



Columbia Center on Sustainable Investment

A JOINT CENTER OF COLUMBIA LAW SCHOOL
AND THE EARTH INSTITUTE, COLUMBIA UNIVERSITY

A Framework to Approach Shared Use of Mining-Related Infrastructure

Case Study: Mozambique

March 2014

Nicolas Maennling, Alpa Shah and Sophie Thomashausen



Australian Government
Department of Foreign Affairs and Trade



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Suggested Quote

Nicolas Maennling, Alpa Shah, Sophie Thomashausen, "A Framework to Approach Shared Use of Mining-Related Infrastructure: Case Study: Mozambique, Columbia Center on Sustainable Investment," Columbia University (2014).

Acknowledgements

The research has been funded by the Australian Department of Foreign Affairs and Trade through the Australian Development Awards Scheme under the award titled, *Using Mining Infrastructure for Broader Economic Development*. The research output includes the framework document and three case studies (Liberia, Mozambique and Sierra Leone). To better understand the conclusions and recommendations of this case study, it is recommended to read the framework document.

The team is grateful to Perrine Toledano for her guidance and Jacky Mandelbaum for her review. We would also like to thank the following Institutions and Organizations that provided us with valuable information during our in country consultations:

African Agriculture Development Company
Agence Française de Développement
Aurecon
Beacon Hill Resources
Beira Agricultural Growth Corridor
Bigen African Services (Pty) Limited
Department for International Development
Electricidade de Moçambique
Empresa Moçambicana de Exploração Mineira
Fasken Martineau
Golder Associates
Hidroeléctica de Cahora Bassa
Instituto de Estudos Sociais e Económicos
Jindal Steel & Power Limited
Ministério das Obras Públicas e Habitação
Ministério dos Recursos Minerais
Ministério dos Transportes e Comunicações
Ncondezi Energy
Odebrecht
Rio Tinto
Sal & Caldeira Avogados
Universidade Eduardo Mondlane
Vale
Vitens Evides International
World Bank

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List of Acronyms and Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AIAS	Office of Infrastructure of Water and Sanitation - Administração de Infraestruturas de Abastecimento de Água
AICD	Africa Infrastructure Country Diagnostic
AMD	Acid Mine Drainage
ARA	Regional Water Administration - Administração Regional de Aguas Urbana em Moçambique
BAGC	Beira Agricultural Growth Corridor initiative
BOT	Build-Operate-Transfer
Btu	British thermal unit
DNM	National Directorate of Mines – Direcção Nacional de Minas
CAPEX	Capital Expenditure
CCFB	Beira Railroad Corporation - Companhia de Caminhos de Ferro da Beira
CCSI	Columbia Center on Sustainable Investment
CDN	Nacala Development Corridor - Corredor de Desenvolvimento do Norte
CEAR	Central East African Railways
CFM	Ports and Railway Company - Portos e Caminhos de Ferro de Moçambique
CLIN	Northern Integrated Logistics Corridor - Corredor Logístico Integrado do Norte
CNELEC	National Electricity Council - Conselho Nacional de Electricidade
CRA	Water Regulatory Council - Conselho de Regulação do Abastecimento de Agua
DAS	Department for Water and Sanitation – Departamento de Água e Saneamento
DNA	National Directorate of Water – Direcção Nacional de Águas
DPOPH	Provincial Directorate for Public Works and Housing in Mozambique – Direcção Provincial de Obras Publicas e Habitação
EdM	Electricity Company Mozambique - Electricidade de Moçambique
EIA	Environmental Impact Assessment
FIPAG	Water Supply Investment and Assets Fund in Mozambique – Fundo de Investimento e Patrimonio do Abastecimento de Agua
GoM	Government of Mozambique
HCB	Cahora Bassa Dam - Hidroeléctrica de Cahora Bassa
ICT	Information and Communications Technology
INCM	Telecommunications Institute of Mozambique – Instituto Nacional das Comunicações de Moçambique
INNATER	National Surface Transport Regulator - Instituto Nacional dos Transportes Terrestres
IPP	Independent Power Producer
JSPL	Jindal Steel Power Limited
kWh	Kilowatt hour
mtpa	Million tons per annum

MW	Megawatt
MCMP	Mozambique Coal Master Plan
MICOA	Ministry for the Coordination of Environmental Affairs – Ministério para a Coordenação da Acção Ambiental
MIREM	Ministry of Mineral Resources of Mozambique – Miniestério dos Recurson Minerais
MPD	Ministry of Planning and Development – Ministério de Planificação e Desenvolvimento
MTC	Ministry of Transport and Communications – Ministério de Transportes e Comunicações
OECD	Organization of Economic Cooperation and Development
OPEX	Operational Expenditure
PESA-ASR	Strategic Water Sector Plan – Rural Water Supply and Sanitation - Plano Estratégico do Sector de Água - Água e Saneamento Rural
PPA	Purchasing Power Agreement
PPP	Public-Private Partnership
PRONASAR	Rural Water and Sanitation Program - Programa Nacional de Abastecimento de Água e Saneamento Rural
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SEZ	Special Economic Zone
SCDN	Northern Development Corridor Company - Sociedade para o Desenvolvimento do Corredor de Nacala
SME	Small and Medium Sized Enterprise
STE	Regional Transmission Backbone Project - Sociedade de Transporte de Energia
TDM	Mozambique Telecom - Telecomunicações de Moçambique
TPP	Thermal Power Plant
DfID	UK Department for International Development
Vale	Vale Moçambique Limitada, a subsidiary of Vale S.A.
VSAT	Very Small Aperture Terminal
WB	World Bank
ZAMCOM	Zambezi Watercourse Commission

Introduction

1. Overview of Mozambique

Table 1: Background facts

Capital City	Maputo
Administrative divisions	Mozambique is divided into 10 provinces, which are made up of districts and further subdivided into administrative posts.
Population size	25,203,395. ¹ While Maputo is the largest city of Mozambique, the South of the country is less populated than the North, with the most populated provinces being Nampula and Zambezia.
GDP (current US\$)	US\$14.24 billion, growth of 7.4% in 2012
GDP per capita (current US\$)	US\$565 ² in 2012

Mozambique’s strategic geographic position to serve the hinterland countries, including Malawi, Zambia, the Southern region of the Democratic Republic of Congo, Zimbabwe, the Eastern region of Botswana and the North-Eastern region of South Africa, resulted in the development of a West-East (from hinterland to the sea) infrastructure grid during the colonial era, which is still largely in place today. The sixteen-year civil war following independence from Portugal in 1975 left the infrastructure in a ruinous state and Mozambique one of the poorest countries in the world. Sound macroeconomic management, increased political stability and high average economic growth rates following the signing of the Rome peace accord in 1992, which marked the end of the civil war, have attracted investments into Mozambique.

2. Infrastructure development and the new PPP law

To rebuild and expand Mozambique’s infrastructure, the Government of Mozambique (GoM) has spent an annual average of around US\$664 million in infrastructure development in the late 2000s (around 10% of national GDP).³ The largest share of the infrastructure spending has gone into the transport sector. Water, information and communication technology (ICT) and power followed with similar spending volumes.⁴ With the exception of investment in the North-South national road (EN1), most of the transport infrastructure spending continues to

¹ World Development Indicators (2012).

