; interview with National Ports Authority of Liberia in July 2013.

²⁶ Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” (2010).

²⁷ Road transportation permitted for 3 years from approval of Feasibility Study.

Figure 1 shows the location of the deposits for each concessionaire along with the existing rail routes and port sites.

Figure 1: Map of Rail-Port Corridors



Source: Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study, Ministry of Planning and Economic Affairs, Republic of Liberia, 2010

There is no dedicated rail focused government institution at present in Liberia. The Ministry of Transport and Ministry of Public Works deal exclusively with road transportation infrastructure. In relation to ports, the state-owned National Port Authority (NPA) was created in 1967 to manage, plan, and build all public ports in Liberia.²⁸

2. Third party access

Table 4 sets out the contractual provisions for third party access to infrastructure specified in each of the MDAs. Although limited detail is given, these provisions leave the door open for future negotiations and third party access to the infrastructure developed by the concessionaire.

Indeed, the Government of Liberia is keen to explore options for third party access rail and port infrastructure built by mining companies. The issue has been raised for the existing

²⁸ National Port Authority of Liberia, Annual Report 2012

railroad from Yekepa to Buchanan with a number of third parties interested in using the railroad.²⁹ In 2010, the Ministry of Planning and Economic Affairs (MoPEA) published a study on development corridors explaining that “*The development corridor strategy will allow growth to accelerate by crowding in investment, creating synergies among diverse activities along growth axes where users can share road, rail, port, power, telecommunications and water infrastructure.*”³⁰

²⁹ Interview with National Investment Commission, Monrovia, July 19 2013.

³⁰ Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” (2010).

Table 4: Detailed provisions of concession contracts for railroad infrastructure

	Rail		Port	
Concessionaire	Third Party Access	Details	Third Party Access	Details
ArcelorMittal	Required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations	<p>Commercial and technical terms to be mutually agreed between the parties</p> <p>Revenue from third party use to be shared between GoL and ArcelorMittal</p> <p>Provision for mutually agreed expansion of Iron Ore Rail Road</p>	Required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations	<p>Commercial and technical terms to be mutually agreed between the parties</p> <p>Revenue from third party use to be shared between GoL and ArcelorMittal</p> <p>Provision for mutually agreed expansion of Iron Ore Port</p>

<p>China Union</p>	<p>Required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations, and at no cost to China Union</p>	<p>Commercial and technical terms to be mutually agreed between the parties</p> <p>Revenue from third party use to be shared between GoL and China Union</p>	<p>Required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations, and at no cost to China Union</p>	<p>Commercial and technical terms to be mutually agreed between the parties</p> <p>Revenue from third party use to be shared between GoL and China Union</p>
<p>Western Cluster</p>	<p>Required for bulk cargo. Railroad to be designed so that it can be expanded on a commercially-feasible basis to carry twice as much traffic as needed by operations on a continuing basis.</p>	<p>Commercially reasonable rates for such usage to be agreed between parties</p> <p>Cost of additional rolling stock and locomotives to be borne by Government or third party.</p> <p>If adverse effect on iron ore transportation expected, cost of the additional investment to avoid such adverse effect to be funded by Government or third party.</p>	<p>Required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations</p>	<p>Commercial and technical terms to be mutually agreed between the parties in accordance with acceptable international industrial standards.</p> <p>Formula to share the revenue fees from third-party agreed between Government and the Company.</p> <p>Third party access and use shall be at no cost to the Company.</p>

<p>Putu</p>	<p>Required for bulk cargo. Railroad to be designed so that it can be expanded on a commercially feasible basis to carry twice as much cargo as needed by operations.</p>	<p>Commercially reasonable rates for such usage to be agreed between parties Cost of additional rolling stock and locomotives to be borne by Government or third party. If adverse effect on iron ore transportation expected, cost of the additional investment to avoid such adverse effect to be funded by Government or third party.</p>	<p>Company shall provide general Port operations services to third parties with respect to up to 1 million metric tons of traffic per year. Land side of the port shall be designed to facilitate future expansion and public or third party access to general petroleum product and general cargo storage and handling facilities.</p>	<p>Any charges for handling of third party products through Company facilities shall be reasonable and shall reflect marginal costs of such handling; the Company shall not charge the full facility average cost. Any such third party products shall be handled on a non-discriminatory basis. Design of port to allow for expansion to double the initial capacity, including additional 50 m on the Iron Ore jetty and the driving of iron ore jetty piles at least 5 m deeper. Port shall be designed to facilitate further large scale development consistent with any expansion of the railroad</p>
<p>BHP Billiton</p>	<p>Government shall use its best endeavors to provide the Company rail capacity from existing infrastructure</p>	<p>Company shall, at its sole discretion continue to operate and manage the Infrastructure,</p>	<p>Government shall use its best endeavors to provide the Company capacity from existing infrastructure</p>	<p>Company shall, at its sole discretion continue to operate and manage the Infrastructure, Company shall be entitled to a</p>

	<p>If this is not possible, right to build new rail.</p> <p>Third party access required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations, and at no cost to company</p>	<p>Company shall be entitled to a commercially reasonable rate of return</p>	<p>If this is not possible, right to build new infrastructure.</p> <p>Third party access required, provided that the company confirms that excess capacity exists and third party use of such excess capacity does not interfere with operations, and at no cost to company</p>	<p>commercially reasonable rate of return</p>
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Source: Compiled using mineral development agreements of each Concessionaire

3. Rail-port infrastructure corridors

This section considers each iron ore mining concession and the associated infrastructure arrangements in more detail, analyzing the scope for both multi-user and multi-purpose access to this infrastructure in these corridors. Given that BHP Billiton's activities in Liberia are still at preliminary stages and it does not have any concrete plans to build greenfield infrastructure, this possibility is not analyzed here.

3.1. Corridor 1: ArcelorMittal: Yekepa-Buchanan

3.1.1. Background

Railway line

As part of its MDA, ArcelorMittal was required to complete the full rehabilitation of the Yekepa to Buchanan railroad, a 250km single track rail, within three years of commencement.³¹ The Brazilian construction company Odebrecht was contracted to rehabilitate the old railroad, adding new sleepers as well as additional sidings to multiple trains to run on the track. ArcelorMittal made its first transfer of ore along the rail and shipment out of Buchanan port in September 2011.³²

The ArcelorMittal operations will take place in phases:³³

Phase 1: Production of 4mtpa (completed in 2011-12)

- Mining of Direct Shipping Ore from Tokadeh and Gangra
- Rehabilitation of 250km rail link from Yekepa to Buchanan
- Rehabilitation of port at Buchanan

Phase 2: Production of 15mtpa (expected by 2015-6)

- Investment in Iron Ore Concentrator at Tokadeh
- Increased utilization of rail capacity
- Expansion of port facilities at Buchanan

Currently ArcelorMittal runs 3 trains per day carrying 20,000 tons of iron ore each, with the 250km journey taking 5.5 hours.³⁴ The second phase of the project will expand the rail service to 6 trains per day. The increased utilization of the rail will involve an increase in the number of loops/sidings, which are used when trains pass each other on the single track. A

³¹ Article V (Work Program) of the Unofficial Restated ArcelorMittal Mineral Development Agreement as Amended with Appendices dated December 28, 2006.

³²“ArcelorMittal Liberia ships 3 million tonnes of ore in 2013, on track for 4.5 million tonnes this year,” *Merkur*, August 2013, available at <http://www.corporatenews.lu/en/archives-shortcut/archives/article/2013/08/arcelormittal-liberia-ships-3-million-tonnes-of-ore-in-2013-on-track-for-4-5-million-tonnes-this-year>

³³ ArcelorMittal: Phase Two Press Release available at: <http://corporate.arcelormittal.com/news-and-media/news/2013/march/01-03-2013>; Appendix C: Tentative Development Plan” in the Unofficial Restated ArcelorMittal Mineral Development Agreement as Amended with Appendices dated December 28, 2006.

³⁴ In-country interviews with ArcelorMittal in Buchanan, July 2014.

dedicated rail maintenance facility will also be established, as well as a radio signaling system for coordination of trains.³⁵

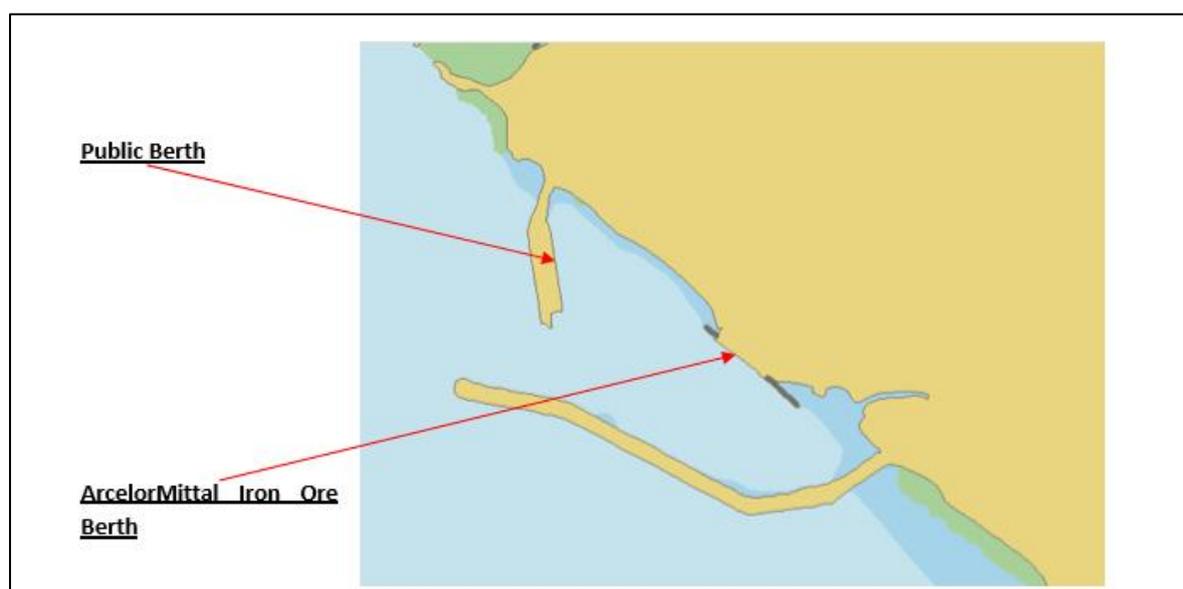
ArcelorMittal stated that during Phase 2 (rail utilization of 15 mtpa) the rail would be near to its maximum capacity. It was noted that a capacity constraint exists due to bridge which has a maximum axle load of 30,000 tons.

The Tentative Development Plan as detailed in Appendix C of the ArcelorMittal MDA appears to have been revised, and it is unclear what levels of production future phases of the project may entail. However, ArcelorMittal stated that it had no intention to expand to a double track system. Production volumes from the previous mining operations at LAMCO were of similar magnitude to the planned Phase 2 ArcelorMittal operations, reaching a peak of 12mtpa in 1974.³⁶

Port

The port of Buchanan is located 272 km South-east of Monrovia and was constructed by LAMCO in 1960 for the export of iron ore.³⁷ Today, Buchanan port is a multi-use port that handles containers and general cargo, with ArcelorMittal having exclusive access to one pier.

Figure 2: Buchanan Port



Source: Eltvedt & O’Sullivan, ArcelorMittal Facility, Port of Buchanan and Monrovia, Liberia 2012

Iron ore berth

ArcelorMittal was required as per its concession agreement to complete the rehabilitation of the Buchanan iron ore berth within three years of the commencement of its concession. Phase 1 of the project involved basic renovations of existing port facilities. Currently, on arrival at

³⁵ Ibid.

³⁶ ArcelorMittal Annual report 2012, available at: <http://corporate.arcelormittal.com/~media/Files/A/ArcelorMittal/investors/annual-reports/2012/Annual-Report-2012.pdf>.

³⁷ National Port Authority of Liberia, Annual Report, 2012.

the port, the wagons are emptied using a mechanical digger onto a conveyor belt, which carries the ore into a storage area. During the rainy season, the ore often arrives wet at the port and therefore needs to be dried. To load the ore onto the ship it is then transferred by bulldozer onto the quay, and then transferred by cranes to the ship.³⁸

As ArcelorMittal plans to increase production from 4mtpa to 15mtpa, Phase 2 of the project will result in further investment in the port, mainly through a single cell toppler and a new fixed ship loader that will have a loading capacity of 6-8,000 tonnes of iron ore per hour.³⁹

Interviews with ArcelorMittal suggest that a significant long-term limitation for its operations would be the port infrastructure. Use of the port is currently limited by the tide - vessels can only enter the port in high tide during daytime hours. It currently has one ship arriving every 1-2 days. In addition, it faces loading restrictions, the major one being that it cannot load ships while it is raining.⁴⁰

The port has a rock seabed, limiting the amount that the port can be dredged to allow larger vessels. Further dredging would require blasting, the shockwaves of which could cause widespread ecological damage.⁴¹ The NPA states that the access channel to the port provides ships with a water depth 11.5 meters below chart datum.⁴² Therefore, to facilitate larger shipments to China, transshipments are made. This involves loading a smaller vessel for 3-4 rotations and transferring up to 60,000 tons of ore to cape-size vessels (up to 200,000 tons).⁴³

Commercial quay:

Buchanan port's commercial quay is run by the NPA and provides services for general cargo and the logging industry. Table 5 shows the volume and variety of goods shipped through the Buchanan port. All vessels apart from iron ore vessels use the commercial quay. Shipping activities have increased recently because of the logging and the equipment handling agreement with UMARCO (the Liberian subsidiary of port logistics company Bollore⁴⁴), which has improved the port's handling capacity and efficiency.⁴⁵

Table 5: Cargo handled at Buchanan Port

³⁸ Eltvéd & O'Sullivan, ArcelorMittal Facility, Port of Buchanan and Monrovia, Liberia 2012.

³⁹ Phase Two press release, March 2013, available at: <http://corporate.arcelormittal.com/news-and-media/news/2013/march/01-03-2013>.

⁴⁰ Interview with ArcelorMittal, London, July 26, 2013.

⁴¹ Ibid.

⁴² NPA website, available at: <http://npaliberia.com/operations/buchanan/>

⁴³ ArcelorMittal press release, August 2013, available at <http://corporate.arcelormittal.com/news-and-media/news/2013/aug/15-08-2013>.

⁴⁴ Bollore Africa Logistics Website, available at <http://www.bollore-africa-logistics.com/qui-sommes-nous/filiales-en-afrique/liberia.html>.

⁴⁵ NPA Website, available at <http://npaliberia.com/operations/buchanan/>.

Type of Vessel	2011 No.	2012 No.	% Change No.	NRT 2011	NRT 2012	% Change NRT
General Cargo	18	18	0%	55,630	156,476	181%
Roro	-	2	-	-	14,485	-
Iron Ore	8	40	400%	85,982	775,973	802%
Logs	20	32	60%	107,623	156,608	46%
Wood chips	9	-	-	143,694	0	-100%
Support Supply	4	17	325%	137	10,886	7,846%
Tugboat	1	-	-	73	0	-100%
Total	60	109	82%	393,139	1,114,428	183%

Table 13: Vessels Entered and Cleared at the Port of Buchanan | 2011 & 2012

Source: National Port Authority of Liberia, Annual Report, 2012

3.1.2. Potential for multi-user access

This section considers the potential for demand by third parties for access to the ArcelorMittal rail and port infrastructure. There are a number of other mining concessionaires on or near to the Yekepa-Buchanan corridor that could either share or extend the existing infrastructure, both for imports of equipment and exports of minerals.

Due to the geographic location of its license area at Kitoma, the MDA of BHP Billiton envisaged that it could make use of the existing Yekepa-Buchanan line (See Figure 1).

Indeed the BHP Billiton MDA provides that:

“Government shall use its best endeavors, including exercising its powers over Land and under any mineral development or infrastructure agreements with third parties, to provide the Company rail capacity for the Term for the purpose of safely and efficiently carrying Iron Ore or other Minerals extracted from Mines located in the Production Area to the point of export of such Iron Ore or other Minerals. Such efforts shall include the exercise of such rights as the Government may have to require access to existing or prospective excess capacity or to have existing or proposed railroads or ports expanded, it being understood that the Government shall not be obligated to undertake any financial obligations in connection therewith.”⁴⁶

As the MoPEA states, BHP Billiton could link to the rail for both equipment importing and ore exporting. Alternatively, it could use the rail only for heavy equipment and build alternate means e.g. a pipeline, to transport the ore to the port.⁴⁷ In 2010, preliminary discussions did take place between ArcelorMittal and BHP Billiton about potentially combining its iron ore

⁴⁶ Section 19.3(c) of BHP Billiton Mineral Development Agreement, 2010.

⁴⁷ Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

interests in Liberia and Guinea into a single joint venture, but they were unable to reach a commercial agreement.⁴⁸

It appears that short rail extensions could make other iron ore deposits in the region economically viable. Hummingbird Resources has an exploration license for the iron ore deposit at Mount Ginka. As it states, the license is situated only from the Yekepa-Buchanan railway line. This suggests its intention to use the rail for iron ore transportation when it reaches production.⁴⁹

Figure 3: Iron Ore Deposits



Source: <http://amlibgroup.com/media/Iron%20Ore%20brochure.pdf>

Figure 3 shows that AmLib also has an iron ore exploration license along the Buchanan-Nimba railway line (Kokoya Iron Ore project). The MoPEA notes that this would likely be a stranded investment (i.e. not commercially viable to develop), without access to the railroad. Indeed, AmLib notes in its corporate brochure that infrastructure remains a key impediment to the development of remaining West African mineral deposits. It then goes on to note that it has a significant infrastructure advantage because it is located within 5km of the existing iron-ore rail line and 140km from the deep-sea iron ore loading terminal.⁵⁰

There is also a strong rationale for extending the railroad to serve a number of mining concessionaires in Guinea, which are located near the Guinea-Liberia border. These include the Guinean Nimba, Diake and Belekoyo deposits as well as the very large iron ore deposits

⁴⁸BHP Billiton press release, January 2010, available at: <http://www.bhpbilliton.com/home/investors/news/Pages/Articles/BHP%20Billiton%20and%20ArcelorMittal%20Enter%20preliminary%20discussion%20to%20potentially%20combine%20assets%20in%20Liberia%20and%20Guinea.aspx>. BHP Billiton press release, September 2010, available at: <http://www.bhpbilliton.com/home/investors/news/Pages/Articles/BHP%20Billiton%20and%20ArcelorMittal%20Terminate%20Discussions%20to%20Combine%20Assets%20in%20Liberia%20and%20Guinea.aspx>

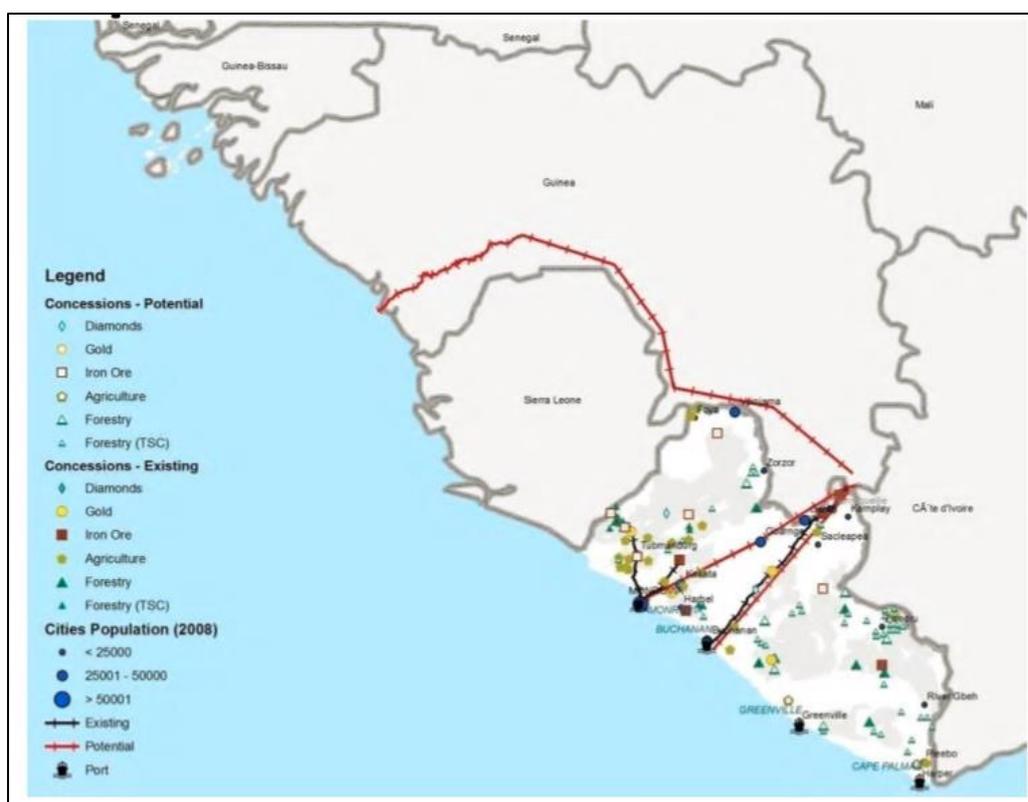
⁴⁹ Hummingbird Mount Ginka Iron Ore Project Overview, available at:

<http://www.hummingbirdresources.co.uk/exploration/projects/iron-ore-license/>.