² Ibid.

³ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective,” Africa Infrastructure Country Diagnostic (AICD), June 2011.

⁴ Ibid.

be along the East-West transport corridors. Power and ICT infrastructure follow these corridors to high population concentrations.

While Mozambique has spent a relatively high proportion of GDP on infrastructure in comparison with other African countries, the World Bank estimates that the country needs to spend more than US\$1.7 billion annually to reach a broad set of infrastructure targets. This equates to around 26% of GDP and is among the highest in Southern Africa.⁵ In particular, the power sector was identified as demanding significant increases in spending to address public service needs. Connecting the East-West corridors would help development of less populated areas.

To help finance the infrastructure gap in the country, the GoM is considering ways to leverage large-scale private sector investment. In May 2011, the Public Private Partnership (PPP) and Large-Scale Project (LSP) law was passed.⁶ The law applies to: (1) all public-private partnerships aimed at the provision of public services or essential goods; (2) concessions involving the use of public goods or patrimony regardless of size and activity involved; and (3) mega-projects, defined as all those that involve investments above MZN12.5bn (≈US\$500 million) in 2009 prices. Hence, this law covers large-scale commercial mining related projects, as well as public infrastructure service projects including rail, port, power, water and telecommunications. Article 33 of the law reserves Mozambican participation for PPP and LSPs by requiring the sale of 5-20% shares via the Mozambican stock market. The stock may be kept in trust by the State or the project implementing entity. For natural resource projects, the GoM can acquire a 5% free-carry interest at any stage of the project phase.⁷

The PPP infrastructure projects are to be passed onto the GoM at the end of the concession time period.⁸ The duration of the PPP infrastructure agreements will be dependent on the financial analysis of the project and determined in the contract, with the maximum length dependent on the nature of the project. Greenfield projects have a maximum concession length of 30 years and can be expanded for a further 10 years. Brownfield projects that require rehabilitation and expansion works have a maximum time span of 20 years, and existing infrastructure projects that do not require major works have a maximum concession length of 10 years. The new PPP and LSP law will also affect mining projects and associated infrastructure investments.

3. Mining projects

With coking coal prices at an all-time high in 2011, international mining companies flocked into Mozambique to explore Tete region. The “coal rush” culminated with the US\$4 billion acquisition of Riversdale by Rio Tinto that year. By October 2012, the Government had approved 245 mining concessions and exploration licenses in Tete province (see figure 1), with coal mining licenses making up one third of these.

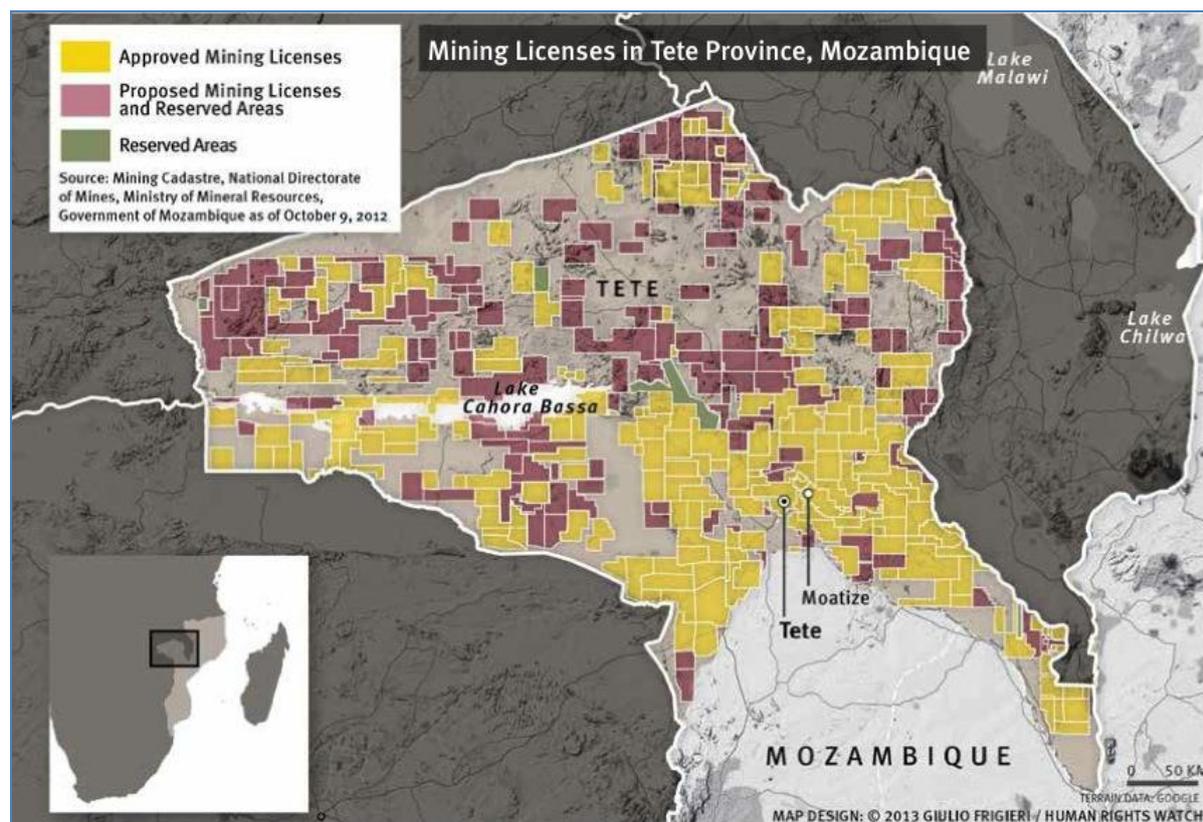
⁵ Ibid.

⁶ Law n°15/2011.

⁷ Decree n°16/2012.

⁸ The sub modalities include: Build Operate Transfer (BOT), Design Build Operate Transfer (DBOT), Build Own Operate Transfer (BOOT), Design Build Own Operate Transfer (DBOOT), Rehabilitate Operate Transfer (ROT), or Rehabilitate Own Operate Transfer (ROOT).

Figure 1: Mining licenses in Tete Province



Source: Human Rights Watch (2013), What is a house without food? Mozambique’s Coal Mining Boom and Resettlement

Although the hype around the Mozambican coal-fields has somewhat faded along with the fall of coal prices, the continued uncertainty about a long-term low cost logistics solution for exports, and Rio Tinto’s US\$3 billion write-down on its Mozambique assets, several mining companies in Tete have already started production and are looking to ramp up once additional rail and port capacity is in place. While there is no consensus among the mining companies and/or the GoM on potential production figures and the timelines of output ramp-up, table 2 lists what the Preliminary Mozambique Coal Master Plan calls “Likely Mining Projects” in Tete province⁹.

Table 2: Production forecasts of likely coal mining projects in Tete region

Mine (license)	Concession Holder	Production forecasts (mtpa)	State implementation of
Minas de Moatize (1163 C)	Beacon Hill Resources	2.8	Operating
Moatize I (867 C)	Vale	11	Operating
Moatize II (867 C)	Vale	11	Approved
Benga (3365 C)	Rio Tinto, Tata Steel	10	Operating
Zambeze (4695 C)	Rio Tinto	15	Approved
Chitima (3605 C)	Jindal Steel Power	7	Operating

⁹ The production figures have been updated for those projects according to the Fichtner Mining & Environment GmbH, “Preliminary Mozambique Coal Master Plan – Final Report” (2013).

	Limited (JSPL)		
Ncondezi (5967 C)	Ncondezi	10	Approved
Minas de Revuboé (4046c)	Talbot Group, Nippon Steel, Posco	9	Approved
Estima (6127 C)	ENRC	10	Pending approval

Due to the high concentration of mining concessions in the region, this case study primarily focuses on the advanced coal projects around Moatize and the potential to leverage the related infrastructure projects. As a high volume commodity, coal requires significant capacity allocation on rail and port infrastructure (as opposed to high value and low volume minerals such as gold). It also provides high potential to serve the country’s power generation capacity. Furthermore, significant water demand is associated with the coal washing process, which requires water supply and treatment facilities to lower the mining company’s water footprint. Lastly, the mining companies will demand telecommunication infrastructure to maximize the efficiency of the mining and logistics process.

Although this study focuses on the coal projects in Tete province, it should be noted that there is also high potential for extractive investments in non-coal projects in Tete and in other provinces. Kenmare Resources, for example, is currently operating a titanium minerals mine in Moma, Nampula Province. Sasol is extracting natural gas from the Temane gas fields in Inhambane Province. Anadarko and ENI have announced giant gas discoveries in the Rovuma basin offshore Cabo Delgado, and Baobab Resources is advancing with its final feasibility study of its iron-ore project in Tete. Further extractive industry investment opportunities are promoted in gold, titanium, ilmenite, zircon, rutile, tantalite, precious stones and marble.¹⁰ These resources, depending on the size and requirements, will also provide the opportunity for the GoM to leverage infrastructure-related investments for broader economic development in surrounding regions in the future.

¹⁰ Investment Promotion Centre, available at: <http://www.cpi.co.mz/index.php/en/business-opportunities/mineral-resources>.

A. Scope for shared use of rail and port infrastructure

Mozambique's publicly owned ports and rail company, Portos e Caminhos de Ferro de Moçambique (CFM), has recently announced that it needs between US\$20-25 billion dollars to implement all of its major construction and rehabilitations projects.¹¹ To realize these investments, CFM is hoping to rely on PPPs. Several rail and port projects to service the coal-mining region of Tete are already at an advanced stage. This chapter will assess the potential to leverage the rail and port infrastructure investments, which are necessary to make these projects viable, for broader economic development in the region. It is divided into four sections. The first section provides an overview of existing rail and port infrastructure in the country. It also outlines the current logistical problems faced by the mining companies in Tete province and the proposed solutions that have been put forward. Section 2 explains the current stance of the GoM on open access on these projects. The third section goes into more depth on the most advanced coal exporting corridor proposals, including the Beira, Nacala and Macuse corridors. The final section summarizes the findings and provides recommendations.

1. Background

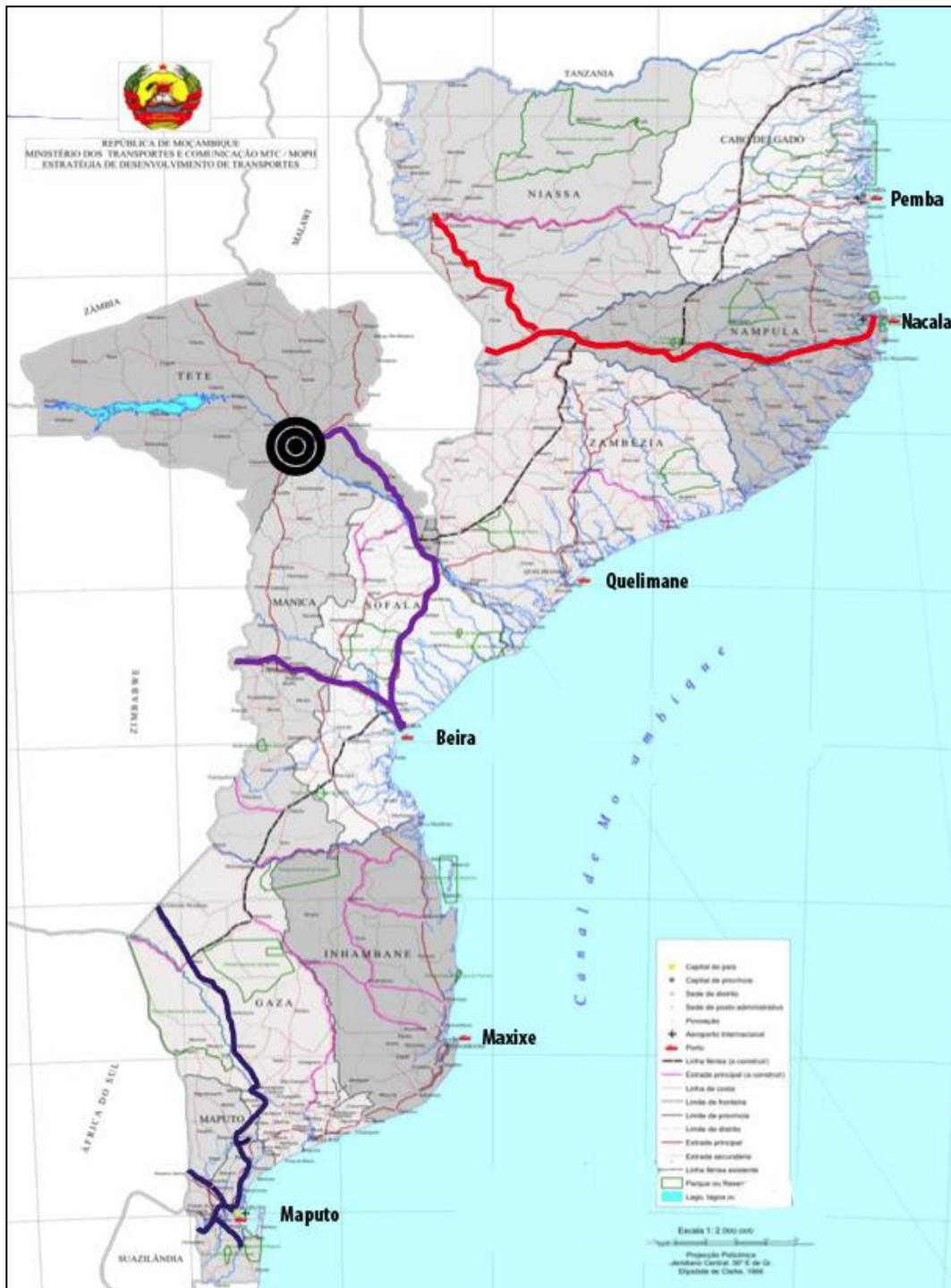
1.1. Existing rail and port infrastructure

Mozambique's existing rail network constitutes of approximately 3,000km of railway lines structured around three East-West corridor networks that connect the hinterland to Maputo port in the south, Beira port in the center and Nacala port in the north of the country (see figure 2). A total of 11 million tons were transported on the railway network in 2012 and 26 million tons were handled at the ports during the same time period. More than 95% of the cargo went through the three major ports of Maputo, Beira and Nacala with only small traffic volumes at the Quelimane and Pemba ports.¹²

¹¹ "Mozambique: CFM Needs Over 20 Billion Dollars," *AllAfrica*, March 20, 2013, available at: <http://allafrica.com/stories/201303210565.html?viewall=1>

¹² CFM, "Situação dos Grandes Projetos Ferro-Portuários de Moçambique", 2013.