⁵⁰ AmLib corporate brochure, available at <http://amlibgroup.com/media/Iron%20Ore%20brochure.pdf>.

further north in Simandou.⁵¹ For these companies, the shortest route to the coast for export is through Liberia. The most realistic export option within Guinea would be using the port of Conakry, 800km away from Simandou.⁵² By contrast, the distance from the port of Buchanan is only 350 km.⁵³ Vale-BSGR estimates that time to build the infrastructure would be reduced from 7 years to 3 years. The Nimba deposit in Guinea lies even closer to the Liberian border, less than 60km from the rail line at Yekepa.⁵⁴

Figure 4: Rail Options from Guinea



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

The World Bank estimates that for iron ore mines located on the Guinean side of the border, when the full lifecycle costs of running the two alternative railroads are taken into account, the cost savings of exporting via Liberia are of the order of US\$1 billion over a twenty year period (\$3.49 per ton via Conakry versus US\$1.22 per ton via Buchanan).

A bilateral agreement has been put in place between Liberia and Guinea to allow companies mining the Nimba deposit to use the Liberian transport route for the export of ore. It has recently been reported that Sable Mining, a concession-holder in the Nimba iron ore project in South-West Guinea has been granted an export license authorizing the transport of iron ore

⁵¹ Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

⁵² World Bank, “Leveraging investments by natural resource concessionaires,” Infrastructure Policy Notes, World Bank for the Republic of Liberia (Washington D.C.: The World Bank, 2011).

⁵³ Vale-BSGR Project Overview available at: <http://www.bsgresources.com/mining-and-metals/iron-ore/>.

⁵⁴ Ibid.

through Liberia to the port of Buchanan.⁵⁵ Discussions are also underway between the Governments of Liberia and Guinea regarding shared use of the rail.⁵⁶

In 2011, Vale-BSGR (which has rights to mine the Simandou deposit) began negotiations with the GoL a concession to provide rail access to a Liberian port. However, the deposits at Simandou are estimated to be significantly larger than those of ArcelorMittal and BHP Billiton combined, requiring significant additional investment into either expanding the capacity of the existing rail or building a new one (see Section 3.13 below for further detail).

3.1.3. Technical constraints to multi-use

Potential users of the Yekepa-Buchanan infrastructure can be divided up into 1) large-scale mining companies that have the financial capacity to invest in alternative infrastructure of their own to make their project viable (Simandou license holders, Mount Nimba license holders, BHP Billiton) and 2) smaller “junior” mining companies who do not have the resources to finance the infrastructure investment necessary to transport their minerals from mine to port (Hummingbird Resources, Amlib). The smaller mining companies would want the infrastructure to be built with excess capacity to ensure that they can use the infrastructure when needed, in exchange for a user fee.⁵⁷

ArcelorMittal has stated that it would have a better sense of the potential excess capacity on the railroad once the Phase 2 investment is complete. If there is spare capacity, there exists the possibility of small-scale volumes from other mining companies to be transported. Similarly, in relation to the Buchanan port, ArcelorMittal emphasized the limitations of the current and planned port facilities, and was not optimistic about the scope for accommodating excess demand.

Depending on the financial resources of the small-scale mining company in question and timeframe of the project, some may be interested in contributing to the investment costs to generate excess capacity on the railway line and port terminal. For example, investment into alleviating the load limit imposed by a bridge along the rail route using additional reinforcements would allow heavier loads to be carried, and additional locomotives may allow for higher train speed. At the port, additional investment into a currently un-refurbished lay-by berth previously used by LAMCO would allow for increased loading efficiency at the port.⁵⁸ The scope for increasing capacity through marginal investment should be carefully investigated.

For the large deposits, it is clear that the capacity of the current single-track railway will not be sufficient to handle traffic from both mining companies, demanding further investments. In this case, these concessions may need to develop their own railroads, raising the possibility of new tracks running close to or even parallel with the existing ArcelorMittal line.

⁵⁵“Nimba export license in line with Guinea, Liberia agreement – Sable,” *Mining Weekly*, October 11 2013, available at: <http://www.miningweekly.com/article/nimba-export-licence-in-line-with-guinea-liberia-agreement-sable-2013-10-11>.

⁵⁶ “Liberia: 'Long-Term Benefits'? Nimba Rail Attracts Huge Investment to Liberia”, *AllAfrica*, March 21 2014, available at: <http://allafrica.com/stories/201403211293.html?page=3>.

⁵⁷ Perrine Toledano, Sophie Thomashausen, Alpa Shah, and Nicolas Maennling “A framework to approach shared use of mining-related infrastructure,” Columbia Center on Sustainable Investment, Columbia University (2014), available at: http://ccsi.columbia.edu/files/2014/05/A-Framework-for-Shared-use_March-2014-2.pdf

⁵⁸ Interview with ArcelorMittal, Buchanan, July 15, 2013.

Two railroads or one?

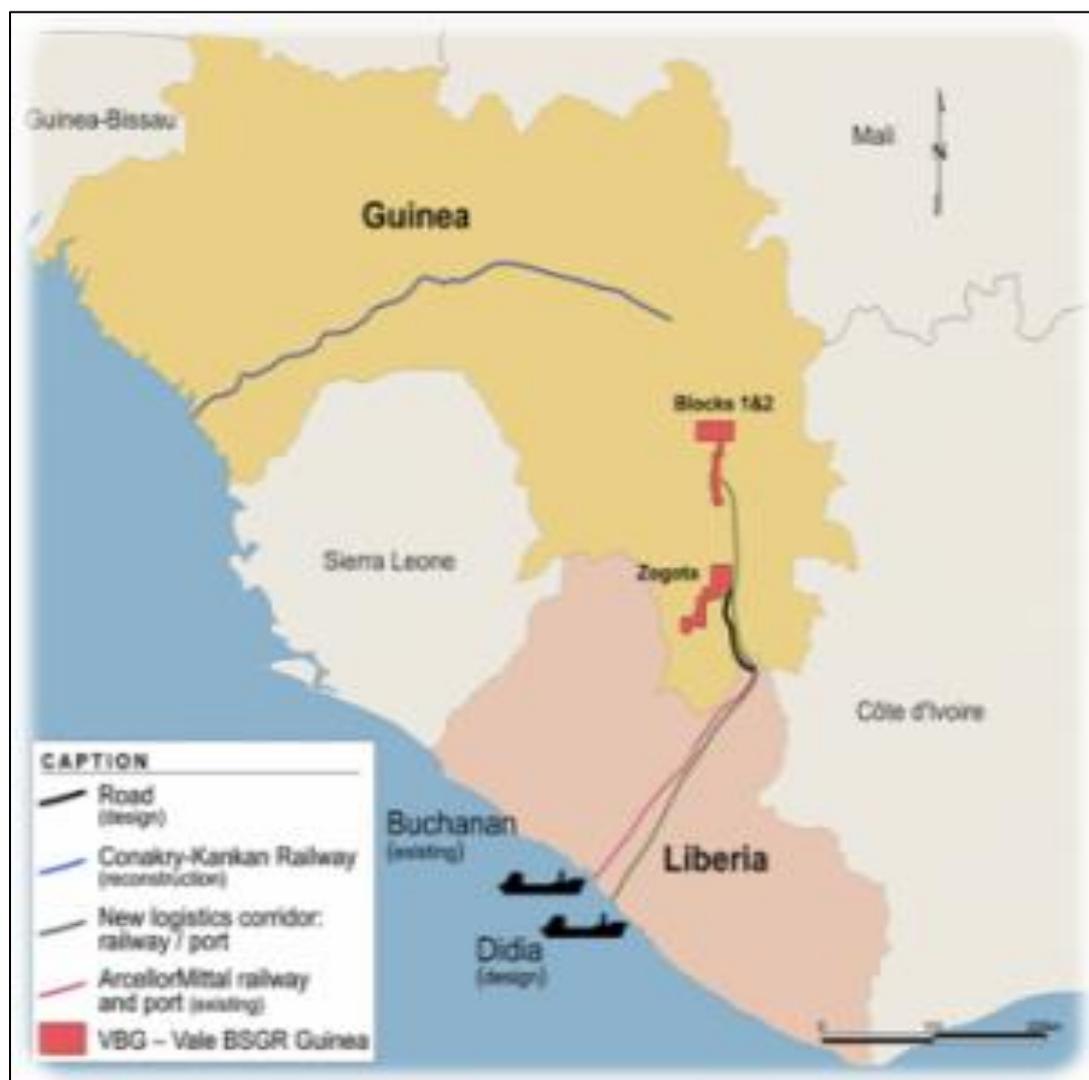
Depending on the railway route of the proposed alternative transport corridor, the GoL will need to assess whether it should push for a single infrastructure solution or a shared solution. A single solution may benefit the government in terms of revenues from the two mining projects, due to economies of scale associated with the construction of one high volume railway line and port terminal as opposed to two with lower capacities. However, the alternative logistics solution may reduce the countries' dependence on one export corridor in case bottlenecks arise, and/or the potential for broader economic development along both corridors if these are open access.⁵⁹

Vale-BSGR hopes to transport its iron ore from their deposits in Zogota as well as Simandou Block 1 & 2 deposit through Liberia. The anticipated volumes from these deposits are estimated at 50-70mpta,⁶⁰ and dwarf the current capacity of the Yekepa-Buchanan railway.

Figure 5: Vale-BSGR proposed Liberia Export Solution

⁵⁹ Toledano, Thomashausen, Shah, and Maennling "A framework to approach shared use of mining-related infrastructure," op cit.

⁶⁰ Vale-BSGR Project Overview available at: <http://www.bsgresources.com/mining-and-metals/iron-ore/>.



Source: <http://www.bsgresources.com/mining-and-metals/iron-ore/>

Vale-BSGR states that its planned transport solution through a port near Buchanan in Liberia includes the construction of a connecting railway from Zogota to the existing railway in Liberia during Phase 1 of the project. Phase 2 would involve the building of an integrated new railway and deep-sea port south of Buchanan.

An alternative approach would be to consider upgrading the ArcelorMittal single track railroad into an integrated system comprising two parallel lines operated as a double track rail system.⁶¹

Analysis undertaken by the World Bank suggests that there are operational and financial benefits of a double track system over development of two parallel lines. The capital investment costs alone are significant. A double track system is estimated at US\$629 million versus US\$826 million for two parallel lines. Operationally, the World Bank notes that moving 3 million tons per month, or 36 million tons per year on using a single track involves a large degree of careful coordination. With a possible 15 daily train rotations this would

⁶¹World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," World Bank, op cit.

involve 30 train crossings on a single track, which needs to be planned and monitored. The logistical challenges of coordinating passing trains on a single track are avoided with a double track. A double track would allow trains to move faster (70km/h vs 60km/h). There are also cost savings from the use of longer trains (pulling 105 rather than 70 wagons), requiring fewer locomotives and drivers. The report notes that track maintenance costs from a double track system are substantially lower than on two parallel tracks. Taking into account savings in both capital and operating costs, the World Bank concludes that the double line generates savings of US\$313 million over and above the two single lines.⁶²

This would suggest that a coordinated effort between ArcelorMittal and mining companies with large deposits wanting to use the Yekepa-Buchanan corridor, and willing to invest in the rail infrastructure, would yield significant results. However, the scope for coordinated investments should be carefully assessed. An upgrade to a double-track system may be sufficient to accommodate ArcelorMittal and the small-to-medium sized deposits in the Nimba range and along the Yekepa-Buchanan corridor, but the Simandou deposit may necessitate a new railway simply due to the sheer volumes of ore expected.

Expanding the Port Capacity

It is important that the capacity of the port facilities are sufficiently expanded or upgraded to complement any additional use of the rail infrastructure. As mentioned above, ArcelorMittal currently sees the port logistics as a major constraint to its operations.

The World Bank notes that the nature of the required port facilities depends on the scale of export. For export volumes of approximately 10mtpa, it is possible for companies to utilize standard quay facilities and Panamax (70,000 tonnes) vessels. Beyond these volumes, larger vessels such as Capesize (180,000 tonnes) and Chinamax or Valemax (400,000 tonnes) are required. However, the draft requirements of these ships are large and it is often technically challenging and very costly to dredge port entry channels to such depths.⁶³ As mentioned above, ArcelorMittal states that Buchanan port cannot even be dredged to the depths required to accommodate Panamax vessels due to the bedrock depth necessitating smaller vessels and/or transshipments, increasing their freight costs.

ArcelorMittal notes that one option would be to build a long (2-3km) jetty/finger pier out into the ocean to allow access by larger ships. It estimates a cost of US\$400 million, and at present it has no plans to make such an investment. However, a larger operation may justify such an investment. Vale states that the deep-sea waters (>28m) off the coast of Liberia are critical to the use of 'Valemax' or very large ore carrier vessels (VLOC). These deep-sea waters start 2 to 3 km from the Liberian shore (in comparison in Guinea these waters start at around 15km to 20km from the coast).⁶⁴ The economics of using these large vessels would warrant the construction of such finger pier/jetty infrastructure.

However, ArcelorMittal also notes that third party use of the port at Buchanan would require additional stockpiling areas to deliver material, since it already uses significant space for stockpiling and drying their ore. Additional material handling facilities would also be required. Vale-BSGR notes the need for a dedicated facility if it were to export ore through Liberia, and have identified a site south of Buchanan.

⁶² Ibid.

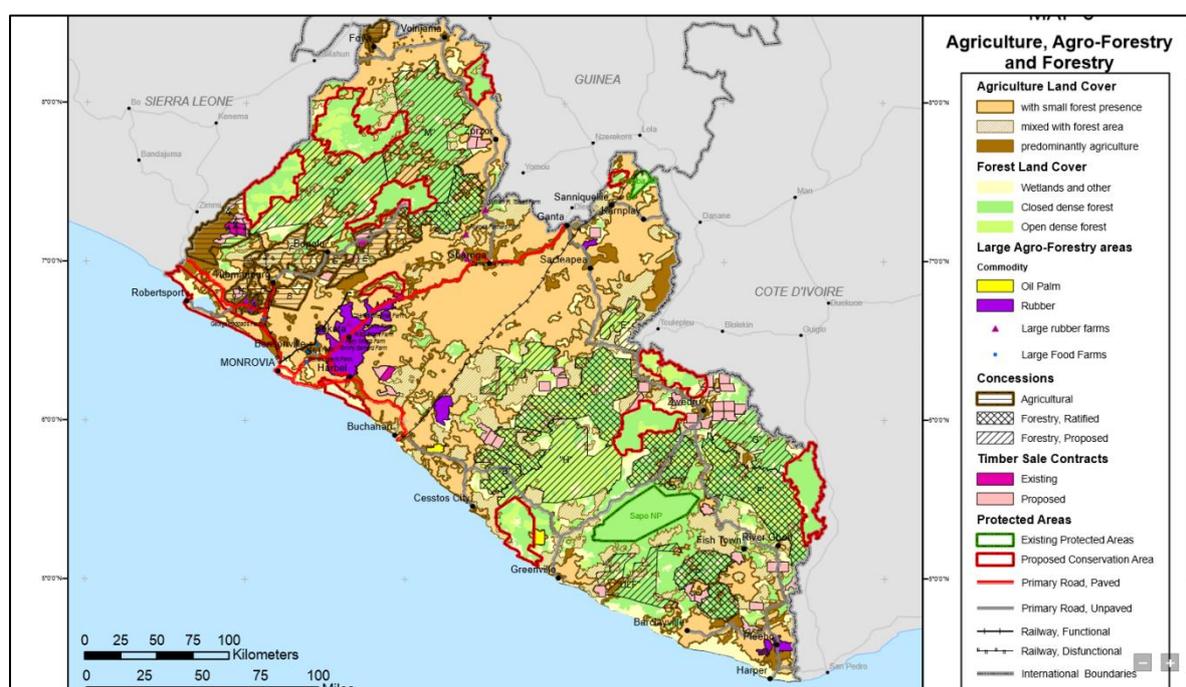
⁶³ Ibid.

⁶⁴ Vale-BSGR Project Overview available at: <http://www.bsgresources.com/mining-and-metals/iron-ore/>.

3.1.4. Potential for multi-purpose access

MoPEA identifies the Yekepa-Buchanan route as a major development corridor. As it points out, the Buchanan-Yekepa railway runs almost entirely through agricultural land, suggesting opportunities for the transport of high-value crops. A rubber plantation owned by the Liberia Agricultural Company is located along the railway about 40km North of Buchanan. Two existing forestry concessions, a further proposed forestry concession area, plus several timber sales contracts may also warrant multi-purpose use of the railway. Timber exports greatly increase the maintenance costs of roads, which are badly impacted by the weight of timber-carrying trucks. The MoPEA states that rail transport costs 1/6 as much as road transport, which is a major incentive for the companies to seek access to rail transportation.⁶⁵

Figure 6: Agricultural and Forestry in Liberia



Source: Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study, Ministry of Planning and Economic Affairs, Republic of Liberia, 2010A Development Corridors report

In addition, 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.⁶⁶ As companies in the interior including ArcelorMittal will be powering its operations using HFO or diesel generator plants, imports of fuel from the port using the railroad might be economical. Imported equipment needed by companies along the corridor might also be transported along the rail-route, although different wagons may be required for such back-haulage.

⁶⁵ Liberia Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

⁶⁶ Toledano, Thomashausen, Shah, and Maennling “A framework to approach shared use of mining-related infrastructure,” op cit.

There may also be scope for multi- purpose access to the port facility, which is accessible by road by companies operating near to Buchanan, such as the Liberian Agricultural Company rubber concession and Equatorial Palm Oil. The NPA states that the Port of Buchanan can be used as an alternative port to the Freeport of Monrovia due to its location, 272 km southeast of Monrovia.

3.1.5. Technical issues

Yekepa-Buchanan Railway line

The specification and the capacity of the rail will determine the scope for multi-purpose use. As a practical matter, carrying non-mining loads on a railway will require the provision of rolling stock specific to the requirements of each sector, construction of sidings with loading facilities at appropriate junctions.⁶⁷ However, as the IFC notes, there is no technical reason why passenger and general freight services cannot use the same infrastructure as heavy-haul mining services, and many well-known lines currently do so.⁶⁸ Rail capacity is not a rigid linear concept. If well-managed, occasional passenger and general cargo trains could run in between the larger mineral trains without disrupting the schedule or service.⁶⁹ Indeed, it is reported that LAMCO operated a dedicated passenger/cargo train for its employees during the pre-war operations in Yekepa.⁷⁰

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 would not leave much scope for non-mining traffic. 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.⁷¹ By contrast, 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.⁷²

Another question is whether the size of this demand, particularly from forestry and agricultural concessions would justify the use of rail. ArcelorMittal notes technical challenges associated with attaching non-mining wagons to a mining train and stated that there would have to be a dedicated train for such cargo.⁷³ However, the volumes involved will likely be only a fraction of those generated by the mines. Figure 7 shows a World Bank simulation of export traffic through Liberia's ports. By the end of 2017,⁷⁴ total agriculture and forestry volumes across the country would only amount to 1.7mtpa (11% of ArcelorMittal's production by 2016). In addition, the World Bank notes that compared to projected mineral freight - forestry and agricultural traffic is quite dispersed in nature, making it relatively

⁶⁷ Liberian Ministry of Planning and Economic Affairs, "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

⁶⁸ IFC, "Fostering the Development of Greenfield Mining-Related Transport Infrastructure Through Project Financing," (2013).