Figure 2: Existing rail and port infrastructure in Mozambique



1.2. Proposed Logistics Solutions

The projected production figures in table 1 will largely depend on the rail/port capacity and the logistics costs of transporting the coal from mine to market. Currently, only the Sena railway line is transporting coal for Vale and Rio Tinto to Beira port. It is estimated that less than 4mtpa were transported on the line in 2013,¹³ which is far less than the originally

¹³ “High cost logistics hit Mozambique coal producers hard,” *Mineweb*, December 2, 2013, available at: <http://www.mineweb.com/mineweb/content/en/mineweb-whats-new?oid=220166&sn=Detail>.

anticipated export volumes by the mining companies. Rio Tinto is reported to be stockpiling 1 million tons of thermal coal and 200,000 tons of coking coal at mine mouth due to lack of capacity on the railway line, and with close to capacity stockpiles has been forced to temporarily stop production.¹⁴

Beacon Hill and JSPL are currently trucking their coal to Beira port and are using a truck and skip operation to load vessels at the general cargo terminal, as they do not have access to the provisional coal terminal that was jointly financed by Vale and Rio Tinto. This logistics operation is thought to cost Beacon Hill and JSPL in excess of US\$65/ton.¹⁵ To put this into perspective, figures 3 and 4 show the cash cost curves for global seaborne metallurgical and thermal coal. These cash costs include mining, coal preparation, transport, port loading and overhead costs.¹⁶ Each column represents a mine, which is color coded according to the country of production.

Figure 3: Global seaborne metallurgical coal cash cost curve (2012)

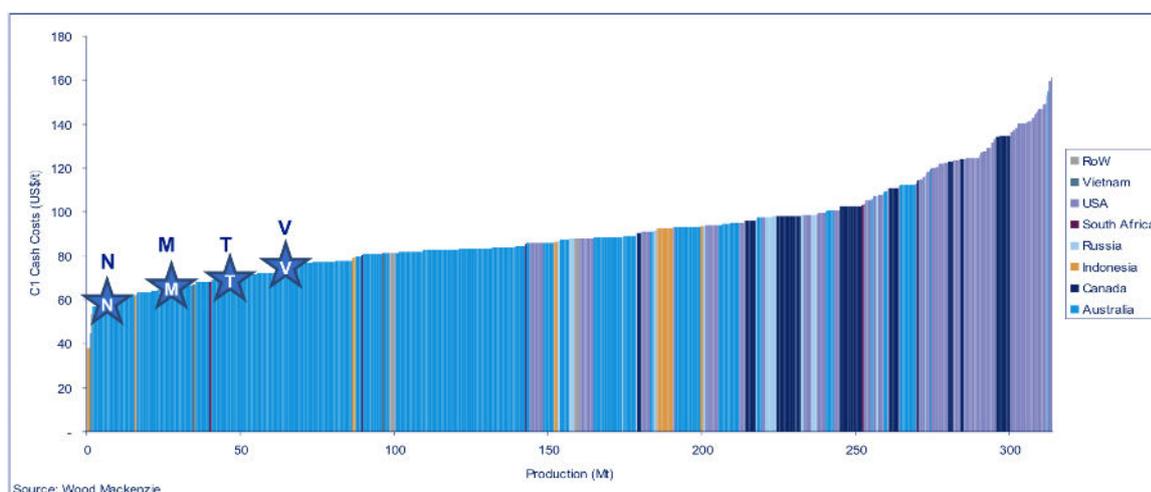
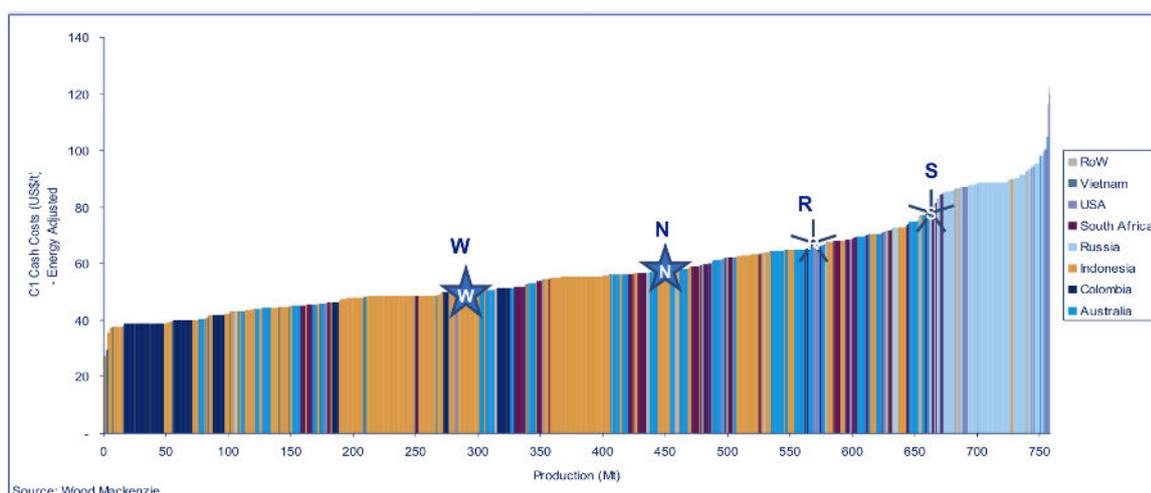


Figure 4: Global seaborne thermal coal cash cost curve (2012)



¹⁴ “Mining: Hazards of the frontier” *Financial Times*, September 11, 2013, available at: <http://www.ft.com/intl/cms/s/0/ad6ac89a-1a03-11e3-b3da-00144feab7de.html>

¹⁵ In country interviews.

¹⁶ Royalties and levies are not included.