⁶⁹ Toledano, Thomashausen, Shah, and Maennling "A framework to approach shared use of mining-related infrastructure," op cit.

⁷⁰ Interview with Liberian Ministry of Public Works, July 16, 2013

⁷¹ Toledano, Thomashausen, Shah, and Maennling "A framework to approach shared use of mining-related infrastructure," op cit.

⁷² World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," op cit.

⁷³ Interview with ArcelorMittal, London, July 26, 2013.

⁷⁴ This is the end of the PRS 2 period, 5 years after the 2012 launch of PRS2.

costly to organize and collect it at railroad loading points.⁷⁵ Such traffic may benefit more from the improvement of service roads running parallel to rail tracks than from the rails themselves. ArcelorMittal is rehabilitating the unpaved service road that runs along the rail route in order to provide access to, and maintenance of, the rail link. This road could be developed and maintained to provide year round access and, together with a system of minor feeder roads, allow agricultural and forestry areas to access the rail link.⁷⁶ In addition, ArcelorMittal is to build a 70km paved road connecting Ganta and Yekepa, as part of its Phase 2 investment.⁷⁷

Figure 7: World Bank Estimation of traffic through Liberia’s ports

(a) As of 2011									
'000s Mt pa	Other Agriculture	Agriculture and forestry			Agriculture and forestry			Minerals	
		Agricultural Concession	Forestry Concession	Total	Dry bulk cargo	Liquid bulk cargo	Total		
Monrovia	-	276.7	3.8	280.5	103.1	177.3	280.5	6.6	
Buchanan	-	13.1	8.3	21.4	19.0	2.4	21.4		
Greeneville	-	3.2	12.9	16.2	12.9	3.2	16.2		
Harper	-	7.2	7.2	7.2	7.2	-	7.2		
National	-	300.3	25.0	325.3	142.3	183.0	325.3	6.6	

Note: Forestry figures provided by SGS. Other figures derived from LISGIS data apportioned across ports according to size and location of concession areas.

(b) As of end PRS2 (simulated)									
'000s Mt pa	Other Agriculture	Agriculture and forestry			Agriculture and forestry			Minerals	
		Agricultural Concession	Forestry Concession	Total	Dry bulk cargo	Liquid bulk cargo	Total		
Monrovia	170	1,121	36	1,326	49	1,277	1,326	12,500.0	
Buchanan	59	34	77	170	90	80	170	12,500.0	
Greeneville	27	18	121	165	123	42	165	5,000.0	
Harper	26	14	-	40	4	36	40	-	
National	282	1,186	233	1,701	266	1,435	1,701	42,500.0	

Note: Estimates based on full production potential of existing agriculture and forestry concession contracts only, plus 20 percent of potential production of smallholder agriculture. Minerals based on 50 percent of potential production from existing mining concessions only.

(c) As of 2030 (simulated)									
'000s Mt pa	Other Agriculture	Agriculture and forestry			Agriculture and forestry			Minerals	
		Agricultural Concession	Forestry Concession	Total	Dry bulk cargo	Liquid bulk cargo	Total		
Monrovia	848	1,084	187	2,119	253	1,867	2,119	44,900.	
Buchanan	297	34	117	448	184	264	448	25,000	
Greeneville	134	18	221	373	233	139	373	10,000	
Harper	131	14	14	159	34	125	159	-	
National	1,410	1,150	540	3,100	705	2,395	3,100	79,900	

Note: Estimates based on full production potential of existing agriculture, forestry and minerals concession contracts only.

Source: Infrastructure policy notes: Leveraging investments by natural resource concessionaires, World Bank, (2011).

It should be noted that the viability of passenger rail has been examined by the GoL. As the AICD reports, Liberia is characterized by low population density, widespread poverty, and isolated pockets of economic activity.⁷⁸ The World Bank notes that along the existing and planned rail-routes, there are no towns with a population of above 40,000. Therefore it may

⁷⁵ World Bank, “Infrastructure policy notes: Leveraging investments by natural resource concessionaires,” op cit.

⁷⁶ Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

⁷⁷Phase Two Press Release, available at: <http://corporate.arcelormittal.com/news-and-media/news/2013/march/01-03-2013>.

⁷⁸ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” AICD, op cit.

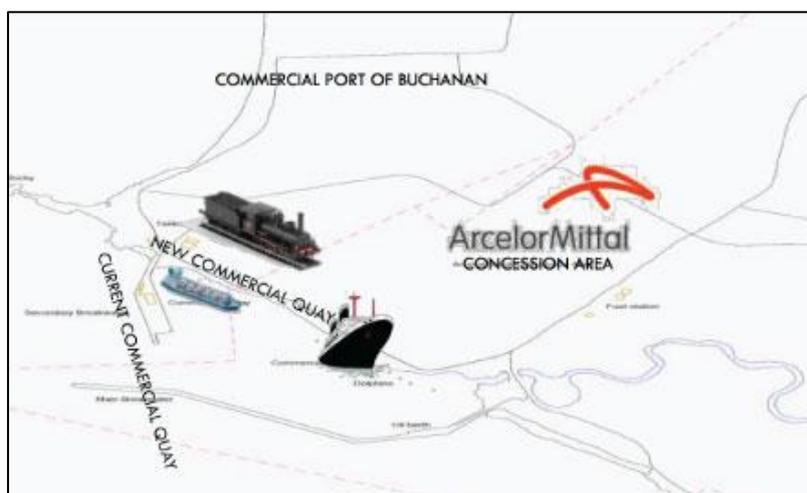
be unrealistic for small population sizes could generate enough passenger traffic to justify a dedicated train.⁷⁹ During the formulation of the National Transport Plan, it was determined that the practicalities of establishing a public rail network due to the different rail gauges used on the different lines, along with the realities of subsidization of a passenger rail system by an already severely budget-constrained government has led the Ministry of Transport and the Ministry of Public Works to focus their attention on roads.⁸⁰

Buchanan Port

ArcelorMittal explained that the current handling and loading facilities at the iron ore quay are designed specifically for the movement and loading of iron ore which has a density of 2.5 tonnes per cubic meter. It is not designed for the loading of containers and general cargo, and the ArcelorMittal port staff also pointed out that using the port infrastructure for other non-mining commodities with a much lower density such as woodchips would be an inefficient use of the facilities.⁸¹

However, in Buchanan, since there is a commercial quay, which can accommodate containers and other non-mining cargo, it would be more productive to increase utilization of this side of the port. The NPA has authority over operations and the capability to allocate access to different users at the commercial quay. Increased utilization of the commercial quay would be preferable to routing non-mining cargo through the mining pier, which would necessitate specific infrastructure to be built to handle it, or would result in inefficient use of the iron ore handling equipment. NPA plans to develop a second commercial quay at Buchanan. This would involve some adjustment to the area currently leased by ArcelorMittal at Buchanan, which ArcelorMittal are reportedly amenable to.

Figure 8: Plans for a new commercial quay at Buchanan



Source: <http://npaliberia.com/operations/buchanan/>

Table 6 summarizes the options for multi-use rail in Liberia.

Table 6: Scope for multi-use rail in Liberia

⁷⁹ World Bank, “Infrastructure policy notes: Leveraging investments by natural resource concessionaires,” op cit.

⁸⁰ Interview with GIZ, Monrovia, July 11 2013.

⁸¹ Interview with ArcelorMittal, Buchanan, July 11 2013.

Multi-User Situation	Potential Users	Shared Use Model	Regulation
<p>Scenario One:</p> <p>Limited additional investment, ArcelorMittal allows excess capacity to be used by small-scale miners</p>	<ul style="list-style-type: none"> • Smaller-scale mining companies such as Amlib, Hummingbird looking to securing access for their initial production levels. • Transportation of fuel and related equipment into the interior. • For non-mineral loads, the commercial quay in Buchanan presents a viable logistics solution, leaving little need for the adaptation of the loading and unloading facilities at the iron ore port 	<ul style="list-style-type: none"> • ArcelorMittal MDA does not clearly specify the model to be used. • ArcelorMittal has stated that it would prefer a haulage model if it were to transport small quantities of minerals from other mining companies. • Access fees would be charged under long-term “take or pay” agreement. 	<ul style="list-style-type: none"> • ArcelorMittal MDA gives the GoL significant oversight over access arrangements. It requires the GoL to authorize third party access to excess capacity of the railroad and port, in consultation with ArcelorMittal, and that the revenue for third party use to be shared between the GoL and ArcelorMittal. The MDA provides for a joint committee to review decisions regarding third party access.⁸²
<p>Scenario Two:</p> <p>Additional Investment by Large-Scale Mining Company (e.g. Nimba license holders)</p>	<ul style="list-style-type: none"> • Mining companies with large operations near to the corridor, such as BHP Billiton, or license holders in the Mount Nimba deposits in Guinea. • Large investment into a double track as well as additional facilities at Buchanan and a 2-3km jetty to allow larger vessels to be used.⁸³ 	<ul style="list-style-type: none"> • Separation of ownership of the infrastructure (both rail and port) from ArcelorMittal. A special purpose vehicle (SPV) could be setup, which owns and operates the rail and port infrastructure⁸⁴. Alternatively, the government could award the upgrade and operation of rail and port infrastructure concession to a third party. To 	<ul style="list-style-type: none"> • The government has to monitor and ensure non-discriminatory access, as well as oversee the setting of tariffs. • Stronger government intervention and cross-subsidization may be necessary for more price sensitive cargo such as agriculture products or passenger rail. Along the Yekepa-Buchanan corridor, potential shared use is likely to be taken advantage

⁸² Article IX, Section e. Third Party Access to the Railroad and the Buchanan Iron Ore Port, Unofficial Restated ArcelorMittal Mineral Development Agreement as Amended with Appendices dated December 28, 2006

⁸³ The ArcelorMittal MDA mandates the company to undertake the expansion and modernization of the railroad and port at the request of the government, the terms of which would be negotiated by the parties in good faith. Failure to do so gives the government the right to proceed on its own or through a third party, subject to consensus on excess capacity and revenue sharing formula.

		<p>finance the investment, the SPV would have to be backed by long-term take-or-pay agreements by future users.</p> <ul style="list-style-type: none"> • ArcelorMittal 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. • To maximize efficiency, haulage regime should be the preferred operational model. • Such a regime would also guarantee that smaller mining projects or agricultural/forestry project can access the railway line without having to invest in rolling stock themselves. 	<p>of by mostly other mining companies. Given the scarce resources available to the GoL, a lighter-touch supervisory role may be more appropriate.</p>
<p>Scenario Three: Separate Cross-Border Corridor built by Simandou license holder</p>	<ul style="list-style-type: none"> • License holders from the Simandou deposit. Vale-BSGR’s plans show (see Figure 5), that such a license holder would look to create their own rail and port logistics solution. • Third party access by other mining 	<ul style="list-style-type: none"> • The type of model chosen could follow either Scenario 1 or Scenario 2 above, depending on the size of the other mining operations interested in using the infrastructure. • The associated increase in political risk due to cross border 	<ul style="list-style-type: none"> • Regional agreement on regulation is necessary. An inter-governmental agreement should be signed, with details of the type of goods that will be transported on the line, associated transit cargo fees, and the rules for open access and non-discriminatory

⁸⁴ Indeed, ArcelorMittal stated that if another company were willing to come in and make a large investment to upgrade the current infrastructure to a double line, they would anticipate forming a joint venture company for the management of the infrastructure.

	<p>companies in the corridor (e.g. Mount Nimba deposit holders, or medium-scale mining companies such as Amlib and Hummingbird Resources)</p>	<p>transportation may result in increased difficulties to source funding. Multilateral agencies such as the World Bank and/or the African Development Bank can be considered to help with the financing.</p>	<p>access to the port. These agreements should be embedded in both domestic and international law.</p> <ul style="list-style-type: none"> • An intergovernmental rail authority could help supervise the tariff structure and pricing mechanisms of non-mineral services. This will also help to avoid issues of transfer pricing between affiliated infrastructure and mining companies.
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3.2. Corridor 2: China Union: Bong-Monrovia

3.2.1. Current status

Railway line

China Union took over the mining rights previously held by Bong Mining Company (BMC) over deposits in Non-Goma in Bong County. The previous railroad was 80km single track rail from the Non-Goma mines to Monrovia. Until the recent rehabilitation of the rail for industrial use, an informal service was being used on the railroad to export scrap and iron ore pellets from the previous mining operations along with some agricultural produce.⁸⁵

The China Union concession contract grants the company the right to develop, use, operate and maintain the railway linking the Non-Goma Mines to the Freeport of Monrovia. Under the agreement it is required to complete the rehabilitation and extension of the line up to a capacity of 12mtpa plus common carrier freight and passenger traffic, within 5 years of the effective date of the agreement. The company also has the right to extend the line to the Goma Mines if it establishes a production area there. An announcement in July 2013 stated that full-scale iron ore operations were about to commence, with the Phase 1 of the project being completed.⁸⁶

Ports

As Figure 9 shows, the Freeport of Monrovia has a main pier (marginal wharf) and three finger piers, which were constructed by the former mining companies LMC, NIOC, and BMC. The Freeport of Monrovia is currently operated under a landlord port model, with the NPA acting as a landlord and the private sector operating the infrastructure. It has concessions with APM Terminals (containers, general cargo and marine service), Firestone (rubber), China Union and Western Cluster (iron ore).

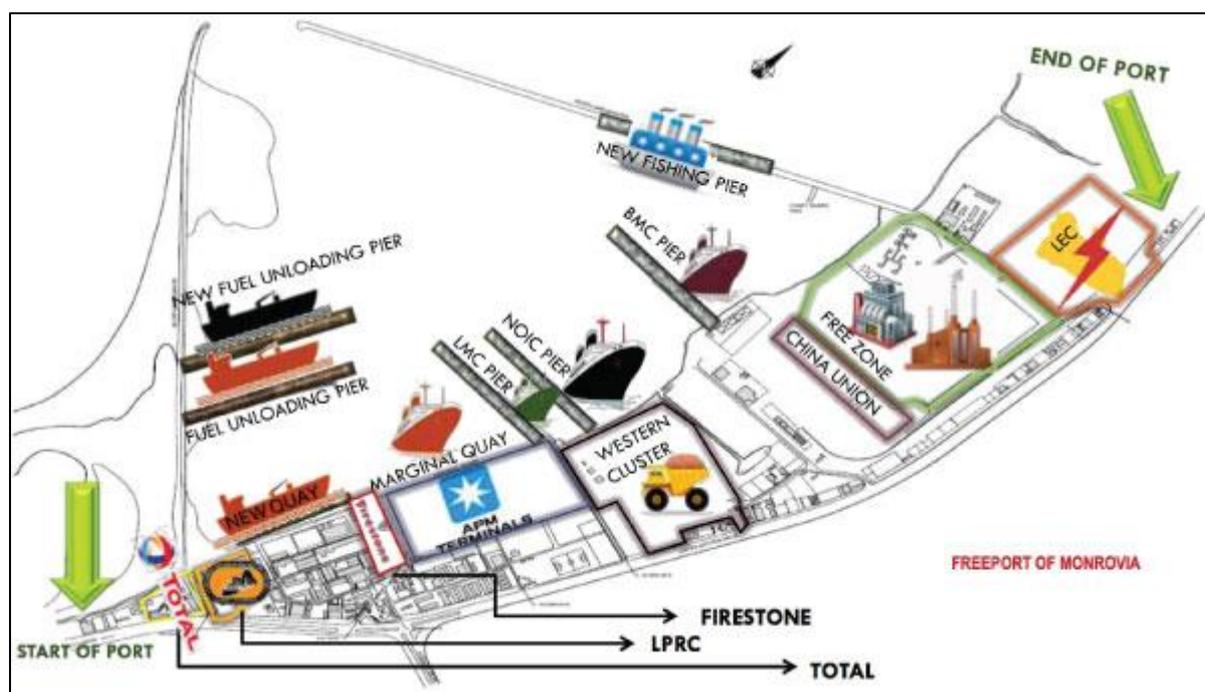
China Union has the right to develop, use, operate and maintain their designated port facility, which is the former BMC pier.⁸⁷ The agreement also states that the government will assist the company in acquiring land outside the port facility that can be used for vehicle maintenance and the construction and operation of a railway station.

⁸⁵ Ministry of Planning and Economic Affairs, "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

⁸⁶ "Sirleaf Lauds Progress Made at Bong Mines as China Union Commissions Phase One," *AllAfrica*, August 2013, available at <http://allafrica.com/stories/201308010924.html>.

⁸⁷ Interview with National Ports Authority of Liberia, Monrovia, July 11, 2013.

Figure 9: Freeport of Monrovia



Source: NPA website, available at: <http://npaliberia.com/operations/monrovia/>

The NPA stated that China Union will dredge the port channel to a depth of 13.4m, which would still not allow for the larger vessels, but would suffice for the size of vessel that China Union is planning to use.⁸⁸

3.2.2. Potential for multi-user access

According to the NPA, the expected peak production of the iron ore transported on the rail will be 9mtpa. Given the China Union contractual obligation to rehabilitate the rail to a capacity of 12mtpa, this suggests that excess capacity does exist on the line for use by third parties. There may even be the possibility for additional locomotives and trains to increase the utilization of the single track rail. Similarly, it is expected that the pier and associated port infrastructure will not be used at full capacity by the mine.

While there is limited immediate scope for shared use with other mining operations, the MoPEA and the World Bank both note that the existence of the railway creates the possibility that iron ore deposits still further north might justify longer extensions of the railway. Kpo⁸⁹ and Wologizi are potential, but as yet unproven iron ore reserves. Figure 1 shows their location in the North-West of Liberia, 60km and 130km from Bong mine. Although a new direct rail-route to Monrovia would be feasible, the World Bank notes that significant cost savings would result from extending the existing Bong railroad. It estimates a saving of US\$100 million (or 20%) in overall lifecycle costs for rail transport.⁹⁰ Sable Mining, an exploration license holder in the Kpo Range notes the importance of its proximity to the

⁸⁸ Interview with National Ports Authority of Liberia, Monrovia, July 11, 2013

⁸⁹ Sable Mining Kpo Project overview available at: <http://www.sablemining.com/portfolio/kpo-range.html>.

⁹⁰ World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," op cit.

Bong mine rail link to Monrovia.⁹¹ In addition, the MoPEA notes that if the Bong railway were to be extended all the way to Wologizi it would become the closest route from Simandou in Guinea to the coast.

The nature of the additional investment in the rail infrastructure would depend on the volumes associated with these deposits, which are as yet unknown, although initial estimates suggest that they are large deposits.⁹² Similarly, additional port capacity may have to be found to accommodate new port loading facilities as well as larger ships, which would be needed to transport larger volumes of ore. The World Bank notes that the volumes of iron ore involved if all the western mining sites (Bong, Western Cluster, and Wologizi) were to be developed may warrant for the development of a dedicated port facility to the West of Monrovia.⁹³

3.2.3. Potential for multi-purpose access

A negotiation is underway between Jindal Steel & Power (JSPL) and the Government of Liberia to build a 350 MW, coal-fired power plant. The company plans to ship coal from Mozambique. While news reports suggest that the plant will be in Monrovia, the exact location is unknown. Given the connection of the Bong mine railway to the port in Monrovia, the company may benefit from the use of empty wagons returning from the port to transport coal to a plant site along or near to the Monrovia-Bong corridor.

MoPEA also states that an extension of the railway to Kpo and Wologizi would open up Lofa County's rich agricultural and forestry potential, noting that there are currently two large forestry concessions in the area (Alpha Logging & Wood Processing⁹⁴). Again, the technical and economic feasibility of carrying such volumes on a rail route should be carefully assessed.

The non-exclusivity over the use of the BMC pier allows for other users to access the pier if it is not being used. For example, the Bong mines pier is currently also used by fishermen. With the anticipated volumes from the China Union project, ships would certainly not be docking daily, allowing for other users of the iron ore conveyor belt loading facility. The possibilities for JSPL to use the facility to unload their ships could be explored, depending on the extent to which the same loading and unloading facilities can be used. Moreover, the NPA noted that the conveyor belt to load ships is only on one side of the pier, leaving room for use by other industries. Additionally, since the pier is elevated by 5 meters, other ships can dock under it if the pier is not in use by the mining company. Given the presence of terminals and facilities for other types of cargo and containers, it seems logical that the BMC pier remains used primarily as a mineral pier, but scope for multi-purpose use with marginal additional investment could still be explored in the context of the current constraints and limited immediate scope for expansion of Monrovia port.