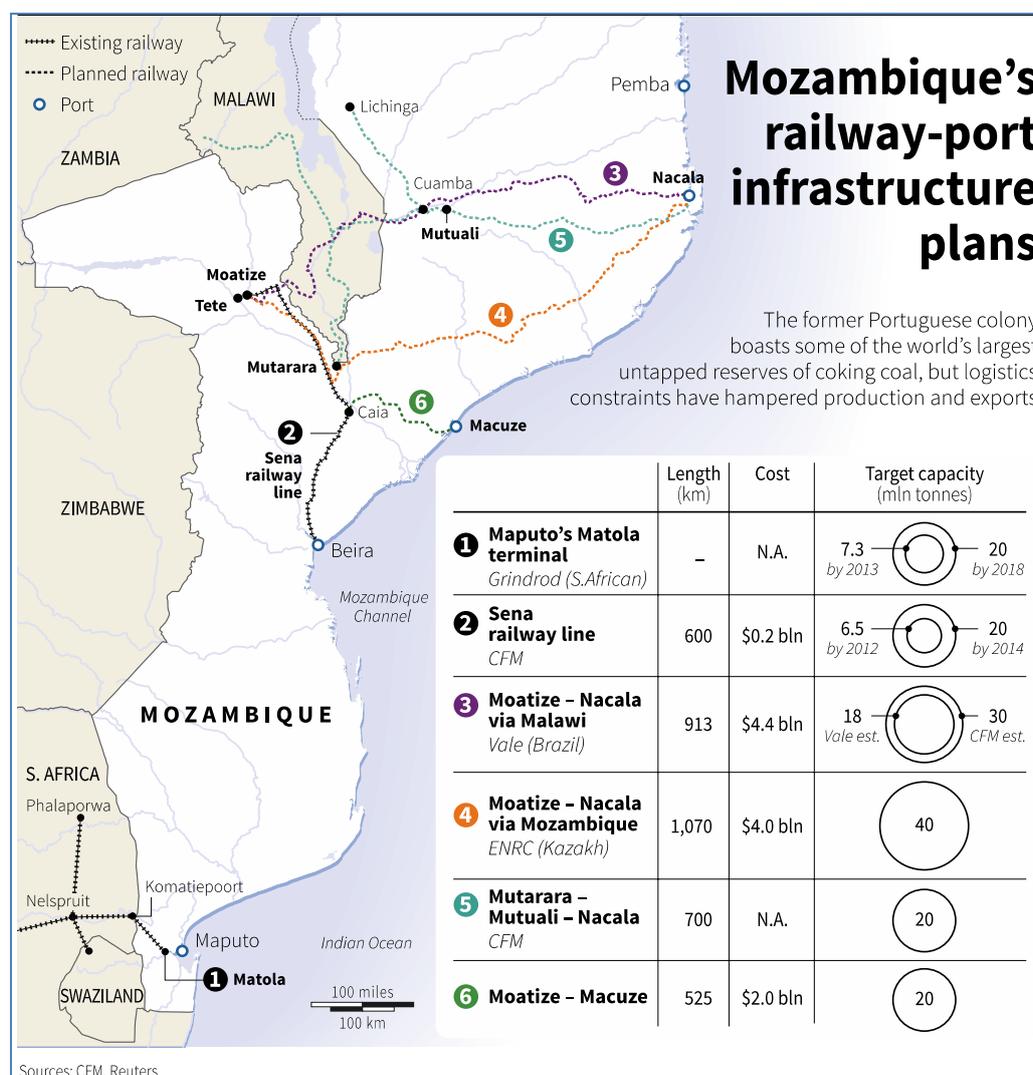
From these figures, it can be deduced that currently only the transport and port-handling costs of JSPL and Beacon Hill Resources are higher than the total cash costs of a number of coking coal projects and most of the thermal coal projects around the world.

Albeit lower transport costs due to access to the railway line and coal terminal at Beira port, Rio Tinto and Vale are also thought to be currently making operational losses. As highlighted during the Coaltrans Mozambique conference in Maputo in December 2013:

“In order for Mozambican coal producers to be sustainably profitable and not go out of business, the all-in logistics costs component of a Free on Board (FOB) per ton coal price (i.e. rail access and operations, and port charges) need to be below US\$35. Given current market prices, which are expected to remain subdued for the short and medium terms, at current rail (and even worse by road) and port costs, no company mining coal in Mozambique is profitable.”¹⁷

To make existing operators profitable and future projects viable, the logistics solutions set out in figure 5 have been proposed.

Figure 5: Rail and port logistics proposals



¹⁷ “High cost logistics hit Mozambique coal producers hard,” *Mineweb*, December 2, 2013, available at: <http://www.mineweb.com/mineweb/content/en/mineweb-whats-new?oid=220166&sn=Detail>

The current rehabilitation that CFM is undertaking on the Sena line is meant to increase the capacity to 6.5mtpa in 2014 and the Minister of Transport and Communications has recently announced that the rail capacity on the line will be further increased to 20mtpa by February 2015,¹⁸ along with the construction of a new coal terminal at the port of Beira (line 2 in figure 4). Apart from the Beira corridor, the two most advanced alternative proposals are the Tete-Nacala line, to be built and operated by Vale (line 3 in figure 4), and the greenfield Macuse rail and port project, which has recently been awarded to the Thai engineering company Italthai (line 6 in figure 4).¹⁹ These three corridors will be analyzed in more detail in section 3.

ENRC had proposed to build and operate a fourth railway line to Nacala port, which goes around Malawi (line 4 in figure 4). The 1,070km cape gauge line was proposed to carry 40mtpa, with 20mtpa being allocated to ENRC and the remaining 20mtpa to third party coal mining companies. However, this undertaking is unlikely to go ahead in the near future, as a result of ENRC being under criminal investigation in the United Kingdom.²⁰ CFM has also proposed to rehabilitate the Mutarara branch to Malawi and link it to Mutuali and Nacala (or alternatively go around Malawi). However, there is not much information available about the implementation of the project (line 5 in figure 4). The expansion of the Maputo port coal terminal (point 1 in figure 4) is in a more advanced stage, but is not servicing Mozambican coal projects.

Box 1: Techobanine port proposal

Apart from the infrastructure development proposals around the Moatize coal fields, the GoM announced in April 2013²¹ that it has awarded the concession for the construction of a deep sea port at Techobanine, which is located in the south of Maputo. The port is meant to complement the port of Maputo and service a greenfield heavy haul railway line from the coalfields in Eastern Botswana, crossing Zimbabwe and entering Mozambique in Gaza province (1200km).²² Apart from servicing mineral exports from Botswana, Zimbabwe and South Africa, the port is also meant to serve as a regional hub for fuel imports. The project is estimated to cost between US\$5.3-7 billion and is thought to be viable if a minimum of 43mtpa of cargo is handled. The GoM has reserved 30,000 hectares for the development of the port and 11,000 hectares for an industrial estate around the port. It remains to be seen whether the concessionaire secure sufficient take-or-pay agreements to finance this large scale investment.

¹⁸“Mozambique: CFM Earns \$53 Million From Coal,” *AllAfrica*, November 12, 2013, available at: <http://allafrica.com/stories/201311130366.html>

¹⁹ “Terms of Lease on Macuse port, railway agreed,” *Club of Mozambique*, December 5, 2013, available at: <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=business&id=30776&tipo=one>

²⁰“SFO launches criminal investigation into ENRC,” *The Telegraph*, April 25,2013, available at: <http://www.telegraph.co.uk/finance/newsbysector/industry/mining/10017960/SFO-launches-criminal-investigation-into-ENRC.html>

²¹ “Concession awarded for construction of Techobanine port,” *Club of Mozambique*, April 20, 2013, available at: <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=business&id=28370&tipo=one>

²² CFM presentation, “Situação dos Grandes Projetos Ferro-Portuários de Moçambique”(2013).