⁹¹ Sable Mining Kpo Project overview, op cit.

⁹² Overview of Mineral Exploration in Liberia, Available at <http://www.molme.gov.lr/content.php?sub=51&related=20&res=51&third=51>, Sable Mining Kpo Project overview, op cit.

⁹³ World Bank, "Infrastructure policy notes: Leveraging investments by natural resource concessionaires," op cit.

⁹⁴ Ministry of Planning and Economic Affairs, "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

Table 7: Scope for multi-purpose rail

Multi-User Situation	Potential Users	Shared Use Model	Regulation
<p>Scenario 1: Existing rail and port used for non-mining demand</p>	<ul style="list-style-type: none"> • Transportation of coal inland for Jindal Steel and Power. • A cost benefit analysis of the transportation of logs/agricultural produce on the rail is necessary to determine feasibility • For non-mineral loads, the commercial quays in Monrovia present a viable logistics solution, leaving little need for the adaptation of the iron ore loading and unloading facilities. 	<ul style="list-style-type: none"> • Haulage model would maintain the efficiency of the current operations • Access fees would be charged under long-term “take or pay” agreement. 	<ul style="list-style-type: none"> • China Union’s MDA gives the GoL sufficient oversight over access arrangements. It requires the GoL to authorize third party access to excess capacity of the railroad and port, in consultation with China Union, and that the revenue for third party use to be shared between the GoL and China Union. The MDA provides for a joint committee to review decisions regarding third party access.⁹⁵
<p>Scenario 2: Future extension of rail to Kpo and Wologizi ranges</p>	<ul style="list-style-type: none"> • License holders of the Kpo and Wologizi ranges. • Additional investment necessary to increase capacity and reach of rail. • New port facilities required • Multi-purpose access for agricultural/forestry loads to be assessed. 	<ul style="list-style-type: none"> • Separation of ownership of the infrastructure (both rail and port) from mining companies either through an SPV, which owns and operates the infrastructure or by third party. • China Union would be compensated for existing investment, most likely through an equivalent equity share in the infrastructure company. • Haulage model to maximize efficiency. 	<ul style="list-style-type: none"> • Government has to monitor and ensure non-discriminatory access, as well as oversee the setting of tariffs. • Shared use is likely to be predominantly taken advantage of by other mining companies. Given scarce resources available to government, a lighter-touch supervisory role may be more appropriate.

⁹⁵ Section 6.7 of China Union Mineral Development Agreement, 2009.

3.3. Corridor 3: Western Cluster: Bomi-Monrovia

3.3.1. Current Status

The MoPEA reports that of the previous 140km⁹⁶ Monrovia–Mano River rail link, only the embankment and some structures remain. This railway line will be rehabilitated by Western Cluster to transport iron ore from the Bea Mountain, Bomi Hills and Mano River Iron Ore deposits. The Mano River Iron Ore Deposits were previously mined by the NIOC, the Bomi Hills Iron Ore Deposits by the former Liberia Mining Company (LMC) and the Bea Mountain Iron Ore Deposits remain unexploited.⁹⁷ Interviews suggest that it plans to start initial production at 2mpta, transporting the ore by road for up to 3 years as permitted by their MDA, and ramp production up to 30mpta within 5-10 years.⁹⁸

With regard to port infrastructure, Western Cluster has non-exclusive, but priority use rights of the NIOC and LMC Iron Ore piers located in the port of Monrovia.

3.3.2. Potential for multi-user/multi-purpose access

The Monrovia-Mano link stretches all the way to the Sierra Leonean border, suggesting the possible extension and use of the rail line as deposits in the South-Eastern region of Sierra Leone are developed. As yet undeveloped bauxite, rutile and iron ore deposits lie in the South Eastern part of Sierra Leone.⁹⁹ AICD also suggests that the Freeport of Monrovia has the potential to become a maritime hub for mining traffic from the Eastern side of Sierra Leone.¹⁰⁰ This claim would need to be investigated, particularly with the recent announcement of the Chinese investment into a new port planned at Sulima in South-Eastern Sierra Leone.¹⁰¹

As the MoPEA notes, the possible future Monrovia–Wologizi corridor mentioned in Section 3.2 could either go via the Bong deposit or via the Western Cluster’s Bomi deposit.¹⁰² In terms of non-mining demand, the MoPEA suggests that such an extended rail link would open up access to a currently un-awarded forest management concession, as well as a number of agricultural concessions.¹⁰³ However, once again, the volumes associated with these projects should be assessed and a determination made as to whether rail use can really be justified.

The specifications of the planned railway line therefore the scope for excess capacity is unknown. The Western Cluster concession agreement makes provision for the event that the

⁹⁶ Interview with Western Cluster, Monrovia, July 11 2013.

⁹⁷ Western Cluster Project Overview available at: <http://www.elenilto.com/projects/iron-ore/liberia-western-cluster/>

⁹⁸ Ibid.

⁹⁹ Overview of Key Minerals in Sierra Leone, available at: <http://www.slminerals.org/index.php/country-information/key-minerals>

¹⁰⁰ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” AICD, op cit.

¹⁰¹ Sophie Thomashausen and Alpa Shah, “A framework to approach shared use of mining-related infrastructure: Case study: Sierra Leone,” CCSI (2014).

¹⁰² Ministry of Planning and Economic Affairs, “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

¹⁰³ Ibid.

Freeport of Monrovia cannot support the volumes anticipated from the project, suggesting that expected usage may be at or even above full capacity.¹⁰⁴ In this case a new port or jetty would be constructed. The scope for third party use of the Western Cluster port facilities should then be assessed further. As mentioned in the previous section, given the presence of terminals and facilities for other types of cargo and containers in Monrovia port, as well as excess capacity available at the China Union port facility, the Western Cluster port facility may not pose an immediate constraint to the low-to-medium volume use of the Western Cluster railroad.

It can be seen above that although demand for access to the Western Cluster infrastructure from Sierra Leone or the Wologizi/Kpo deposits is anticipated, it is yet to materialize. Mining companies will be reluctant to build excess capacity if there is no guarantee of it being utilized. However, as section 4 explains, in this situation the GoL could require the technical design of the infrastructure as well as the contract design to allow for future expansion and third party use should the demand for access prove to be significant.

3.4. Corridor 4: Putu: Southeast- Greenville

3.4.1. Current Status

Recent announcements indicate that the Putu deposit contains up to 4.4 billion tons of iron ore resources with an average 34% iron grade.¹⁰⁵ Figure 1 shows the isolated greenfield location of the Putu iron ore mine in the South East. It does not have any option to share the rail with other concessionaires, and therefore plans to construct its own railroad. This is due to be constructed by 2017. The location of the port is still unknown. Feasibility studies are currently being carried out on Greenville port and other South-Eastern port locations.¹⁰⁶

3.4.2. Possibilities for multi-user/multi-purpose access

The MoPEA reports that once this railway is constructed, it will become a possible export route for iron ore and nickel deposits in Côte d'Ivoire north of Man and Eastern Guinea. This creates the possibility of a regional rail network and expanded regional trade.¹⁰⁷ In addition, since much of Liberia's forestry activity is concentrated in the South East, it is possible that the railway line could serve a vast area of forest management concessions (See Figure 6). The MoPEA notes that although it will not extend to Zwedru, the road linking Zwedru to the rail could unlock the forestry and agriculture potential of this area.¹⁰⁸

Much of this demand is anticipated in the future, rather than being an imminent possibility. The volumes associated with the forestry companies in the South-East and the viability of take-or-pay arrangements to justify excess capacity should be investigated. If the government is certain that excess capacity will be needed, it could provide funding itself. However, this is a risky strategy if the future mining projects do not materialize. Instead, the government

¹⁰⁴ Section 6.7 (c) of Western Cluster Mineral Development Agreement, 2011.

¹⁰⁵ Press Release, available at: <http://www.severstal.com/eng/media/news/document7477.phtml>.

¹⁰⁶ "Putu Begins Shipment in 2017" *AllAfrica*, January 16, 2013, available at: <http://allafrica.com/stories/201301161385.html?page=2>.

¹⁰⁷ Liberian Ministry of Planning and Economic Affairs, "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

¹⁰⁸ Ibid.

could require the infrastructure to be designed in such way that future capacity expansion is possible.¹⁰⁹

As it was noted in Section 3.1.2, the volumes associated with agriculture and forestry activities may not justify the use of rail transportation. However, the port which is developed in the South-East may certainly prove beneficial to many companies in the region. These include a large number of forestry concessions, as well as the Cavalla rubber plantation and Maryland oil palm plantation. Figure 7 shows the World Bank prediction that 373,000tpa of agricultural and forest products will be exported through the Greenville port by 2030. In addition, as the NPA notes, Greenville is in close proximity to eight of the offshore oil blocks, suggesting that there may be demand from exploration companies to use the port infrastructure for their service vessels and a logistical shore base.¹¹⁰ Indeed the Putu MDA envisages such multi-purpose access to the port, stating “The Company shall provide general port operations services to third parties with respect to up to 1 million metric tons of traffic per year,” and leaves room for future expansion (See Section 4 below).

4. Laying the foundations for shared use

It has been mentioned in earlier sections that there remains scope for potential third party use when concessions are awarded for currently untapped deposits. It is important that the GoL has a clear plan for the scope for integration of rail and port systems between existing operations and new licenses. For example, when the GoL decides to run a tender process for the Wologizi deposit, or when mineral development agreements are negotiated for the Kpo range, it will be critical to think about synergies in the rail links between the deposit and either the Bong Mines or Western Cluster railroads. It may be necessary for a new port facility to be developed, and in this case, sharing of the new port facilities might make sense for new license holders or existing license holders as the Freeport of Monrovia becomes capacity constrained. Similarly for the Putu infrastructure, regional demand from Guinea and Côte d’Ivoire may materialize when the rail route becomes a reality.

Many of the Liberian concession agreements are designed to allow such future expansion. Both the Putu and Western Cluster concession agreements mandate a design that leaves the door open for future expansion of the railroad:

Section 6.7 (a) of the Western Cluster MDA states:

“The Railroad shall be designed so that it can be expanded on a commercially feasible basis to carry on a continuing basis twice as much traffic as is contemplated by the preceding sentence but the Company shall not be under any obligation to build such additional capacity except as it may elect pursuant to this Section 6.7. The Government or any third-party may elect to have the capacity of the Railroad expanded to service the requirements of the Government or such third-party with the costs of such expansion to be borne by the Government or such third party, as applicable. The Government shall retain title to the fixed assets of the railroad.”

The Putu agreement mandates the same for the new port facility:

¹⁰⁹ Toledano, Thomashausen, Maennling, Shah, “A framework to approach shared use of mining-related infrastructure,” op.cit.

¹¹⁰ National Port Authority of Liberia, Annual Report, 2012.

*"The Port shall be designed and constructed such that it can be expanded on a commercially feasible basis to handle twice as much capacity as is contemplated by the preceding sentence. Such expansion capacity shall include the possible construction of an additional 50 meters on the Iron Ore jetty and the driving of iron ore jetty piles at least 5 meters deeper. The Port basin shall be designed to facilitate further large scale development consistent with any expansion of the railroad (e.g., lengthening of primary wharf, room for addition of additional wharf, or adequate protected anchorage)."*¹¹¹

It even envisages the expansion for non-mining demand:

*"The land side of the port shall be designed to facilitate future expansion and public or third party access to general petroleum product and general cargo storage and handling facilities."*¹¹²

Both contracts are designed to leave room for flexibility with respect to the operational model used in the event of third party use of the railroad:

*"If the Government or one or more third parties wish to use the Railroad to carry bulk cargo, the Company may continue to operate the Railroad itself and carry out the operation of all trains on the Railroad, or the Company may transfer operational responsibility for the Railroad to an operating company owned by the Company and each other entity that has contributed to the capital investment (exclusive of motive power and rolling stock) in the railway, and such operating company may either operate the Railroad and all trains, or may be responsible solely for the operation and maintenance of the fixed rail facilities and allow all persons that meet non-discriminatory operating standards to operate their own bulk cargo trains on the fixed rail facilities."*¹¹³

Moreover, the Western Cluster agreement allows for the Government or a third party to undertake expansion plans even if the Western Cluster does not elect to do so, provided that such expansion would not unreasonably interfere with their operations.¹¹⁴

5. Findings and Conclusions

With four existing mining infrastructure corridors, Liberia has a lot to gain from shared use of its rail and port infrastructure. While the scope for use of rail by the forestry and agriculture sector seems less realistic at this stage, there are a large number of untapped mineral deposits, both nationally and regionally which may benefit from third party access in the future. The current concession agreements lay a good foundation for third party use of infrastructure. However, careful planning and strategic negotiation will be necessary to ensure that this becomes a reality.

The identified possibilities for shared use along the different mining corridors are summarized in the table below:

Table 8: Summary of the findings for shared use possibilities in relation to rail and port infrastructure in Liberia

¹¹¹Section 6.7 (e) of Putu Iron Ore Mining Mineral Development Agreement.

¹¹² Section 6.7 (f) of Putu Iron Ore MDA.

¹¹³ Section 6.7(g) of Western Cluster MDA.

¹¹⁴ Section 6.7 (i) of Western Cluster MDA.

Corridor	Concessionaire	Shared Use Possibilities
Yekepa - Buchanan	ArcelorMittal	<ul style="list-style-type: none"> • Small-scale mining operations • Larger deposits along Liberia-Guinea border (if double track can be financed)
Bong- Monrovia	China Union	<ul style="list-style-type: none"> • Back haulage transportation of coal for Jindal thermal plant • Future possibilities for shared use with Wologizi and Kpo license -holders
Bomi-Monrovia	Western Cluster	<ul style="list-style-type: none"> • Future possibilities for shared use with Wologizi license-holders, regional trade from Sierra Leone
Southeast- Greenville	Putu	<ul style="list-style-type: none"> • Future possibilities of regional demand from Côte d'Ivoire and Guinea • Use of port facilities by forestry and agricultural concessions

B. Scope for shared use in the context of power

1. Background

1.1. Key facts on the power sector in Liberia

Installed capacity	22.6 MW generated through four high speed diesel generating stations in or near Monrovia (Paynesville, Congo Town, Bushrod Island and Kru Town). Installed under two emergency power programs in 2006 and 2008, using donor funding. ¹¹⁵
Transmission	Grid infrastructure only in place in Monrovia, a medium and low-voltage distribution network. ¹¹⁶
Tariffs	US\$0.43 per kWh ¹¹⁷
Electricity Access	10,000 customers (LEC) ¹¹⁸
Policy Entity	Ministry of Lands, Mines and Energy
Regulator	No regulator
Utility	Liberia Electricity Corporation (LEC) – a vertically-integrated utility responsible for electricity supply in Liberia. Since 2010, the LEC is operated under a management contract by Manitoba Hydro International of Canada.

1.2. How do the mines currently get their power?

At present, every mining company operating in Liberia has its own electricity generation infrastructure on-site to power its operations. During their initial start-up phases, mining companies are using diesel or heavy fuel oil (HFO) plants. These generation arrangements involve transportation of imported fuels from ports to mining sites by road.

- ArcelorMittal’s Phase 1 involved a 15-16MW diesel plant. For its Phase 2, it plans to build a 20MW HFO to power its port operations in Buchanan, and a 50-60MW HFO for its mining operations in Yekepa.¹¹⁹
- Western Cluster has recently released a tender notice for a 50MW HFO based power plant to power its project, including the power distribution system.¹²⁰
- Putu Iron Ore Mining (Putu) plans to use module diesel generators for its ramp-up period, and fuel oil module power stations thereafter.¹²¹

¹¹⁵ Interview with Norwegian Embassy Energy Consultant, Monrovia, July 16, 2013.

¹¹⁶ Ibid.

¹¹⁷ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” AICD, op cit.

¹¹⁸ Interview with Norwegian Embassy Energy Consultant, Monrovia, July 16, 2013.

¹¹⁹ Interviews with ArcelorMittal, Buchanan, July 14-15, 2013.

¹²⁰ “Vedanta Expression of Interest: Beneficiation Plant/Civil Works/Power Plant/Infrastructure works/Logistics for Iron Ore mining project, West Africa,” available at:

<http://tendernoticeafrica.com/ArchiveTenderPrint.aspx?srno=9791471&encp=3cb655fdf86b4ab95>.

¹²¹ Severstal Corporate Presentation, November 2012, available at

http://www.severstal.com/eng/ir/conferences_presentations/business_presentations/7816.pdf.

- The gold mining projects (Hummingbird, Aureus Mining) have a lower power demand and given their lower overall capital expenditure and shorter mine lives, they prefer diesel generation rather than HFO due to the lower upfront costs, despite higher operational costs. Hummingbird plans to construct a 30MW diesel plant to power its crushing operations, and Aureus Mining has a 15MW diesel power plant.¹²²

2. Power Generation and Transmission Gaps in Liberia

2.1. Insufficient National Supply

The current installed generation capacity in Liberia is 22.6MW. Of this, around 10MW is supplied to a customer base of 10,000 people in Monrovia.¹²³ The MoPEA states that demand is estimated at 30MW but acknowledges that this figure is generally agreed to be an underestimate and is expected to increase substantially as the economy expands.¹²⁴ The AICD estimates that public demand for electricity in Liberia (excluding the mining sector) is expected to reach between 140 and 280 MW between 2010-20.¹²⁵

Therefore the current generation capacity is clearly insufficient to meet domestic power consumption, let alone industrial demand from mining companies. Currently LEC's efforts are focused on increasing power generation and distribution in Monrovia and surrounding areas on a much smaller scale than would be necessary for the mines. Immediate generation plans include three 10MW donor funded HFO plants, and the donor-funded rehabilitation of the Mount Coffee Hydro plant, which under current plans would provide 65-80MW of power in the rainy season, but only 10MW in the dry season due to the lack of a reservoir storage facility.¹²⁶ In addition, there are plans for regional interconnection and importation of power from the WAPP, although according to the West Africa Power Pool (WAPP) Master Plan, the availability of such power for import to Liberia is constrained to 80MW in the medium term.¹²⁷ A pilot project is also underway which connects Liberia with Cote D'Ivoire and would allow the importation of 18MW of power along low and medium voltage lines¹²⁸ (See Box 2).

For the large-scale iron ore mining operations, long-term power demand could ultimately reach as much as 150-200MW. For example, reports suggest that during Phase 3 of ArcelorMittal's operations, the mining company plans to construct a coal-fired 150-200MW

¹²² Interview with Hummingbird Resources, Monrovia, July 17, 2013.

¹²³ Interview with Liberia Electricity Corporation, Monrovia, July 17, 2013.

¹²⁴ Ministry of Planning and Economic Affairs, "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

¹²⁵ Foster and Pushak, "Liberia's Infrastructure: A Continental Perspective," AICD, op cit.

¹²⁶ Interview with Norwegian Embassy Energy Consultant, Monrovia, July 16, 2013.

¹²⁷ WB Report/Options for the Development of Liberia's energy sector. Africa Energy Unit (AFTEG) Energy Sector Policy Notes Series, IBRD, 2011 available at http://siteresources.worldbank.org/EXTAFRREGTOPENERGY/Resources/717305-1266613906108/Liberia_Energy_ESW_11-4-11web.pdf.

¹²⁸ "Nimba County Goes Agog...Several towns connected to national grid," Ministry of Information, Cultural Affairs and Tourism website, August 2013, available at <http://www.micatliberia.com/index.php/media/news/latest-news/1537-nimba-county-goes-agog-several-towns-connected-to-national-grid>.

power plant at the Yekepa iron ore mine.¹²⁹ AICD estimates that over the next 30 years, Liberia's mining concessions will require 840MW of power generation capacity.¹³⁰

2.2. High Power Costs

AICD suggests that power tariffs in Liberia are likely to be the highest in Africa at \$0.43/kWh. It notes that this level is about three times the average power tariff in Sub-Saharan Africa (around \$0.14/kWh), and about six times higher than average power tariffs in other parts of the developing world (around \$0.07/kWh).¹³¹ The tariffs are extremely high due to the high cost of the diesel fuel, the high level of technical losses (9.5%) and non-technical losses, and the large incidence of theft when supplying electricity to very poor areas with ineffective monitoring and enforcement.¹³²

Under these circumstances, most private buildings and businesses find that the cost of running a diesel generator is cheaper than receiving electricity from the LEC. Many companies also receive tax relief on gas imports, a benefit which the LEC does not get. The new Consolidated Tax Amendment does not allow for any import duty exemption on gasoline or gas oil for mining projects,¹³³ yet many agreements have exemptions written into the contract with strong stabilization clauses, rendering the Tax Code ineffective.¹³⁴ The World Bank also suggests that cost of generating power with HFO for the mining concessions could be lower than for the Liberia Electricity Corporation because of their ability to purchase the fuel at a large scale. It estimates that using smaller diesel or HFO plants, power generation costs would be approximately \$0.20/kWh.¹³⁵

2.3. Lack of Transmission Infrastructure in Mine Areas

At the date of this report, Liberia lacks a national power transmission grid that would allow mining companies to source power that was generated by LEC or third party IPPs. LEC is currently only able to distribute 10MW of its 22MW capacity due to the inadequate transmission and distribution infrastructure. Grid infrastructure is currently only in place in Monrovia and some surrounding areas, and therefore it would only be realistic for nearby mines such as the Bong Mine or Western Cluster to tap into any existing grid infrastructure. Moreover, the existing grid is a medium and low-voltage distribution network that would require upgrading before any mining company could connect.¹³⁶ Therefore these transmission lines would certainly not be adequate to carry industrial level voltage to power the mines.

¹²⁹ West Africa Mining Summit: ArcelorMittal eyes 200MW power plant in Liberia, Steel First, June 2013 available at <http://www.steelfirst.com/Article/3214231/WEST-AFRICA-MINING-SUMMIT-ArcelorMittal-eyes-200MW-power-plant-in-Liberia.html>

¹³⁰ Foster and Pushak, "Liberia's Infrastructure: A Continental Perspective," AICD, op cit.

¹³¹ Ibid.

¹³² Interview with Norwegian Embassy Energy Consultant, Monrovia, July 16, 2013

¹³³ Section 1708 b of Amendments to the Revenue Code of Liberia Act of 2000, Republic of Liberia, 2011.

¹³⁴ Article XXV Section 1 Import Duties and Other Payments of ArcelorMittal Mineral Development Agreement.

¹³⁵ World Bank, "Leveraging investments by natural resource concessionaires," Infrastructure Policy Notes, op cit.

¹³⁶ Interview with Liberia Electricity Corporation, Monrovia, July 17, 2013.

The current mandate of the Manitoba Hydro Corporation does not focus on any areas outside of Monrovia, and instead aims to increase connections in Monrovia, to reduce transmission losses and increase the capacity of the LEC staff.¹³⁷ Therefore it does not seem likely that there will be a national grid in the immediate future. However, the WAPP is planning to lay a high-voltage transmission line along the coast connecting Sierra Leone to Guinea, Liberia, and ultimately Côte d'Ivoire which will provide a backbone off which to expand the domestic grid (See Box 1). Commissioning for this transmission line is expected in 2015.¹³⁸

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

Under these circumstances, it is clear that to meet the immediate needs of their mining operations, self-generation is the most obvious solution for mining companies. However, as this section explains, there are ways in which Liberia may be able to integrate planned power generation investments by the mining sector into its national power development plans.

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

Off-Grid Solutions

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 GoL in 2010 established an independent Rural and Renewable Energy Agency to encourage the development and supply of energy products and services to rural areas through the private sector as well as community initiatives.¹³⁹ The mines could either work with this agency to deliver such services, or along with donors and NGOs, pursue off-grid technologies that make use of low cost and small-scale renewable energy such as mini-hydro schemes or solar technology.

Mini-Grid Solutions

One can also consider the scope for provision of additional power to surrounding areas, developing a mini-grid. Since most of the country remains far from any existing transmission infrastructure, the development of mini-grids 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, NGOs and utilities. For example, the mining company could establish

¹³⁷ International Bank for Reconstruction and Development, "Options for the Development of Liberia's Energy Sector," Report No. 63735-LR, available at:

http://siteresources.worldbank.org/EXTAFRREGTOPENERGY/Resources/717305-1266613906108/Liberia_Energy_ESW_11-4-11web.pdf.

¹³⁸ WAPP, "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.

¹³⁹ Rural and Renewable Energy Agency website: http://www.rrea.gov.lr/page_info.php?&7d5f44532cbfc489b8db9e12e44eb820=MTAy.

the mini-grid and the public utility could be in charge of operation, management, tariff collection and any additional policy initiatives necessary for the success of the project.¹⁴⁰

Table 9 builds upon a table constructed by the World Bank,¹⁴¹ detailing the contractual provisions relating to power in existing iron ore mining agreements. Almost all of the contracts consider the possibility of concessionaires having excess power generation capacity. However, none of the mining companies at present appear to be supplying power beyond the scope of their operations, although ArcelorMittal provides power to Yekepa and Tokadeh townships, and has offered to build an extra 10MW power plant in Ganta and in Buchanan.

The provisions show that excess power generation is optional in the case of the ArcelorMittal and China Union agreements, but is obligatory for Western Cluster and Putu. Putu is required to develop power generation capacity so that it can be expanded on a commercially feasible basis to have twice the capacity needed for mining operations. In addition, the mine has an obligation to provide power to all third party users within a 10 km radius of the plant. As these companies develop their feasibility studies, it is important for the GoL to coordinate with the companies to explore the dimensions of such excess power generation.

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 generation and distribution in mining areas or off-grid solutions with on-going operational 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 beforehand. Mining companies may be reluctant to supply power directly to communities. While the mining company may be willing to fund the construction of low voltage distribution infrastructure, tariff collection responsibilities as well as handling risks of non-payment fall well outside the scope of its core activities.

An alternative arrangement would see the LEC play the role of offtaker of all the power supplied to the mini-grid. However, given the current inefficiencies and weak balance sheet of the LEC (see Section 4c below), along with concerns over the quality

¹⁴⁰ Toledano, Thomashausen, Maennling, Shah, “A framework to approach shared use of mining-related infrastructure,” op.cit

¹⁴¹ World Bank, “Leveraging investments by natural resource concessionaires,” Infrastructure Policy Notes, op cit.

of governance in Liberia, mines might question the security of such a take or pay arrangement, and the additional securities required (partial risk guarantees, letters of credit) would increase the expense of the arrangement to the government. LEC is currently not present outside of Monrovia, therefore institutions would have to be built to oversee the distribution of power. Decentralized governance in Liberia remains very weak, and it is NGOs and donor funded programs that currently attempt to fill the service delivery gap at a local level.

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. For example during Phase 3 of ArcelorMittal's mining operations, reports suggest that it plans to construct a coal-fired 150-200MW power plant at the Yekepa iron ore mine.¹⁴² In these situations, mining companies can be incentivized or required to build excess power capacity to be sold back to the grid.

Interviews suggest that in the previous pre-war operations of the Bong Mine, there was a symbiotic relationship between the Mount Coffee hydropower plant and the Bong Mine thermal oil plant (at a time when oil was cheaper than current levels) whereby the Bong mine could fill the power supply gap of the hydro plant in the dry season and offtake power to compensate for this during the rainy season.¹⁴³

The World Bank has estimated the cost impact of such an arrangement where the mines generate power at a large scale through 100MW coal-fired plants and connect to the grid so that the surplus can be sold to the Liberia Electricity Corporation. Under the assumption of 700MW generated to serve the mines, and 160MW of excess supply to the grid, the analysis suggests an average cost of power for the country of \$0.12/kWh by 2030. This is \$0.03/kWh cheaper for Liberia than the \$0.15/kWh that they predict would otherwise result by 2030 under the base case scenario of mine self-generation.¹⁴⁴

Coordinated Mine- Power Investments

In theory, given the large future power demands of the mining companies operating in Liberia, there is scope for achieving economies of scale under a coordinated investment for the mines which are located within relative proximity to one another. With power being such a large operating cost to the mines, there could be substantial savings made from resource pooling and joint strategy among the mining companies. The mines would jointly form or else contract with an independent IPP to manage the generation and transmission system for such an investment. This may be difficult in reality given the highly competitive environment of mining, as well as the geographic dispersion of the mines across the country and the different time schedules associated with their operations.

To demonstrate the cost savings, the World Bank expands on the calculation mentioned above to analyze the theoretical possibility of a single cost-effective large scale thermal plant

¹⁴² "West Africa Mining Summit: ArcelorMittal eyes 200MW power plant in Liberia," *Steel First*, June 2013 available at <http://www.steelfirst.com/Article/3214231/WEST-AFRICA-MINING-SUMMIT-ArcelorMittal-eyes-200MW-power-plant-in-Liberia.html>.

¹⁴³ Interview with Stanley Consultants, Monrovia, July 13, 2013.

¹⁴⁴ World Bank, "Leveraging investments by natural resource concessionaires," op cit.

which would be developed at a coastal site to supply all mines, building in surplus power generation to be sold to LEC. With the coordinated power plant investment, the average cost of power in Liberia by 2030 would fall to \$0.08/kWh, compared to \$0.15/kWh with mines self-supplying, or \$0.12/kWh with mines individually building power plants with excess supply capacity. It notes that the largest savings accrue to the mines, which would reduce overall energy costs from US\$6.8 to US\$5.4 billion, a saving of US\$1.4 billion over a 20 year period (or US\$70 million annually).¹⁴⁵

Economies of Scale in Hydropower

There is significant hydropower potential in Liberia. Hydropower holds scope for significant economies of scale and can generally deliver lowest cost electricity on a leveled cost basis. The World Bank has made some calculations to demonstrate the cost savings, which could be achieved by building a shared power plant in Guinea. Given the similarity of the country context, the calculations are taken to be illustrative of the scale of savings which could be achieved in Liberia. Under a scenario where mines self-supply through diesel fuelled self-generation units, initial power costs amount to a unit cost of \$0.245/kWh. Investment costs would be relatively modest, but on-going fuel costs and operating expenditure would be high. However, this can be compared to a scenario where a shared hydro power generation plant is developed. The power plant acts as an independent power producer (IPP) with power purchase agreements from the mining companies. The investment cost and maintenance of the grid connecting the mines and the plant would be the responsibility of the IPP, which could be owned by the mining companies or could be a separate private entity. This arrangement results in a generation unit cost of \$0.049/kWh, almost one-fifth of the cost of self-generation.¹⁴⁶

Currently plans for the expansion of the Mount Coffee power plant do not appear to include a reservoir to smooth seasonal variations in power supply.¹⁴⁷ This would necessitate an additional investment, but the reservoir is essential for future hydro plants to be built along the St Paul River (See Section 3.3). Mining companies may collaboratively not only have the capacity to deliver such a project, but also the incentive to optimize the scope of the plant. Given the need by mining companies for the continuous power all year round, they would be incentivized to build the reservoir as well as a hydropower plant. If sufficient excess capacity cannot be financed by the companies themselves, coordination with donors could help deliver such a project. In fact, China Union's agreement explicitly gives the company a right to build a 130MW hydro-power project on the St Paul River or purchase 100MW from other hydro-electric power plants on the St Paul River.¹⁴⁸ The BHP Billiton agreement also makes reference to hydropower stating that any plans to develop hydro-power project require the prior approval of the Minister and must utilize the full hydro-potential available at the site.¹⁴⁹

¹⁴⁵ Ibid.

¹⁴⁶ 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

¹⁴⁷ Interview with Stanley Consultants, Monrovia, July 13, 2013.

¹⁴⁸ Mineral Development Agreement between the Government of Liberia and China Union (Hong Kong) Mining Co. Ltd and China Union Investment (Liberia) Bong Mines Co Ltd dated January 19, 2009.

¹⁴⁹ Mineral Development Agreement between the Government of Liberia and BHP Billiton (Liberia) Inc. and BHP Billiton Iron Ore Holdings Pty Ltd, 2010.

Constraints to Excess Power Generation

However, the feasibility 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.
- **National Power Utility as an Offtaker:** Such an arrangement would see the LEC play the role of offtaker of the excess power being supplied to the grid. Given the current inefficiencies and weak balance sheet of the LEC (see Section 4c below), along with concerns over the quality of governance in Liberia, mines might question the security of such a take or pay arrangement, and the additional securities required (partial risk guarantees, letters of credit) would increase the expense of the arrangement to the government. Once the WAPP regional project is completed (see Box 1), this risk may be reduced because if there is insufficient national demand, the regional energy market provides an additional market for excess supply.
- **Transmission Infrastructure:** In order to distribute excess power to the grid, there is a need for adequate transmission infrastructure. In the absence of a nation-wide grid infrastructure, transmission lines would need to be created. However, with the advent of the new WAPP line (See Box 1), extension of the transmission infrastructure to the mine sites may be a much less costly undertaking for any of the government, donors or mining companies than in the complete absence of any infrastructure (see Section 4.4).

Table 9: Provisions in Mining Development Agreements detailing power arrangements¹⁵⁰

¹⁵⁰ Adapted from World Bank, “Leveraging investments by natural resource concessionaires,” Infrastructure Policy Notes, World Bank for the Republic of Liberia (Washington D.C.: The World Bank, 2011).

Mining concessionaire	Section	Details
Western Cluster		<ul style="list-style-type: none"> • The power plant shall be designed to generate a quantity of electric energy in excess of the power required by Western Cluster for its operations to supply third party users located within a 10 km radius of the mine on a 7 days per week, 24 hours per days basis in accordance with third party user demand from time to time, provided that Western Cluster shall not be required to build a power plant in a manner that it generates an excess of more than 10% over the electric energy required by it for operations.” • Western Cluster shall only be obligated to provide the power at the gates of any power plant and interconnection between the third party consumers and the Power Plant and the distribution of the electricity shall be done on the Government’s infrastructure • Western Cluster may charge third party users rates at market price for their power usage. Western Cluster shall provide electric power free of charge to government agencies in the 10 km radius area surrounding any power plant; provided that the GoL is responsible for and pays the costs associated with interconnection and distribution of from such power plant to such government agencies. • Any power plant shall also be designed and constructed so that it can be expanded on a commercially feasible basis to have twice the electricity generating capacity necessary to service operations. <p>(Source: Western Cluster MDA)</p>
Putu	19.3	<ul style="list-style-type: none"> • The power plant shall be designed to exceed energy needs of Putu and excess energy supplied to third party users within a 10km radius (24/7 access). • Residential users shall be charged at reasonable rates based upon their ability to pay. • Companies shall be charged at reasonable rates. • Non-profits and government agencies will be supplied free of charge. • If sold to third parties Putu shall have no liability for any franchise, license or similar fees, otherwise imposed by applicable law, but shall be imposed by tax applicable to the sale of electricity, including service tax • The power plant shall be designed and constructed so that it can be expanded on a commercially feasible basis to have twice the electricity generating capacity necessary to service operations.
ArcelorMittal	16.c (2007)	<ul style="list-style-type: none"> • Entitled to generate, transmit and use electricity according to Law regulating such use. • Electricity purchased from the government will be charged at fair market pricing • If ArcelorMittal produces more power than it utilizes it shall sell the extra production to the GoL and if the GoL declines, to other third party users, in each case at fair market price.

BHP Billiton	19.4	<ul style="list-style-type: none"> • Feasibility Report should spell out energy generation plans. • All parties acknowledge that the energy facility constructed may (but company is under no obligation to) generate more power than is needed by the company and that the Government has the first right to purchase this “Excess Energy” as long as the government enters into a four year contract or longer, if not the Company has the right to sell the excess energy to any third party. • The price charged for the excess energy sold to the Government will be agreed between the parties, plus a return on equity of 12% per annum of marginal cost of the installed capacity to generate the excess energy.
China Union	19.3	<ul style="list-style-type: none"> • In accordance with Modified Bid materials the Company is entitled to provide for its energy needs by i) constructing a heavy-oil power plant ii) development of a hydro-electric power plant at SP1 on the St. Paul’s river near Hyendi town with the generating capacity of 130MW and iii) the purchase of 100MW of power from other hydroelectric plants in the St Paul’s River basin, leading to a total of 130MW of power as a result of the activities from ii) and iii). • The Hydropower plant shall be designed, constructed and operated in compliance with the National Power Development Plan for the St Paul’s basin • Government will provide technical information regarding development plans to Government technical advisors and shall also enter into additional agreements with the Government and other third party developers regarding technical, operational, ownership, and economic matters related to the Hydro-Power plant. • If Concessionaire produces more electricity than it utilizes it shall sell the extra production to the Government, and if the Government decides to decline to another Third Party, in each case at a price equal to costs plus a reasonable profit margin to be agreed by the Concessionaire and the Government • If sold to third parties the Concessionaire shall have no liability for any franchise, license or similar fees, otherwise imposed by Applicable law, but shall be imposed by tax applicable to the sale of electricity, including service tax.

3.3. Leveraging Mines for increased generation: Mines as an anchor for IPP power generation

Although the country’s current power infrastructure deficit means that mining companies are generating their own power for current operations, diesel and heavy fuel oil is expensive, and interviews suggest that they are keen to explore cheaper alternative options such as offtaking power from IPPs.¹⁵¹ As this section explains, mines can play an important role as anchor customers for IPP generation investments that require outside investment. 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 an offtake agreement, which would provide helpful demand guarantees to increase the bankability of the power investment.

It may be challenging to coordinate such an agreement, since mining and power investments follow different time horizons (power plants generally take longer to build than a mine). However, if this can be coordinated, the power demand can significantly help in progressing investments which might not otherwise take place.

Current IPP Generation Plans in Liberia

There are currently very few IPP plans in Liberia. Table 10 lists some potential future projects. Jindal Steel & Power’s coal plant is the most advanced, while Buchanan Renewables has recently abandoned its operations. With respect to the St Paul river hydro projects, IPPs have not yet been identified for these projects.

Table 10: IPP Investments in Liberia

Jindal Steel Power Limited – Thermal Coal Plant ¹⁵²	<ul style="list-style-type: none"> • 350MW Coal Based Power Plant (using imported coal) in its first phase. It will extend the capacity in the next phase based on the demand from various companies and the Government. • Coal to be imported from JSPL’s coal mine in Mozambique
Buchanan Renewables Biomass Plant ¹⁵³	<ul style="list-style-type: none"> • Two 17.5 MW wood fired biomass plants fuelled using wood from old rubber trees in Kakata • A net power supply of 30 MW to LEC substation in Paynesville for distribution to other parts of Monrovia and to other parts of Montserrado County. • Project recently abandoned, apparently due to inability to negotiate mutually agreeable PPA.
Hydro (St Paul)	<ul style="list-style-type: none"> • Stanley consultants have proposed that once the main

¹⁵¹ Interview with ArcelorMittal, London, July 26th 2013

¹⁵² “Jindal Africa to Build Coal-Fired Power Plant in Liberia's Capital,” *Industrial Info Resources*, September 2013, available at <http://www.industrialinfo.com/news/abstract.jsp?newsitemID=238241>

¹⁵³ Information on the Concession Agreement and Power Purchase Agreement Signed between the Government of Liberia and Buchanan Renewable (Monrovia) Power Inc., available at <http://www.molme.gov.lr/content.php?sub=14&related=7&res=14&third=14>, *Interviews in-country, July 2013*

River) ¹⁵⁴	<p>dam/reservoir at Mount Coffee is built, it can have IPPs tapping into the river at various points to tap into the large hydro potential of the St Paul River. Contracts to build the initial and subsequent plants would benefit from PPAs with industrial users such as mining companies</p> <ul style="list-style-type: none"> • Could be done with other rivers e.g. the Mano River, St John River, Via River (tributary of St Paul). • No IPPs yet identified to do this • The initial Mount Coffee rehabilitation project is to be donor-funded and may be completed by 2015, although this does not currently include plans for a storage reservoir.
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3.4. Challenges to leveraging mining demand for IPP generation

Power Price

The incentive for mining companies depends on the cost of the power that can be acquired from these IPPs through a future grid connection. The World Bank has calculated these cost differentials, which are shown in Table 11 below. It can be assumed Liberia will meet its demand by gradually drawing on a range of domestic hydro (Mount Coffee, St Paul River, Mano river) and thermal options (diesel, heavy fuel oil, biomass).

Table 11: Estimated Power costs¹⁵⁵

Liberia National Grid	US\$/kWh	Concessionaires	US\$/kWh
Mount Coffee Hydro	0.100	Diesel (<10MW)	0.290
Mano River Hydro	0.160	Heavy Fuel Oil (>20MW)	0.160
Saint Paul Hydro	0.160	Biomass (benchmark)	0.110
Heavy Fuel Oil	0.160	Coal-fired (100MW)	0.090
Biomass (benchmark)	0.110	Coal-fired (500MW)	0.076
Diesel (benchmark)	0.290		
Diesel (current)	0.320		

Source: World Bank

All the non-diesel/HFO grid generation options appear to provide cheaper power than self-generation diesel and HFO plants, suggesting that mining companies would have some incentive to source power from such IPPs in the short to medium term. Certainly, recent press releases

¹⁵⁴ Interview with Stanley Consultants, Monrovia, July 13, 2013.