2. Third party access in Mozambique

There is currently no overarching law in Mozambique's mining or infrastructure regulations that impose third party access on rail and/or port infrastructure. However, the GoM has maintained a strong position that rail and port infrastructure servicing the Tete coal region should guarantee access for general cargo and passenger services. The Sena railway line is running two passenger trains a week from Beira to Marromeu and Beira to Moatize.²³ Provisions for transporting non-coal cargo and passengers have also been included in the Nacala rail concession and similar requirements are in place for the Macuse tender.²⁴

The Ministry of Transport and Communications (MTC) has also indicated that apart from the Nacala project, it prefers ownership and operations of rail and port infrastructure to be independent from the mines, as this is going to increase the likelihood of third party access and non-discriminative tariff setting.²⁵ It is thought that this is/was one of the key selection criteria when selecting the winning bidder for the Beira coal terminal and the Macuse rail and port project.²⁶

To date, it is unclear how third party access requirements will be implemented, how the access charges are going to be defined, and who will subsidize the loss-making passenger services.²⁷ In the past, while being attributed to the MTC under Decree No. 22/2000, CFM has assumed the regulatory role in practice. CFM has therefore been both, shareholder and regulator of port and rail infrastructure in Mozambique. Its regulatory roles have included the compliance of environmental and regulatory standards, public interests, public social obligations and terms of contracts.²⁸

To regulate these issues in the future, the GoM approved the National Surface Transport Regulator (*Instituto Nacional dos Transportes Terrestres* or INATTER) on August 12, 2011. For the railway sector, the regulator has the competency to:

1. Propose railway-related legislative and regulatory measures to be approved by the Government,
2. Regulate the construction of railway infrastructure and ensure that access of operators is non-discriminatory,
3. Monitor that applicable regulations, licenses and concession agreements are adhered to,
4. Determine the introduction of technical improvements to increase the safety and efficiency of rail transport,
5. Analyze complaints by rail operators and arbitrate accordingly,
6. Regulate the access to rail infrastructure and arbitrate accordingly,

²³ "Sena rail line to re-open on Friday," *Mining Review*, July 22, 2013, available at: <http://www.miningreview.com/sena-rail-line-to-re-open-on-friday/>.

²⁴ "Update 1 – Rio Tinto among main bidders for Mozambique rail project," Reuters April 10, 2013, available at: <http://www.reuters.com/article/2013/04/10/mozambique-rail-riotinto-idUSL5N0CX4BT20130410>

²⁵ 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

²⁶ In country interviews.

²⁷ The World Bank's Mozambique Infrastructure Assessment in 2011 states that in the past CFM subsidized 85% of the passenger service costs.

²⁸ AECOM International Development, "Logistics Review of the Beira and Nacala Corridors" (2012).

7. Guarantee and monitor the rights and interests of railway users.²⁹

While INATTER creates a mechanism for third parties to be able to seek access to rail infrastructure, the fact that it is an entity within the MTC, where the Minister appoints key personnel, poses uncertainty for the infrastructure owners that the regulation and arbitration process will be neutral and based on an independent assessment. Furthermore, it also remains to be seen whether INATTER has the political backing and technical capacity to impose its regulatory authority on the powerful state-owned railway company CFM, which has been in charge of setting tariffs on rail traffic in the past. The UK Department for International Development (DfID), which has supported the MTC in setting up INATTER, has recognized these challenges and views “turning INATTER into a robust and independent regulatory body as a medium to long term endeavor.”³⁰

3. Coal exporting corridors

3.1. Beira Corridor

3.1.1. Recent developments and expansion plans

Railway

The 576km Sena railway line connects Beira port to the coal-mining town of Moatize and has a railway spur from Inhamitanga to the sugar estates at Marromeu, and from Muatara to Malawi, which is currently not operational and is in need of rehabilitation. The line was strewn with landmines during the civil war, prior to which it carried as much as 2mtpa and hundreds of passengers per day.³¹ The GoM started to rebuild the line in 2002, but due to insufficient funds to complete the rehabilitation, it subsequently opted to tender the concession as part of the central railway system, which includes the Machipanda railway line that connects Beira port to Zimbabwe. Five bids were received and, under the supervision of the World Bank, Rites and Icon International (RICON) were awarded the contract in 2004. This led to the creation of the Companhia de Caminhos de Ferro da Beira (CCFB), which at the time was 51% owned by RICON and 49% owned by CFM. Under the concession agreement, RICON was responsible for the management of the central railway network as well as its full rehabilitation by January 2009.³² However, this target was not met and as a result the GoM rescinded RICON’s concession in 2011. While the management for the central rail network was taken over by CFM in 2011,³³ the legal structure of CCFB is unclear

²⁹ Boletim da República, Decree No. 32/2011

³⁰ DfID, “Mozambique Regional Gateway Programme Review,” March 27, 2013.

³¹ “Mozambique railway mines cleared,” *BBC*, October 18, 2006, available at: <http://news.bbc.co.uk/2/hi/africa/6061844.stm>.

³² “Mozambique: Transport Minister Explains Sena Line Crisis,” *All Africa*, March 16, 2011, available at: <http://allafrica.com/stories/201103170174.html>.

³³ “Traffic interrupted on Maputo South-Africa railway line,” *Club of Mozambique*, February 25, 2013, available at:

<http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=mozambique&id=27754&tipo=one>

to date³⁴ and RICON is planning to take the Mozambican Government to arbitration over this matter.³⁵

The line has been plagued by further rehabilitation delays and quality problems that have led to derailments and damage due to flooding. Neither Rio Tinto nor Vale were able to reach their export projections for 2013, given that both companies currently rely on this line. Beacon Hill Resources and JSPL have resorted to trucking the coal from their mining operations to Beira port, as they wait for the Sena line's capacity to be expanded.

Upgrade and rehabilitation works on the Sena line are ongoing and by mid-2013 Rio Tinto and Vale ran an average of 12 trains per day. By the end of November 2013, Rio Tinto reported a new monthly record of coal dispatched from the Benga mine as a result of continuing improvements on the Sena line.³⁶ Rio Tinto has also ordered new locomotives and 110 wagons to further increase exports. With ongoing rehabilitation work, it is expected that the line will be able to carry 6.5mtpa in 2014 (from about 4mtpa in 2013), which is in line with the capacity currently installed at Beira Port. Pending the completion of this upgrade, Beacon Hill Resources will be the third mining company granted access on the railway line with an allocation of 0.5mtpa.³⁷

The immediate demand for further capacity on the Sena line is immense and the GoM has announced that it will increase the capacity to 20mtpa by February 2015. CFM has estimated that this upgrade will cost around US\$200 million.³⁸ All operational mining companies would welcome access to additional capacity. Vale, which is currently developing the Nacala route, also intends to maintain its capacity on the Sena railway line and take additional capacity in its expansion if it is at the right price.