¹⁵⁵ Adapted from World Bank, “Leveraging investments by natural resource concessionaires,” op cit.

regarding Jindal's 350MW coal power plant state that "power from the new project will sell on the local market at a price 66% lower than that for power from diesel generators, which are currently used."¹⁵⁶ Stanley Consultants calculate the cost of hydropower from IPPs along the St Paul River and come up with a range of US\$0.14-16/kWh based on a 12% IRR to the investor. However, the World Bank suggests that in the long run mining companies may be able to build large-scale coal plants to meet their power demands which would prove to be more economical. Ultimately, the IPP's ability to develop alternative power sources more cheaply than the mining company itself depends on the economies of scale that they can take advantage of and the cost of capital that they are accessing to develop the power plant.

Offtake amount

Once the mining company has agreed to be an offtaker for an IPP project, a key issue is how much power it should be permitted to offtake. The balance of this distribution of the power would determine the bankability of the project, as well as the contribution to broader economic development. For example, reports suggest that feasibility studies had been undertaken regarding the rehabilitation of the Mount Coffee power plant by China Union, but the use of the power by the mining company may have left little or no power to be supplied for use by the rest of the country.¹⁵⁷

While it is preferable for a significant amount of power to be bought up by the government to be supplied nationally to end users, the LEC is a less credit-worthy partner and a guarantee from the LEC would reduce the bankability of the project. AICD reports that operational efficiencies and underpricing result in total hidden costs which amount to 158% of its revenues. Compared to the performance of neighboring countries in West Africa, it notes that this is a relatively high level.¹⁵⁸ The presence of the GoL as an offtaker necessitates a number of risk mitigation demands from financiers, such as sovereign guarantees, escrow accounts, letters of credit and Multilateral Investment Guarantee Agency (MIGA) insurance. It should be noted that once the WAPP regional project is completed, the financial risks to Liberia will be reduced because excess supply can be sold into the regional energy market if there insufficient national demand. This will make private investment more attractive to independent power producers.

It is worth noting that, with lower cost hydropower projects in the foreseeable future, mining companies or even the GoL might be reluctant to sign long term PPAs for a power supply from smaller-scale power projects such as biomass generation projects. For example, regarding a potential PPA with Buchanan Renewables, the Ministry of Planning and Economic Affairs reported: "*LEC is hesitating because the cost of electricity would be more than double that of hydro-power. On the other hand, it would be only two-thirds the cost of the cheapest electricity available in Monrovia at present. The Buchanan Renewables project can more than double the*

¹⁵⁶ "Jindal Africa to Build Coal-Fired Power Plant in Liberia's Capital," *Industrial Info Resources*, September 2013, available at <http://www.industrialinfo.com/news/abstract.jsp?newsitemid=238241>

¹⁵⁷ Ministry of Planning and Economic Affairs "Liberia's Vision for Accelerating Growth: Development Corridors Desk Study," op cit.

¹⁵⁸ Foster and Pushak, "Liberia's Infrastructure: A Continental Perspective," *Africa Infrastructure Country Diagnostic*, op cit.

*power supply in Monrovia approximately two years after an IPP agreement is signed with the LEC.*¹⁵⁹

Regulatory Environment

At present there is no independent regulatory body overseeing the power sector due to the lack of any private participation in national power supply and the dominance of LEC in power generation. The current lack of clear rules and frameworks for IPP generation and the associated PPAs means that for new entrants, many of these details must be negotiated.

However, as Liberia emerges from its period of emergency power provision, it is looking to accelerate the pace of electrification by facilitating increased private sector investment in the electricity supply industry through the unbundling of the generation, transmission, distribution of electricity.¹⁶⁰ The National Energy Policy of 2009 states the intention for a new Energy Law which will set out the regulatory framework for a restructured power sector, and establish an Energy Regulatory Board.¹⁶¹

Transmission Infrastructure

The lack of transmission infrastructure poses a constraint to the supply of power by potential IPPs in Liberia. It may not be realistic to expect the GoL to extend the transmission infrastructure to supply a mining company and moreover, the mining offtaker then would take on the risk of the GoL delivering on the transmission infrastructure to adequate time and standard. Donors may fund transmission infrastructure if it serves a wide enough community area. However, there are a number of alternative ways in which this transmission infrastructure could be financed.

If the mine or the IPP pays 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.¹⁶²

¹⁵⁹ Ministry of Planning and Economic Affairs “Liberia’s Vision for Accelerating Growth: Development Corridors Desk Study,” op cit.

¹⁶⁰ Ministry of Lands, Mines and Energy, “National Energy Sector White Paper,” (2007), available at: http://www.molme.gov.lr/doc/Liberia-EPP-WhitePaper-Feb2007-DonorConference_20Final.pdf

¹⁶¹ Ministry of Lands, Mines and Energy, “National Energy Policy An agenda for Action and Economic and Social Development,” (2009), available at: http://www.norad.no/en/_attachment/133706/binary/61907?download=true%E2%80%8E

¹⁶² Toledano, Thomashausen, Maennling, Shah, “A framework to approach shared use of mining-related infrastructure,” op.cit

3.5. Leveraging mines for a more robust grid

There are two regional projects which are taking place at present under the WAPP. One is a low-voltage cross-border electrification project with Côte d'Ivoire, crossing the counties of Nimba, Grand Gedeh, and Maryland.¹⁶³ The second is the CLSG transmission interconnection.

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 1,411 km of high voltage (225kV) transmission line. 532 km of this transmission line will be in Liberia, along with four substations planned in Yekepa, Buchanan, Mt. Coffee/Monrovia, and Mano.



Source: 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/>

The WAPP lines run close to many of the mining sites, and the World Bank has calculated that once the CLSG transmission backbone is in place, the cost of extending the transmission grid to the major mining sites is negligible (well below \$0.01/kWh). This is due to the small size of the country and the large power demands of the mines.

In addition, as the World Bank points out, if the major mining sites were brought on to the grid, it would become economical for a number of secondary towns to be connected. If not, it states

¹⁶³ IBRD, "Options for the Development of Liberia's energy sector," Africa Energy Unit (AFTEG) Energy Sector Policy Notes Series, op cit.

that the vast majority of Liberia’s secondary towns would be too small and isolated to justify grid electrification in the foreseeable future.¹⁶⁴

Table 12: Costs of Extending the Transmission Line¹⁶⁵

Mining site	Nearest CSLG Sub-Station (or other mine)	Distance to Sub-Station (kms)	Total Cost of Transmission (US\$m)	Levelised Unit Cost of Transmission (US\$/kWh)
ArcelorMittal	Yekepa	-	-	-
BHP Billiton	Yekepa	-	-	-
China Union	Monrovia	47	16	0.0038
China Union	Belle Resources	56	19	0.0046
Piom	Iron Resources	117	28	0.0061
Western Cluster 1	Monrovia	42	11	0.0023
Western Cluster 2	Mano	39	11	0.0024
Western Cluster 3	Western Cluster	24	8	0.0015

Source: World Bank

There would have to be generation capacity ready for the mining companies to use if they are to be incentivized to extend the grid. Commissioning of the CLSG line is expected by 2015.¹⁶⁶ If power generation in Liberia is still limited upon completion of the line, measures would have to be taken to ensure that the grid supply was 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.¹⁶⁷

4. Findings and Conclusions

¹⁶⁴ World Bank, “Leveraging investments by natural resource concessionaires,” op cit.

¹⁶⁵ Adapted from: World Bank, “Leveraging investments by natural resource concessionaires,” op cit. The World Bank estimates are based on a conservative assumption that power demand would be 100MW at each iron ore mine and 30MW at each gold mine.

¹⁶⁶ WAPP, “West African Power Pool: Priority Projects and Implementation Strategy,” op cit.

¹⁶⁷ Toledano, Thomashausen, Maennling, Shah, “A framework to approach shared use of mining-related infrastructure,” op.cit

Through improved planning and structuring of new power generation and transmission capacity associated with the mining industry’s energy demand, Liberia can aim at building robust power generation facilities and electricity transmission systems as well as accelerating access to electricity in remote areas where mining companies are operating. Sound regulations and efficient coordination mechanisms will be necessary to realize synergies between the power and the mining sectors. If these efforts are successful, mines could benefit from considerable cost-savings and enhance the viability of these projects in an increasingly competitive sector. The potential options for power-mine synergies, along with their associated challenges are summarized in the table below.

Table 13: Summary of Power-Mine Synergies

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

C. Scope for Shared Use of Water Infrastructure

1. Background

Over a decade after the end of Liberia's 14-year civil war in which most of its water supply and waste water treatment systems were destroyed or left in disrepair, Liberia is still struggling to provide safe drinking water and sanitation services to the majority of its population. In 2008 it was estimated that only around 25% of urban households and 4% of rural households had access to safe drinking water, with a majority of Liberians relying on untreated wells, rivers, ponds, creeks and swamps to meet their water needs.¹⁶⁸ Coupled with a lack of adequate sanitation and waste water treatment facilities, and a widespread practice of open defecation, considerable drinking sources are contaminated by sewage, and preventable waterborne diseases are widespread.¹⁶⁹ An estimated 18% of deaths in Liberia are caused by a combination of a lack of safe drinking water, poor sanitation and hygiene.¹⁷⁰

According to the Africa Infrastructure Country Diagnostics (AICD), Liberia should have been investing an annual amount of US\$122 million on water and sanitation between 2006 and 2015 to meet the Millennium Development Goals in water and sanitation by 2015. However, with an annual allocation of around US\$8 million to the water and sanitation sector in 2009, this leaves an annual infrastructure spending gap of around US\$114, not taking into account any efficiency gains that could be had from fixing leaks, reducing water theft and improving system management.¹⁷¹

As also acknowledged in the 2012-2017 Water Supply, Sanitation and Hygiene (WASH) Sector Strategic Plan for Liberia, "with the current poor access to water, sanitation and good hygiene practices in Liberia, [...] Liberia is losing a notable proportion of its GDP and that not financing WASH will contribute to preventing Liberia from reaching its vision of becoming a middle income country by 2030."¹⁷²

This section examines to what extent, if at all, mining sector investments in water infrastructure could be leveraged to meet Liberia's national development goals in water and sanitation. It provides an overview of (1) Liberia's water resources and infrastructure, (2) the legal, regulatory and institutional framework governing water usage in Liberia's mining sector and (3) the scope for shared use of water and water infrastructure.

2. Liberia's water resources and infrastructure

¹⁶⁸ USAID, "WASH: Liberia Water and Sanitation Profile," (2008).

¹⁶⁹ Moses Massah and Chantal Richey, 'Wash Sector Recovery and Resourcing in Liberia' in "On the Water Front", Volume 2, 2010, World Water Week, available at: <http://www.worldwaterweek.org/sa/node.asp?node=1085>.

¹⁷⁰ Ibid.

¹⁷¹ Foster and Pushak, "Liberia's Infrastructure: A Continental Perspective," Africa Infrastructure Country Diagnostic, op cit., p. 32.

¹⁷² Section 1.3 of Massah and Richey, "Water Supply, Sanitation and Hygiene (WASH) Sector Strategic Plan for Liberia," op cit.

Liberia is a water abundant country. It has an average annual rainfall of around 2,391mm per year, with a spatial variation of between 2,000mm and 5,000mm.¹⁷³ Liberia’s wet season lasts around 5-8 months depending on the county; however certain areas still suffer from water shortages, particularly for agriculture, during the dry season.¹⁷⁴ While data on the hydrological resources of Liberia are generally lacking and out of date, ground water is considered to be available in most parts of the country in sufficient quantities to meet rural water supply demands, which to date relies mostly on shallow wells and drilled boreholes.¹⁷⁵

The water and sanitation sector in Liberia is considered to be a dire state.¹⁷⁶ Prior to the war, ten urban centers, including Monrovia, Buchanan (by ArcelorMittal’s port), Gbarnga (Bong County) and Kakata had pipe-borne water supply systems that had been built between 1970 and 1985. However, since the end of the civil war, none of these systems have been fully rehabilitated. By 2009, the White Planes water supply and treatment facility serving Monrovia was at 25% capacity of its-pre-war level of 60.5 million cubic meters of water per day, but is currently being refurbished and expanded by the developer, Eleqtra.¹⁷⁷ A tender notice was also recently issued the rehabilitation and expansion of the water treatment systems in Buchanan, Kakata and Zwedru with funding from the African Development Bank.¹⁷⁸ USAID is similarly funding the rehabilitation and upgrade of water systems in Robertsport, Voinjama, and Sanniquellie.¹⁷⁹

3. Legal, regulatory and institutional framework governing water use in mining

3.1. Institutional framework

There is no separate water ministry in Liberia. The management of water is currently carried out in a fragmented and uncoordinated manner by numerous ministries and entities as set out in Table 14.

Table 14: Institutions regulating the water sector in Liberia

Ministry of Lands, Mines and Energy (MLME)	Leads in policy formulation in the water sector and was responsible for the preparation of the 2007 Integrated Water Resources Management Plan (IWRMP) and the 2009 Water Sector Strategy Plan (WSSP). It also provides hydrological
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¹⁷³ Ibid.

¹⁷⁴ Ibid.

¹⁷⁵ Ministry of Lands, Mines and Energy, “National Integrated Water Resources Management Policy, (November 2008).

¹⁷⁶ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” Africa Infrastructure Country Diagnostic, 2010, p. 19.

¹⁷⁷ Eleqtra project portfolio, available at: <http://eleqtra.com/projects/monrovia-water/>

¹⁷⁸ “ Specific Procurement Notice: Liberia Water & Sewer Corporation: Urban water supply and sanitation project: Buchanan, Kakata & Zwedru water systems rehabilitation and expansion, “ African Development Bank, September 17, 2013, available at: <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-related-Procurement/Liberia%20-%20Urban%20Water%20Supply%20and%20Sanitation%20Project%20-%20SPN.pdf>.

¹⁷⁹ Tetra Tech website, “USAID Liberia Municipal Water Project,” available at: http://www.tetratechintdev.com/index.php?option=com_k2&view=item&id=473%3Ausaid-liberia-municipal-water-project&Itemid=187&lang=us.

	services through the Liberia Hydrological Services Bureau, water analysis, and collection of hydrological data. ¹⁸⁰ Before the civil war the MLME provided water quality analysis for chemical and biological contamination.
Ministry of Agriculture (MOA)	Involved in the provision of safe and adequate water supply to agricultural project localities.
Ministry of Health and Social Welfare (MOH)	Responsible for health promotion, environmental and occupational health, hygiene education and development of sanitation facilities and sets standards for water quality control and environmental health; and coordinates with Ministry of Education for development of sanitation related infrastructure in schools.
Ministry of Public Works (MPW)	Responsible for the design, construction and maintenance of public infrastructure, including road transport infrastructure, sewers, hospitals, public buildings and other public works. The Division of Rural Water ¹⁸¹ at the MPW is responsible for managing the Ministry’s rural water, sanitation and hygiene program as well as working with WASH-related NGOs to provide rural communities with clean and safe drinking water. The MPW leads the development of the Poverty Reduction Strategy Paper for the Wash Sector as well as some sector coordination on a national level.
Environmental Protection Agency of Liberia (EPA)	Established in 2003, the EPA is tasked with the management and coordination of all activities relating to environmental protection and the sustainable use of natural resources, <u>including water quality in the mining sector.</u> ¹⁸²
Liberia Water and Sewer Corporation (LWSC)	Established in 1973, its post-war mandate is to provide water to urban areas with a population of over 5,000 inhabitants. ¹⁸³ It operates on a commercial basis, although it provides basic water requirements to the urban poor at no cost.

As set out in the above table, the MLME is responsible for the overall management, policy formulation, regulation and coordination of water resources in Liberia, including in the mining sector.¹⁸⁴ The National Water Resources and Sanitation Board, once revitalized (it ceased to

¹⁸⁰ Ministry of Lands, Mines and Energy, “Water and Sanitation Policy” (2009), available at: <http://wash-liberia.org/wp-content/blogs.dir/6/files/sites/6/2013/08/Water-Supply-and-Sanitation-Policy.pdf>

¹⁸¹ “Department” section of Ministry of Public Works website, available at: http://mpwliberia.com/index.php?option=com_content&view=article&id=81&Itemid=87.

¹⁸² Ministry of Lands, Mines and Energy, “National Integrated Water Resources Management Policy,” (November 2008).

¹⁸³ African Water Facility, “Fostering Innovative Sanitation and Hygiene in Monrovia, Liberia: Appraisal Report,” (September 2012), available at: <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Liberia%20-%20Fostering%20Innovative%20Sanitation%20and%20Hygiene%20in%20Monrovia%20-%20Appraisal%20Report.pdf>.

¹⁸⁴ MLME, “National Integrated Water Resources Management Policy, op cit.

function during the civil war), is also supposed to be housed in the MLME. This board will comprise representatives from the key ministries involved in delivering water supply and sanitation in Liberia and will be responsible for sector coordination.¹⁸⁵ While its revitalization was set out in the 2007 Integrated Water Resources Management Policy (IWRMP), as of October 2013, it has not yet been re-established.¹⁸⁶ In its new mandate the board will also oversee an appointed Water Supply and Sanitation Commission (WSSC) and a Public Health who will regulate all activities related to water tariffs, licenses, PPPs, service standards, and compliance with water laws.¹⁸⁷

3.2. Legal and Policy framework

There is currently also no comprehensive legal framework governing the use and allocation of water rights in Liberia. The National Integrated Water Resources Management Policy (2007) provides that water resources for industry should be used in a sustainable way, with waste discharges limited to acceptable levels, with the ultimate goal of supporting national development.¹⁸⁸ It also sets out several guiding principles to be taken into account in the planning and allocation of water resources for industry, including mining. These include:

- Water for industrial use should only be allocated after allocations for domestic use have been made, taking into consideration the economic, social and environmental value of water, as well as other demands from other sectors.
- The ‘Polluter Pays Principle’ should be adopted requiring any polluter to be held to account.
- There should be a clear delineation of roles of all agencies and ministries involved with water quality management, monitoring and enforcement, with water quality sub-agencies established in rural areas.
- The assimilative capacity of surface water should be taken into account and standards should be defined in accordance with EPA guidelines on effluent emission standards and monitoring requirements.
- Industries should implement self-monitoring and notify the EPA of effluents discharge.¹⁸⁹

However, there are currently no regulations to implement these principles in law. Moreover, while the MLME is responsible for providing water licenses, there is no water rights allocation system in place. Some mining development agreements (MDAs) provide for the payment of a water levy for water usage, but this provision does not seem to be enforced, and to the extent it is, there does not seem to be any relation between the levy and the quantity of water used by mining companies. As discussed below, the draft model minerals development agreement 2009, along with other MDAs concluded with mining companies that were interviewed for the purpose of this study did not contain stringent standards in relation to the quantity of water mining operations could use or the quality of waste water discharge.

¹⁸⁵ UNDP Water Governance Facility website, available at: <http://www.watergovernance.org/liberia>

¹⁸⁶ “CSO’s WASH representative meets with Sirleaf Johnson,” *NDI-Liberia E-Newsletter*, Issue 17 (October 2013).

¹⁸⁷ “Water and Sanitation Policy,” op cit.

¹⁸⁸ MLME, “National Integrated Water Resources Management Policy,” op cit., p. 24.

¹⁸⁹ Ibid.

Water Rights

The Minerals and Mining Law of 2000 provides, in article 6.7(d) that the surface rights under a mining license should include the use of water and other resources necessary for mining operations. No limitation on the amount of water to be used is included; there is just a provision requiring water usage to be reasonable.

Pursuant to the Minerals and Mining Law, few additional restrictions on water usage have been imposed on mining operations in the MDAs since the end of the civil war other than a requirement that water usage be reasonable and should not interfere with existing water user rights. For example, the MDA between the GoL and ArcelorMittal provides that “the [ArcelorMittal] shall have the right, free of charge to...use water reserves...within the Concession Area, to the extent reasonably needed for [its mining operations].”¹⁹⁰ In addition, it states (1) that ArcelorMittal’s right to remove, extract and use water within the Concession Area for mining activities should not interfere with the water rights enjoyed by any other person who has entered into an agreement with the GoL regarding water usage, and (2) where ArcelorMittal’s water usage deprives someone of constant and reasonable supply of usable water from a previously utilized traditional source, ArcelorMittal is required to replace that water.¹⁹¹

The model MDA 2009, on which subsequent minerals development agreements are based, includes a more comprehensive provision on water usage in its section 6.3(b), which states:

“The [Mining Company] shall not deprive any Person of a constant and reasonable supply of usable water from or pollute a previously utilized traditional source without providing an alternative source of substantially the same quality and quantity, nor shall the [Mining Company], without the Minister [of Lands, Mines and Energy]’s consent and at least 30 days prior notice to the affected community, interfere with any water rights enjoyed by any user under any agreement with the Government made prior to the date of execution of this [Minerals Development] Agreement. Use of water will be subject to charges as provided in applicable Law or in the absence of applicable law, as provided in Section 15.6.”

Section 15.6 provides for a water levy to be negotiated between the parties in light of the mining concessionaire’s requirements as set out in a feasibility report and environmental impact assessment. However, as part of these documents, there is no express requirement for the mining concessionaire to disclose its actual water requirements. Any charge of a water levy therefore appears to be unrelated to the economic value of water, or the availability of water in the mining concession area.

Subsequent minerals development agreements, for example between the GoL and China Union (Hong Kong) Mining Co., Ltd in relation to Bong Mines, contain a slightly watered down version of the above provision which does not require (1) the alternative source of water to be of

¹⁹⁰ Unofficial Restated ArcelorMittal Mineral Development Agreement as Amended with Appendices dated December 28, 2006.

¹⁹¹ Article XXVII: Incidental Rights, s.1 (use of resources).

substantially the same quality or quantity as the traditional water source and (2) 30 days prior notification to the affected local community.¹⁹²

Water infrastructure

The minerals development agreements reviewed, including the model MDA 2009, require the mining company to (1) provide “clean and safe pipe borne water system” in all housing units provided by the mining concessionaire and (2) construct handpumps and other water sources “at its workplaces to ensure a convenient and uninterrupted supply of clean and safe drinking water.”¹⁹³ Drinking water is required to meet or exceed GoL standards for drinking water quality. To comply with this regulation, mining companies would be required to treat water on-site for drinking purposes and test the water quality of their drinking water to, in the absence of GoL drinking water standards, comply with international drinking water standards.

From discussions with ArcelorMittal, Vedanta Resources plc, Hummingbird Resources plc and Aureus Mining, mining companies provide piped water facilities for their workers that live on-site, but are not planning to extend water infrastructure to surrounding communities beyond the needs of the mining communities. Moreover, except for where there were already existing sewerage treatment facilities in place, such as in Yekepa town that was built by LAMCO, ArcelorMittal’s predecessor, smaller mining operations prefer to treat sewerage in septic tanks, or to store sewerage for off-site treatment closer to Monrovia.

Water quality

There are no comprehensive environmental regulations applicable to the mining sector. Instead, provisions regulating the environmental impact of mining operations, and particularly water quality, are contained in the Environment Protection and Management Law (EPML), the Minerals and Mines Law 2000 and the MDA entered into with each mining company.

The EPML was approved in November 2002 with the key objective of ensuring the sound management of environmental and natural resources.¹⁹⁴ However, it does not set out any provisions aimed at regulating the mining sector, let alone any definitive provisions in relation to water quality standards or the discharge of hazardous wastes. For example, section 35 of the EPML provides, among other things, that the EPA will, in consultation with the relevant Ministries, provide a water quality standard in respect of drinking water and water for industrial use, which has not yet occurred. Similarly, section 56 of the EPML prohibits any person from discharging any hazardous substance, chemical, or oil into any water except in accordance with guidelines prescribed by the EPA or relevant Ministry. However, no such guidelines in relation to the mining sector have yet been adopted.

¹⁹²¹⁹² Minerals Development Agreement between the Government of Liberia and China Union (Hong Kong) Mining Co. Ltd and China Union Investment (Liberia) Bong Mines Co Ltd dated January 19, 2009.

¹⁹³ Section 9.5 (Water Supply; Clean and safe drinking water” of the model minerals development agreement.

¹⁹⁴ “National Integrated Water Resources Management Policy, “Ministry of Lands, Mines and Energy, November 2008.

The EPML does, however, provide that mining companies are required to submit an environmental impact assessment (EIA), which must be updated periodically and that all environmental impact assessments submitted to the EPA should be made public.¹⁹⁵

In addition to the EPML, section 8 of the Minerals and Mining Law 2000 provides that a mining company must (1) take all “reasonable, preventive, corrective and restorative measures to limit pollution or contamination of, or damage to, among other things, streams and water bodies and (2) restore all water polluted to its prior state.

Finally, the MDAs generally contain some environmental provisions regulating the acceptable water quality levels of waste water. For example, the model MDA specifies that the mining company must “take appropriate preventive measures to protect all streams and water bodies within or bordering Liberia...from pollution, contamination or damage resulting from [mining operations]. If [the mining operations] ... damage the environment, the [mining company] must proceed diligently to restore the environment as much as possible to its original and natural state (or to remediate the damage where restoration is impractical) and must take appropriate preventive measures to avoid further damage to the environment.”¹⁹⁶ It also requires mining companies to conduct an annual independent environmental audit and allows the Minister of Lands, Mines and Energy and the EPA to carry out periodic inspections.¹⁹⁷

4. Water use in the mining sector

ArcelorMittal, the presently only operational large-scale mining concessionaire, does not process iron ore in Liberia. At the current phase of its operations, it just excavates, crushes and screens the ore excavated from open pits at Tokadeh, before loading it for transport on the Yekepa-Buchanan railway. For this purpose, its main use of water is for dust suppression during the dry season, which is estimated to require no more than 50,000 liters of water per day, and for domestic consumption purposes of the mining community.¹⁹⁸ Water is drawn from aquifers via shallow wells and boreholes to meet these needs and bottled water is provided for drinking purposes. Some of the existing boreholes have been found to be contaminated with tailings from the previous iron ore operations of LAMCO, which operated at Tokadeh prior to the civil war.

In terms of waste water discharge, it has been reported that there is significant rain run-off from the ArcelorMittal mine site, although the quality of this water is unknown. Sewerage treatment from the mining communities also seems to be an issue in Yekepa, where the existing water pipeline distribution network constructed by LAMCO is still defunct and believed to be contaminating a nearby rice paddy and the River Dayea.¹⁹⁹ ArcelorMittal is reported to be planning to rehabilitate this system by 2016.

¹⁹⁵ Annex I(15) and Section 32 of the EPML.

¹⁹⁶ Section 13.1 of the draft model MDA. Section 5.5(a) provides that the environmental management plan adopted must, at a minimum, include detailed plans consistent with the EIA for the mitigation of all environmental harm caused by the mining operations.

¹⁹⁷ Sections 13.2 and 13.3 of the draft model MDA.

¹⁹⁸ URS, “Nimba, Western Area: Iron Ore Concentrator: Mining Project, Liberia” Environmental Impact Assessment prepared for ArcelorMittal (March 2013).

¹⁹⁹ Ibid.

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

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

Given the sparsely populated locations in which ArcelorMittal operates, and other mining companies' exploration activities are occurring, coupled with 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 could potentially leverage mining-related investments in water for the purpose.

5.1.1. Mines and excess supply of dewatered water: leveraging mines' water infrastructure investments for water supply to communities

Excess supply from dewatered water

Water in the open pits – whether from rainfall or underground water flows – or from underground gold mines needs to be drained for mining operations to proceed. This process is known as dewatering. Water extracted by dewatering can and should be recycled for re-use in the iron ore mining process, and/ or can be treated and re-used for other purposes. Given the high seasonal rains in Liberia and the considerable amount of dewatering required to be carried out in relation to ArcelorMittal's open pit mining operations, as well as future iron ore (and gold) operations commencing production, there may be scope for excess water, over and above the water required for a mining operation's needs, to be shared with other non-mining users.

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:

- 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.** water is supplied by the mine to the relevant local government authority, an NGO, or a small-scale water supplier that would then deliver the water to surrounding communities, or directly to an 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 clean water. Given Liberia's current status as a fragile state, the emphasis has been on the provision of improved water sources to Liberians in rural areas rather than ensuring cost recovery of water tariffs at this stage, which affects the sustainability of such shared water infrastructure schemes both during and after a mine's closure at this stage.

5.1.2. Mines as an anchor for investment in water supply: leveraging mines water demand for increased water supply

There may be scope for collaboration with the government and donors such as the AfDB and/ or USAID 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 neighboring towns or communities. This is especially so given the AfDB's and USAID's current funding commitments to the Liberian water and sanitation sector to rehabilitate and expand water infrastructure in key rural towns around Liberia. Few mining companies in Liberia are located close enough to towns or cities with the critical mass of people and the existing water infrastructure to facilitate such synergies at this stage. However, there may be some scope for collaboration in areas such as **Buchanan**, which neighbors ArcelorMittal's port operations, **Yekepa**, neighboring ArcelorMittal's operations, or in **Bong county** (Gbarnga²⁰⁰ and Bong town), in which Bong mines is located.

5.1.3. Provision of low cost water technology solutions as part of CSR in coordination with national and local development action plans

Mining companies are coming under increasing pressure to provide social services, including water, to local and relocated communities in and around their mining operations. There is particular scope for mining companies to support the GoL's development goals in the area of water and sanitation, not least because of the mining sector's footprint on the surrounding water supply. This could be achieved by investing in low cost water technologies such as the drilling or boreholes with handpumps, or self-contained water treatment facilities.

Any potable water schemes provided as part of a CSR project should be aligned the Water, Sanitation and Hygiene Strategic Sector Plan for Liberia 2012-17, which sets out the guidelines rehabilitating old water points and constructing new water points in the country. To ensure the sustainability of any potable water scheme, local buy in is required and local capacity needs to be built to manage and maintain the water system provided. 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.

“Strategies – selection and construction of new water points:

- Carry out needs assessment to identify communities.
- Using poverty reduction and equity considerations, locate these interventions amongst the needy communities in the counties. If sufficient data is available, and based on actual felt needs, carry out district level prioritization.
- Adopt a demand-driven approach and sustainability through community ownership principles.
- Initiate community mobilization and hygiene education activities establishing the water management system and commitment of the community to the capital costs and the operation and maintenance before the project progresses to implementation.

²⁰⁰ According to the 2008 population census, Gbarnga had a population of 34,046. Source: “2008 National Population and Housing Census: Preliminary Results,” Liberia Institute of Statistics and Geo-Information Services, June 2008, available at: http://www.emansion.gov.lr/doc/census_2008provisionalresults.pdf.

- Undertake assessments of options for water supplies in selected communities and share with communities for community decision making.
- Follow minimum standards and government supported pump models and finalize technical designs.
- Support the community to implement the project and provide follow up support for a number of months to ensure the operation and maintenance is proceeding adequately.

Ensure that two or more community members are trained in the regular tasks for operation and maintenance and that the WASH Committee knows where it can get spare parts and can go for outside assistance if they face a problem they cannot solve on their own.”

Source: Section 3.5.2 of the Sanitation and Hygiene Strategic Sector Plan for Liberia 2012-17

5.2. Pre-requisites

A number of institutional and regulatory pre-requisites should be addressed 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. More information as to Liberia’s existing water resources is also required, as is greater community participation in the management and monitoring of water resources.

5.2.1. Water rights

Create a system of water rights allocation

The regulatory framework governing water use presupposes a clear system of allocating water rights among competing users and uses. Such a system has been envisaged in the National Integrated Water Resources Management Policy, but has to date not been drafted or implemented. At a minimum, legislation in this regard should (1) clarify how water will be allocated among competing users, (2) provide for a transparent system of granting and evaluating water licenses, including how the water tariff is calculated, 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.

To be in a position to effectively grant water rights, hydrological data is required to understand the existing water resources, their seasonal renewability and the cumulative impact of water use over time:

- I. Prioritize the collection of hydrological data to understand existing water resources and cumulative impact of users over time:** There is presently very little hydrological data available on Liberia’s water resources as most data records were destroyed during the civil war. This means that the MLME and EPA are reliant on the EIAs of mining companies to be informed about their water usage, without the necessary information to understand the impact of mining and other industrial and agricultural use on existing water bodies, or to independently verify the information provided. A comprehensive study on Liberia’s water points was conducted in 2011, which provides some information as to domestic water use and the state of basic water infrastructure. However, in order to

properly monitor water usage across all sectors, and to regulate competing water demands, a comprehensive baseline study of Liberia's water sources is required.

- II. Capacity:** The MLME needs the capacity to be able to assess, on the basis of each water license application, the amount of water a water licensee requires, taking into account reasonable water minimizing strategies and the water user's ability to re-use and recycle water in its operations, and to be able to monitor such water usage.

Minimize the quantity of fresh water each mining company is permitted to extract/ use for its mining operations

Unlike other water users, mining operations do not require fresh water for all their mining operations. Mining companies can and should reduce their fresh water demand through efficiency, technology, frequent monitoring and the use of lower quality and recycled water as process water, or for dust suppression. Given the extended rainfall in Liberia during the wet season, mining companies can also re-use dewatered water. Therefore, mining companies may not require much fresh water, if any, for their mining operations, and should only be allocated minimal rights to abstract fresh water.

5.2.2. Water treatment and discharge

Environmental regulations governing the mining sector should require all mining companies to recycle all mine water and minimize their use of fresh water usage

Excess water not used in the mining process should also be purified to acceptable levels before being discharged. A provision requiring recycling of dewatered water should be included in the new mining and minerals law currently under discussion, forthcoming MDAs and any subsequent regulations addressing the environmental impact of water usage of the mining sector. Mining companies that are unwilling or unable to recycle their waste water to acceptable levels before discharge should be subject to high penalties, or otherwise be required to obtain dispensation from both the MLME and the EPA for not doing so.

Tighter environmental regulations are required with strict liability and high penalties for non-compliance.

The environmental regulations governing the mining sector in Liberia were adopted in a piecemeal manner. Relevant provisions can be found in the EPML, the Mining and Minerals Law 2000 and the relevant minerals development agreement entered into between the GoL and the mining company. A comprehensive set of environmental regulations applicable to the mining sector in Liberia should be adopted that consolidates existing environmental regulations and more specifically sets out water quality requirements and effluent management and discharge standards, particularly in relation to tailings, acid mine drainage and surface run-off. There should also be a stringent financial penalty for the unlawful discharge of waste water.²⁰¹

²⁰¹ While section 56 of the EPML provides that the discharge of hazardous substances into a water body could lead up to a fine of US\$ 50,000 and a prison sentence of up to 20 years, the draft model MDA only requires mining companies to make diligent efforts to restore water to its previous quality. It is therefore unclear if the penalties are applicable to mining operations. Considering the size of large-scale iron ore mining operations, and the potential

In addition to strengthening the environmental regulations and mining laws regulating water usage and discharge, the following should be considered:

- I. **A stronger institutional presence of EPA and MLME capability to monitor mining activity:** The EPA is tasked with the management and coordination of all activities relating to environmental protection and the sustainable use of natural resources, including water quality in the mining sector.²⁰² However, its capacity to monitor water quality is hampered by a lack of any decentralized representatives in the counties where mining operations are located. Monitoring is carried out sporadically by a limited number of staff based in Monrovia.²⁰³ It also lacks the capacity to effectively monitor water quality and is not involved in monitoring water usage, which is in the remit of the MLME.
- II. **Greater sector coordination between Ministries and government agencies dealing with the water and mining sectors:** To ensure that mining companies are properly being regulated in relation to their environmental obligations and water footprint, the Ministry of Lands, Mines and Energy needs to coordinate and collaborate more closely with the EPA. 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. Given that both the MLME and the EPA are empowered to monitor the environmental impact of mining operations, they need to pool resources and collaborate with site visits to mining operations. The EPA should also be involved in the negotiations of the MDAs with mining companies, so that they are in the room when the environmental obligations are agreed they the EPA is subsequently required to monitor and enforce, including in relation to water quality requirements.²⁰⁴

6. Conclusions and findings

There is, at present, little scope for synergies between mining-related investments in water infrastructure and the water infrastructure investments that need to be made to supply surrounding communities with clean water. The most likely scenario is one where mining companies provide water to surrounding communities as part of a CSR program, whether it is treated dewatered water, which mining companies provide at cost, or for no payment, or the provision of small-scale water supply and filtration technologies.

Table 15: Summary of options for leveraging mining-related investments in water infrastructure

Option	Description	Challenges	Potential to leverage
Excess supply from	A portion of the	Regulations requiring	Moderate for

detrimental effect of large-scale gold mining or diamond mining operations on water, any fine imposed for the contamination of water should be sufficiently high to incentivize mining operations to comply with environmental water regulations.

²⁰² MLME, “National Integrated Water Resources Management Policy,” op cit.

²⁰³ Interview with Environmental Protection Agency, July 15, 2013.

²⁰⁴ Roundtable discussion with various representatives of the Environmental Protection Agency in Monrovia, July 15, 2013.

<p>dewatered water</p>	<p>excess water that collects in the open pits is drained (dewatering), treated and supplied to surrounding communities</p>	<p>companies to limit their fresh water usage and treat dewatered water before it is discharged into the environment.</p> <p>Coordination with LEC, NGO, donor, local water supply company.</p> <p>Lack of water infrastructure connecting mine sites water systems of surrounding communities.</p>	<p>companies to re-use dewatered water in their mining operations.</p> <p>Moderate-low for mining companies to provide treated dewatered water to surrounding communities because of a lack of piped water infrastructure connecting the mines to community water systems.</p>
<p>Mines as a demand anchor for investment in water supply, storage and treatment infrastructure</p>	<p>Mining company provides guaranteed demand for water supply infrastructure and possible additional technical expertise.</p>	<p>Small size of target communities and towns neighboring mine sites.</p> <p>Limited probability of cost recovery given GoL priority on provision of clean water over cost recovery.</p>	<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 GoL emphasis on small-scale technologies to extend access to water supply rather than piped water infrastructure and cost recovery.</p>

D. Scope for shared use in the context of ICT

1. Background

1.1. Key Facts of ICT Infrastructure in Liberia

Policy Entity	Ministry of Posts and Telecommunications
Regulator	National Telecommunications Authority
National Operator	Libtelco
Operators	Lonestar Cell, Cellcom, Comium, Libercel
Access Rate (Mobile Phone)	42% in 2013 ²⁰⁵
Access Rate (Internet)	2.8% in 2013 ¹

1.2. Mobile Coverage

The fixed line infrastructure of Liberia was almost completely destroyed during the civil war, and therefore mobile telephony dominates the telecommunication sector.²⁰⁶ At present, there are four mobile phone operators in Liberia. A recent survey carried out by the Liberia Telecommunications Authority (LTA) and West African Regional Communications Infrastructure Program (WARCIP) reports that mobile phone penetration in Liberia now stands at 42%, with 1.5 million out of the total 3.5 million population having access to a cell phone.²⁰⁷ This is the result of significant recent growth in the mobile phone sector – AICD reports that Liberia’s mobile footprint (the percentage of the population living within range of a mobile signal and hence able to subscribe to service) grew, from 18% to 32% between 2003 and 2009.²⁰⁸ In 2007, between 60% and 70% of the population centers received signals from at least one of the mobile providers’ services.²⁰⁹ Figures 10 and 11 show the coverage areas of the two leading operators in Liberia, Lonestar Cell and Cellcom.²¹⁰ Moreover, Liberia’s 2007 Demographic and

²⁰⁵ “Liberia mobile phone penetration rises to 42 pc,” survey, *Africa Review*, August 2013, available at <http://www.africareview.com/Business---Finance/Liberia-mobile-phone-subscribers-increase/-/979184/1938786/-/5g4kdk/-/index.html>

²⁰⁶ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” Africa Infrastructure Country Diagnostic, op cit.

²⁰⁷ “Liberia mobile phone penetration rises to 42 pc,” *Africa Review*, op cit.

²⁰⁸ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” Africa Infrastructure Country Diagnostic, op cit.

²⁰⁹ Michael Best et al, “Post-Conflict Communications: The Case of Liberia,” Communications of the ACM, 2007, available at <http://cs.furman.edu/~chealy/fys1107/PAPERS/liberia.pdf>.