Several technical issues will need to be resolved in order to increase the capacity to 20mtpa, including the provision of additional workshop space for rolling stock maintenance³⁹ and the upgrade of the 3.67km long Dona Ana Bridge that passes the Zambezi River half-way between Moatize and Beira. The current users of the Sena line are also concerned that the expansion work will disrupt their operations. However, the real medium to long-term bottleneck for the expansion of the railway line is Beira port. There is currently no infrastructure in place to handle more than 6.5mtpa of coal and the construction of the new coal terminal has yet to begin. It will be difficult for CFM to access finance for the railway expansion if the Beira port bottleneck is not resolved.

³⁴ On the new website of CFM, RICON is still the majority stakeholder of CCFB, which holds the concession for the central rail network (<http://www.cfm.co.mz/sobre-o-cfm/parcerias/>)

³⁵ "Indian firms to take legal route against Mozambique government," *Live Mint*, February 12, 2013, available at: <http://www.livemint.com/Industry/thQIHtUC96XYXwEMezfzJ/Indian-firms-to-take-legal-route-against-Mozambique-govt.html>.

³⁶ "Miners invest in infrastructure and development to boost Mozambique coal output," *Mining Weekly*, November 29, 2013, available at: <http://www.miningweekly.com/article/miners-invest-in-infrastructure-and-development-to-boost-mozambique-coal-output-2013-11-22>.

³⁷ Beacon Hill Resources (February 11, 2013), Receipt of 0.5mtp Sena rail line allocation, available at: <http://www.bhrplc.com/News.aspx?ArticleId=20681316>

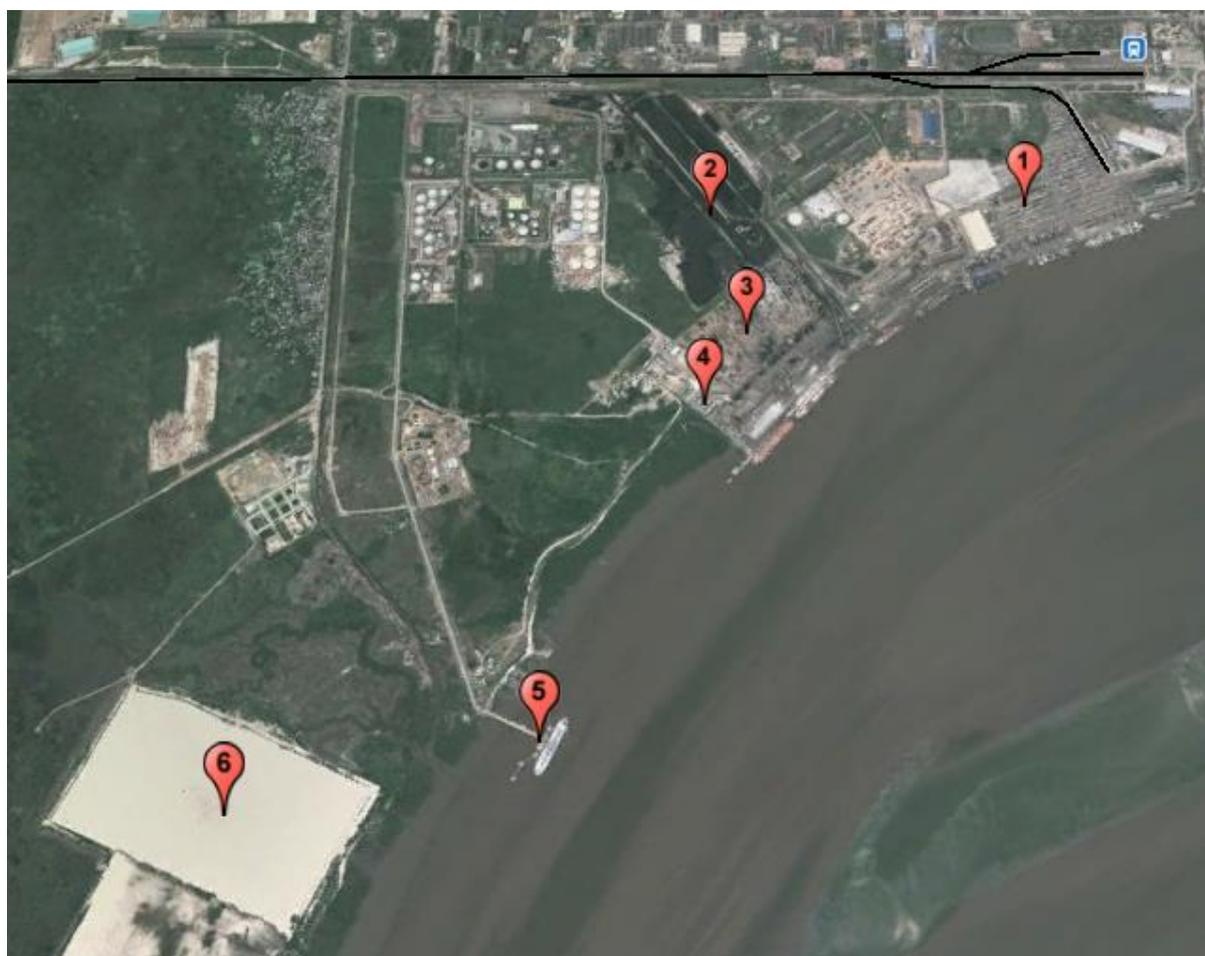
³⁸ "Mozambique's Sena line upgrade to cost \$200 mln," Reuters, July 5, 2011, available at: <http://www.reuters.com/article/2011/07/05/ozabs-mozambique-rail-idAFJOE7640KP20110705>

³⁹ Interview with Aurecon

Port

Beira port is the second largest port in Mozambique with 11 berths and is situated at the mouth of the Pungoe River, 20km from the open sea. It consists of five terminals as shown in figure 6, including the container terminal (1), coal terminal (2), general cargo terminal (3), grain terminal (4), and oil terminal (5). Apart from serving as the export port for coal from the Tete region, it is linked by rail and road to Zimbabwe via Mutare (319km) and by road to Malawi via Mwansa/Dzedza (685km). Cornelder de Moçambique, a joint venture between Cornelder Holdings in Rotterdam (67%) and CFM (33%), has a 25-year concession to operate the port.⁴⁰ The port suffers from silting and shifting of underwater sandbanks due to the Pungoe and Buzi rivers carrying sand downriver, and the port channel is considered to be one of the most difficult to maintain in the region requiring constant dredging.⁴¹

Figure 6: Beira Port



The coal terminal at berth 8 was inaugurated in June 2012 and is thought to have cost US\$200 million. CFM, the owner of the terminal, signed a memorandum of understanding with Rio Tinto and Vale that grants exclusive access to the terminal until 2017, in return for financing the project. It has an estimated capacity of 6mtpa⁴² with 68% of the capacity being

⁴⁰ With the exception of the oil terminal, which is owned and operated by CFM.