²¹⁰ TLC Africa Website: http://www.tlcafrica.com/technology_Liberia_Telecommunication_Sector_Data.htm

Health Survey reported that 29% of households had a mobile telephone, and AICD deems the country's mobile penetration rate to be on a par with other low-income countries in Africa.²¹¹ Regarding the cost of mobile phone usage, AICD finds evidence to suggest that prices have fallen over time, noting that the cost of a SIM card fell from \$65-85 in 2001 to \$3-5 in 2010.²¹² In addition, the average revenue per user received by the main mobile phone operator fell from \$43 per month in 2003 to \$11 per month by late 2009, following the entry of new operators.²¹³

Figure 10: Coverage of Lonestar



Source: Mobile World Live²¹⁴

Figure 11: Coverage area of Cellcom

²¹¹ Foster and Pushak, "Liberia's Infrastructure: A Continental Perspective," AICD, op cit.

²¹² Ibid

²¹³ Ibid.

²¹⁴ Liberia - Coverage and Network Information, Mobile World Live, available at http://maps.mobileworldlive.com/network_info.php?nid=333&org_id=5434&cid=75



Source: Mobile World Live²¹⁵

1.3. Internet

The LTA/WARCIP study shows that internet penetration remains low with only 2.8% of the population having access.²¹⁶ Until early 2013, Liberia did not have a landing station to facilitate access to a fiber optic cable. The main way of accessing the internet was through satellite connections, which is expensive and beyond the affordable reach of most of the population.

Liberia now has a submarine cable and landing station linking it with Europe, acquired in 2013 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.²¹⁷ The government has created a special purpose vehicle, Cable Consortium of Liberia (CCL),²¹⁸ which holds the fiber equipment and is responsible for facilitating use of the cable by service providers.²¹⁹ Currently service providers are connected to the cable through microwave links, as the fiber has not yet been laid, apart from one stretch between the CCL and the Cellcom offices.²²⁰ While it is possible to more immediately tap into the fiber optic cable through microwave links from the landing station, ultimately there are plans to lay the cable in the country and facilitate direct connections. Libtelco, the government telecommunications company, is currently facilitating the connection of Monrovia to the fiber optic cable by starting to lay the cable around the capital city. In an

²¹⁵ Ibid.

²¹⁶ “Liberia mobile phone penetration rises to 42 pc,” *Africa Review*, op cit.

²¹⁷ Interview with Cable Consortium of Liberia, July 22, 2013.

²¹⁸ CCL Website: <http://cclnetwork.weebly.com/>

²¹⁹ The Cable Consortium of Liberia is a PPP between the GoL, Lonestar, Comium, Cellcom and, Libtelco. The Government has a 55% shareholding in the company while the service providers have 35%. (From interview with Cable Consortium of Liberia, July 22, 2013).

²²⁰ Interview with Cable Consortium of Liberia, July 22, 2013.

interview with Libtelco, it explained that Phase 1 of this project would involve a ring around Monrovia, with offshoots up to edge of the Bomi Mines, and to the Fendell campus of Liberia University. There are then plans to build out the backbone to supply broadband into the country's interior. It would either lay the cable underground or where possible use the incoming West African Power Pool (WAPP) power line infrastructure to hang the cable overhead.²²¹

However, while the fiber optic cable might contribute to lowering the cost of internet, high electricity costs are currently having the opposite effect, since network equipment relies on electricity to operate, and companies need to spend a large amount of money to fuel their masts and internet equipment. This then translates into high fees for internet service.²²²

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 through better logistics allowing virtual operations, grade optimization and improved exploration analyses. Instantaneous access to video, voice and data communications provides mining companies 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.²²³

Mining sites in Liberia are dispersed throughout the country suggesting that experience of ICT infrastructure may vary. While some mines are closer to Monrovia and other population centers (Western Cluster, Bong Mines), others are located in much more remote and uninhabited areas (Putu, Hummingbird). Moreover, some of the current and planned mining railroads pass through remote uninhabited territory to reach the ports.

The notion of ICT infrastructure and service provision by the mines to surrounding areas may not be appropriate in Liberia, because where companies make their own ICT arrangements, they typically would use private satellite infrastructure rather than reconstructing a very 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 infrastructure and services as part of a voluntary CSR initiative. While a mining company may fund the capital cost of a satellite antenna for nearby communities, 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 can play a role in increasing access to ICT service in surrounding areas.

²²¹ Interview with Libtelco, Monrovia, July 11, 2013.

²²² Based on CCSI interviews in-country, July 2013.

²²³ 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>

2.1. ArcelorMittal

ArcelorMittal's operations are in the interior of the country, in Nimba County near the border with Guinea. While its port operations are in Buchanan, which is a population center and well served by national ICT infrastructure, the story is quite different in the areas around its mine production site, which is quite remote and required ArcelorMittal to supply its own telecommunications infrastructure.

The sparsely populated interior presents a challenge for the expansion of ICT infrastructure by telecoms companies, because investing in high-cost infrastructure where there is relative low demand may make little commercial sense.²²⁴ The operator Lonestar Cell had previously stated that it was aiming to provide services to 80%–90% of *populated* areas by the end of 2007,²²⁵ but many mining sites and surrounding areas may be extremely sparsely populated or not populated at all. ArcelorMittal staff spoke of old and dilapidated telecoms towers near the mine site that had to be dismantled for safety reasons,²²⁶ indicating the lack of interest by telecoms companies in these areas. As a result, ArcelorMittal, like most other mining companies, uses the national mobile phone infrastructure where available, backed up by the use of satellite phones.²²⁷

For internet connections at the mines and at its site in Buchanan, ArcelorMittal has installed private VSAT connections.²²⁸ This is likely to be the case for all mining companies operating in Liberia currently, as VSAT is the most reliable method of connecting to the internet. Experts at the CCL suggested that with the advent of the fiber optic cable, mining companies could receive signals through microwave links from Monrovia,²²⁹ although this is likely to be more realistic for those mines located in close proximity to Monrovia, as clear line of sight along a series of telecoms towers is required to transmit the signal.

Since ArcelorMittal is also operating a railway, telecommunications infrastructure are extremely important to be able to run the railway safely. Particularly with multiple trains using the single-track rail, accurate coordination of passing trains on feeder loops is critical to avoid accidents. Near the mine, there is very patchy cellphone coverage, which currently does not extend to the hinterland through which the railroad passes.²³⁰ Figure 12 shows the coverage of Lonestar Cell, and there are clearly patches of the Nimba-Buchanan corridor which are not covered.

Figure 12: Lonestar Coverage of Nimba-Buchanan Corridor

²²⁴ Ibid.

²²⁵ Michael Best et al, "Post-Conflict Communications: The Case of Liberia" Communications of the ACM, 2007, op cit.

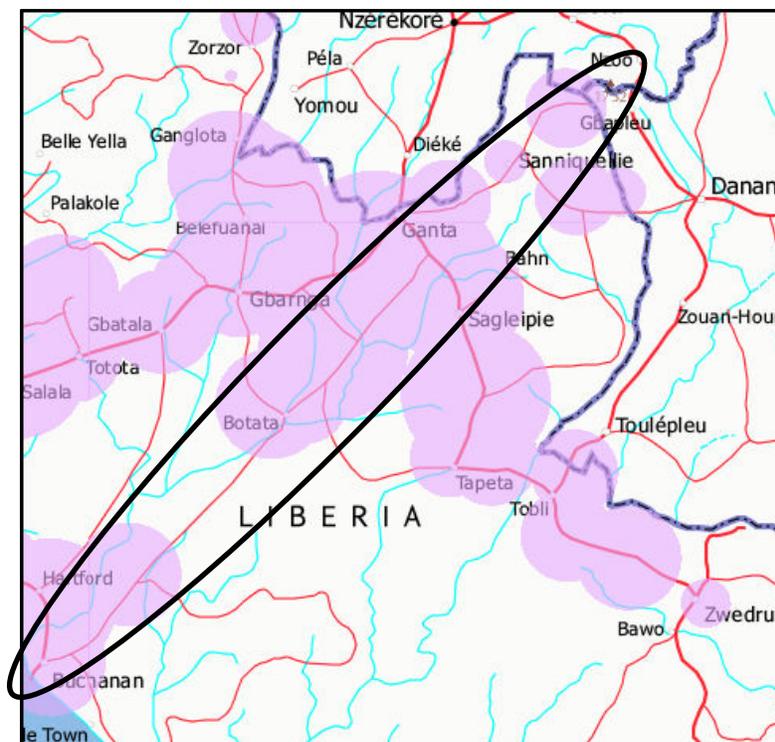
²²⁶ Interview with ArcelorMittal, Buchanan, July 15, 2013.

²²⁷ Ibid.

²²⁸ Ibid.

²²⁹ Interview with CCL, Monrovia, July 22, 2013.

²³⁰ Interview with ArcelorMittal, Buchanan, July 15, 2013.



Source: Mobile World Live²³¹

As a result, ArcelorMittal is investing in its own radio signaling system, for which it has constructed towers along the railway line. The system will provide radio signals for reliable communications throughout the rail corridor.²³²

It should be noted that those mines close to the capital and to population centers, for example the Bong mines railway, or the Bomi mines, may be able to rely more heavily on national mobile phone infrastructure, but it is anticipated that greenfield mine and railroad sites such as Putu in the South Eastern regions are likely to face similar problems to ArcelorMittal. Figure 10 and 11 show that the heavily forested South Eastern regions, where Putu is located, are largely uncovered by any mobile phone provision at all.

2.2. Using mines to extend the national ICT infrastructure

Telecommunications company adds capacity to mine infrastructure

In the Liberian context, where there is no reliable ICT infrastructure in the mining area, ArcelorMittal has chosen to provide its own infrastructure. In this case, opportunities may exist for expanding access to this infrastructure to enable telecoms companies to provide ICT services to nearby communities at a lower cost.

²³¹Liberia - Coverage and Network Information, Mobile World Live, op cit.

²³² Interview with ArcelorMittal, London, July 26, 2013.

This is most realistic with regards to the telecoms tower infrastructure that ArcelorMittal has built for the radio controlled signaling system needed to operate the railway line more efficiently. As mentioned in the section above, in remote and sparsely populated areas, it is often not economical for telecommunications companies to construct towers themselves, due to insufficient demand and high operational cost of running a telecoms tower. Two generators are required, along with around 20 gallons of fuel per day to keep a tower running.²³³

However, with ArcelorMittal funding a large part of the installation cost of towers to facilitate their radio signaling systems, it may become economical for telecom companies to add telecommunication capacity to this infrastructure. Mobile phone operators can add satellites to these telecoms towers, to introduce their service or enhance the service provided in these areas. ArcelorMittal has stated that other telecoms companies are looking to use these towers to provide services to rural populations, and that it is willing to allow these companies to do so free of charge.²³⁴

Company building required infrastructure to mines (e.g.: railways) adds telecommunication capacity at a lower cost

Since most of the costs of building a fiber 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).²³⁵ As mentioned, in remote areas where most mining operations 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. Certainly, the first and second phases of Libtelco's planned backbone infrastructure suggested plans to extend the backbone up to, but not including mining areas such as the Western Cluster mine in Bomi and the ArcelorMittal site in Buchanan.

There are four planned mining rail routes in Liberia, which will require a significant amount of excavation. Since civil works is a major cost when laying fiber optic cable, capitalizing on the work that will take place to rehabilitate the railway and laying the cable at the same time would allow Libtelco to extend the reach of the network without incurring additional costs. Laying cable underground also provides a more protected route for the cable than hanging the cable alongside power distribution lines. This is realistic 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 scope²³⁶ could be significant enough to make telecommunication service provision along these rail routes economically viable while bringing fast and efficient telecommunication technology to the mines that typically rely on expensive VSAT technology.

²³³ Based on information from Interviews with NATCOM in Freetown, Sierra Leone, July 3, 2013, used due to the similarity of contexts between Liberia and Sierra Leone.

²³⁴ Interview with ArcelorMittal, London, July 26, 2013.

²³⁵ Toledano, Thomashausen, Shah, and Maennling, "A Framework to approach mining-related infrastructure," op cit.

²³⁶ 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.

2.3. Shared Infrastructure Access – Regulatory Framework

Having identified two possibilities for shared infrastructure access between mines and telecommunications companies in the Liberian context, we can consider the regulatory conditions that would be conducive to shared infrastructure access.

As the AICD reports, “the Liberian ICT market is dynamic and competitive with burgeoning mobile penetration and very low prices.”²³⁷ The ICT Policy as well as the Telecommunications Act 2007 set out principles for tariff setting, quality monitoring and plans for transparent and efficient licensing and spectrum management.²³⁸ The roles and responsibilities of the policy and regulatory entities are well-defined, and they appear well-resourced in the Liberian context to carry out their roles effectively.²³⁹ This provides a sound foundation for shared access to infrastructure.

The National ICT Policy for 2010-15 recognizes the need for infrastructure sharing and sets out some regulations for co-location of infrastructure and rights of way.

Part 3: Regulations²⁴⁰

3.8 Co-Location

The policy encourages and promotes the sharing of telecommunication infrastructures by operators including collocation to:

- a. Create network redundancy;
- b. Maximize services and prevent network outages;
- c. Reduce operational cost and ensure affordable services

The policy shall not allow building of infrastructure such as separate towers by each operator in a given area where an existing tower can co-host other operators. Infrastructure sharing can lower operational costs and as well consumer costs. LTA shall formulate regulation to save Monrovia and other such communities from being “tower communities”

3.9 Rights-of-Way

The policy supports the use of public land and facilities to install telecommunications networks for services to the general public. The LTA shall develop procedures for operators to lease public property for the provision of telecommunications services. The LTA shall also assist operators, where necessary, to negotiate with appropriate government agencies or private owners for lease agreements on properties and rights of way.

²³⁷ Foster and Pushak, “Liberia’s Infrastructure: A Continental Perspective,” Africa Infrastructure Country Diagnostic, op cit.

²³⁸ Liberia ICT Policy, available at <http://www.lta.gov.lr/doc/ICT%20%20Telecom%20Policy%20Main%20Body.pdf>, Telecommunications Act of 2007 available at http://www.mopt.gov.lr/doc/telecom_act_2007.pdf.

²³⁹ Based on CCSI Interviews in-country, July 2013.

²⁴⁰ Liberia ICT Policy, available at http://www.lta.gov.lr/doc/ICT%20_%20Telecom%20Policy%20Main%20Body.pdf.

Co-location

With regards to co-location of tower resources, as possibilities for sharing of tower infrastructure between mining companies and telecommunications providers become more widespread, it may be beneficial for a more detailed framework to be developed.

Section 41 of the Telecommunications Act of 2007 addresses the issue of co-location, but leaves the details of such arrangements (access charges, rights, obligations) to be negotiated between the parties.²⁴¹ This is generally regarded as best practice, but requires strong dispute resolution mechanisms. In addition, the obligation of co-location is weakened by the fact that it is required only “where such co-location is technically and economically feasible and where no significant additional construction work is required.”²⁴² This might be difficult to enforce in practice; service providers could easily claim the need for additional construction work, particularly when the regulator suffers from a strong asymmetry of information. With this background, it would seem that ArcelorMittal’s willingness to allow telecoms companies to use their tower infrastructure is guided more by its desire to maintain a social license to operate than to comply with its legal obligations.

41. Co-location

“(1) If not otherwise addressed in interconnection or access terms determined pursuant to Sections 34 to 38, and subject to any regulation, rule or order issued by the LTA, service providers with existing telecommunications network facilities shall allow other service providers to co-locate their telecommunications network facilities on those existing facilities, including central office premises and other equipment locations, land and roof tops, mast sites, towers, conduits, poles and underground facilities, where such co-location is technically and economically feasible and where no significant additional construction work is required.

(2) The party requesting co-location shall compensate the party required to provide co-location for such an amount as the parties may agree or, where the parties are unable to agree, as may be determined by the LTA.

(3) Where the parties are unable to agree on the terms and conditions of co-location, either or both of the parties may submit the matter for dispute resolution pursuant to Section 73.”

Source: Telecommunications Act of 2007 available at http://www.mopt.gov.lr/doc/telecom_act_2007.pdf

Rights of Way

Section 3.9 of the Liberia ICT Policy recognizes the need to develop procedures for operators to lease public property for ICT service provision. The development of such procedures would be

²⁴¹ Telecommunications Act of 2007 available at http://www.mopt.gov.lr/doc/telecom_act_2007.pdf

²⁴² Ibid.

an essential precursor to smooth facilitation of shared infrastructure synergies. A number of principles might be considered by the LTA:

- The LTA could increase incentives for additional investment in backbone networks by making such resource and rights-of-way of those infrastructures readily available, especially in public property, limiting the fees charged and simplifying the legal process involved.²⁴³
- It is possible for regulators to instate formal rights which allow carriers the right to access to passive infrastructure that are owned by a non-carrier, i.e. players such as public utilities companies, that provide passive network elements but which do not compete for end users.²⁴⁴ 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.

It is important to note that, while many developing countries have enacted some 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.²⁴⁵

- A dedicated institution for infrastructure sharing could facilitate the coordination of civil works among telecommunications companies as well as between telecommunications companies and mining companies.²⁴⁶ With Liberia currently seeing the development of their mining railroads as well as planning the laying of their 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

²⁴³ Toledano, Roorda, “Leveraging mining demand and investment in ICT for broader needs,” op.cit.

²⁴⁴ 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).

²⁴⁵ Toledano, Thomashausen, Shah, and Maennling, “A framework to approach shared use of mining-related infrastructure,” op cit.

²⁴⁶ “Global Symposium for Regulators GSR 2008: Best Practice Guideline on Infrastructure Sharing,” International Telecommunication Union, available at “<http://www.ictregulationtoolkit.org/en/toolkit/docs/Document/3463>” (2008).

policies on sharing are observed across the region, since a national regulator alone would not be able to resolve significant cross-border issues.²⁴⁷

3. Findings and Conclusions

If sound regulations and efficient coordination mechanisms are put in place in Liberia, synergies between the ICT and the mining sectors could be realized. The potential options for ICT-mine synergies discussed in this case study, along with their associated challenges are summarized in the table below.

Table 16: Summary of ICT-Mine Synergies

Option	Example	Challenges
Telecommunications Company adds capacity to mine infrastructure	ArcelorMittal’s telecom towers built for its railroad signaling system could be used by telecoms providers	Cooperation between mines and telecoms companies
Company building required infrastructure to mines (e.g.: railways) adds telecommunication capacity at a lower cost	Economies of scope between railroad construction and laying of fiber optic cable	Development of an appropriate and enforceable legal and regulatory framework to enable shared access to infrastructure

²⁴⁷ Ibid.

Summary and Conclusions

Liberia is posited to see at least seven large-scale iron ore and gold mining operations become operational in the next decade, while ArcelorMittal is in the process of expanding its operations. Each of the MDA's entered into with mining concessionaires contain third party access provisions in relation to rail, port and/ or power infrastructure that lay a good foundation for leveraging mining-related investments in those infrastructure-types. However, third party access to date is only being implemented in the port sector in Liberia.

With four existing mining infrastructure corridors, Liberia has a lot to gain from shared use of its rail and port infrastructure, although the use in the case of railway lines is likely to be multi-use rather than multi-purpose. Continued investment in road infrastructure is more likely to benefit the agricultural sector, small businesses and consumers.

There is also considerable scope to realize synergies between the power and mining sectors, particularly in relation to Liberia's considerable hydropower potential, which would considerably lower the cost of power to both mines and other power consumers. Through improved planning and structuring of new power generation and transmission capacity associated with the mining industry's energy demands, Liberia can aim at building robust power generation facilities and electricity transmission systems as well as accelerating access to electricity in remote areas where mining companies are operating and can be the anchor offtaker for power financings.

In relation to water, there is, at present, little scope for synergies between mining-related investments in water infrastructure and the water infrastructure investments that need to be made to supply surrounding communities with improved water sources. With access to improved water sources being prioritized over cost-recovery of water supply, it is unlikely that an arrangement whereby mines provide treated dewatered water would be sustainable from a cost recovery perspective, or that private investment into the construction of water infrastructure in the areas in which Liberia's mining concessionaires operate is likely without donor funding. The most likely scenario in thus one where mining companies provide water to surrounding communities as part of a CSR program.

Finally, in relation to Liberia's ICT sector, the main scope for synergies lies in the economies of scope between the construction of mineral railways and the laying of fiber optic cable in the rights-of-way alongside them.