⁴¹ “Dredging biggest headache for Mozambique’s Beira port,” *Reuters*, February 18, 2013, available at: <http://uk.reuters.com/article/2013/02/18/mozambique-beira-port-idUSL6N0BI3S320130218>.

⁴² *Ibid.*

allocated to Vale and 32% to Rio Tinto.⁴³ Once the new coal terminal project is completed (see below), the Government plans to use berth 8 for non-coal shipments to avoid coal contamination⁴⁴ of other types of cargo being handled at the terminal. Beacon Hill Resources and JSPL are currently using the general cargo terminal for their coal exports by relying on a less efficient truck and skip operation.⁴⁵

The port can currently only handle handymax sized vessels with up to 9.5 meters in draft due to channel restrictions.⁴⁶ Vale owns two transshipment vessels specifically designed for Beira port, which load about 30,000 tons of coal at berth 8 and then transship the cargo into ocean going vessels with larger capacities 32 kilometers offshore. The remaining mining companies are limited to exporting up to 40,000 tons of coal per shipment.

The coal operations are currently competing with non-coal throughput. Carlos Mesquita, the managing director of Cornelder de Mocambique, which operates the port, was recently quoted: *"I'm already stuck today. I've got ships sitting outside for 5 to 10 days... Coal is a national agenda that I can't stop, but it's taking away capacity from my traditional cargo."*⁴⁷

To align the port capacity to Sena line expansion plans, area 6 in figure 5 has been reserved for the construction of a new 20mtpa coal terminal. The area is currently the reclamation site for the dredging works and is not in use. This project has been discussed for several years, with a previous tender for the project being cancelled in 2011 with no explanations given as to why. With little progress by CCFB to build the terminal, the MTC launched a second tender in mid-2013. The capital cost for the terminal is estimated at US\$600 million and the concession will be awarded for 35 years. The MTC is expected to announce the winning bidder of 4 shortlisted companies shortly⁴⁸ and construction is scheduled to start in 2014, with the completion anticipated for 2016.⁴⁹

For the construction of the new Beira port coal terminal to proceed, three critical issues need to be addressed: (1) the access channel needs to be deepened to be able to fully load larger vessels that will make 20mtpa of coal shipments viable, (2) constant dredging activities need to be ramped up to keep the new channel depth constant, and (3) arrangements need to be made to ensure that current and future non-coal cargo throughput is not restricted due to increased coal exports out of Beira port.

3.1.2. Current State of third party access

The Sena railway line is open access, with mining companies having to provide their own locomotives and rolling stock. CFM allocates the capacity and negotiates the access tariffs on a take or pay basis. While currently only Rio Tinto and Vale transport coal on the Sena line, the Government has already reached an agreement to allocate 0.5mtpa capacity to Beacon Hill Resources, and has also indicated willingness to provide JSPL access to the line in the

⁴³ "Coal terminal inaugurated at port of Beira in Mozambique," *Club of Mozambique*, June 4, 2012, available at: <http://www.macauhub.com.mo/en/2012/06/04/coal-terminal-inaugurated-at-port-of-beira-in-mozambique/>

⁴⁴ Dust from the coal terminal polluting other commodities handled nearby (for instance sugar).

⁴⁵ Front loader truck fills skips at stockpile, skips are transported to the berth, ship-gear is used to empty the skip in the vessel.

⁴⁶ "Dredging biggest headache for Mozambique's Beira port," *Reuters*, February 18, 2013, available at: <http://uk.reuters.com/article/2013/02/18/mozambique-beira-port-idUSL6N0BI3S320130218>.

⁴⁷ *Ibid.*

⁴⁸ Interview with DfID.

⁴⁹ CFM, "Situação dos Grandes Projetos Ferro-Portuários de Moçambique," (2013).

future. Apart from the coal trains, CFM operates a daily train carrying molasses and sugar from the Marromeu sugar factory, limestone from Muanza and wood from Doa. CFM also offers two weekly passenger services between Beira and Marromeu, and Beira and Moatize.⁵⁰

To guarantee open access on the line going forward, the GoM has been careful to avoid relying on the mining companies funding the expansion of the railway line to 20mtpa. Instead, CFM has been looking for third party finance.⁵¹ While the Sena line is open access, it is unclear how the access charges and tariff rates are determined. It has been estimated that in the first 10 months of 2013, the average tariff rate on the Sena line was US\$17.66/tonne based on the reported US\$53 million earnings CFM made on the line, and the 3 million tons transported to date.⁵² Apart from the tariff rates, it is also unclear on what basis CFM allocates capacity. Clear criteria should be defined that guide these processes in order to avoid uncertainty for the mining companies. Tariff rates should be high enough for CFM to recoup its investment and guarantee the maintenance on the line, but low enough for mining companies to make profits on the mining investments in the long term.

The port of Beira is also open access, but the coal terminal at berth 8 has been restricted to Vale and Rio Tinto until 2017. Therefore Beacon Hill Resources and JSPL are currently incurring significant higher loading costs at the general cargo terminal. The new coal terminal is expected to be open access and the tender has excluded mining companies from participating to promote this.⁵³

3.1.3. Potential future third party demand

Railway

There is already sufficient demand from operational mining companies to allocate the full 20mtpa capacity on the Sena railway line, even if Vale decides to export all its coal through the Nacala corridor. Apart from the coal mining concessions, there are also other mineral deposits in Tete province that are currently being explored that could be transported by rail. Baobab Resources, for example, is in the process of completing the definitive feasibility study to produce 1-4mtpa of pig iron, with the concession located 40km from Moatize rail station.⁵⁴

Apart from the mining projects in Tete province, there is also potential for non-mining projects to be developed along the Sena line. The Beira Agricultural Growth Corridor initiative (BAGC) has identified zone 2 as a high agricultural potential area (see figure 7). However, one of the key constraints in the region is the high transport costs along the corridor that have been estimated to be around US¢9.6/tonne-km in 2010, compared to US¢3.5/tonne-km in Brazil.⁵⁵ Depending on the quantities produced, the distance from Beira port and the nature of the agricultural commodities, there may be scope to transport some of these goods along the railway line. For example, the BAGC has identified the potential for

⁵⁰ “Sena line to re-open on Friday,” *Mining Review*, July 22, 2013, available at: <http://www.miningreview.com/sena-rail-line-to-re-open-on-friday/>

⁵¹ Interview with Aurecon.

⁵² “High cost logistics hit Mozambique coal producers hard,” *Mineweb*, December 02, 2013, available at: <http://www.mineweb.com/mineweb/content/en/mineweb-political-economy?oid=220166&sn=Detail>

⁵³ In country interviews.

⁵⁴ Baobab Resources: “Unlocking the Iron and Steel Wealth in Mozambique,” (May 2013).

⁵⁵ *Ibid.*

several large sugar production estates along the Sena railway line and Enerterra has acquired 18,500 hectares to produce biofuels at Cheringoma.⁵⁶ Both these agricultural products are suitable for railway transport.

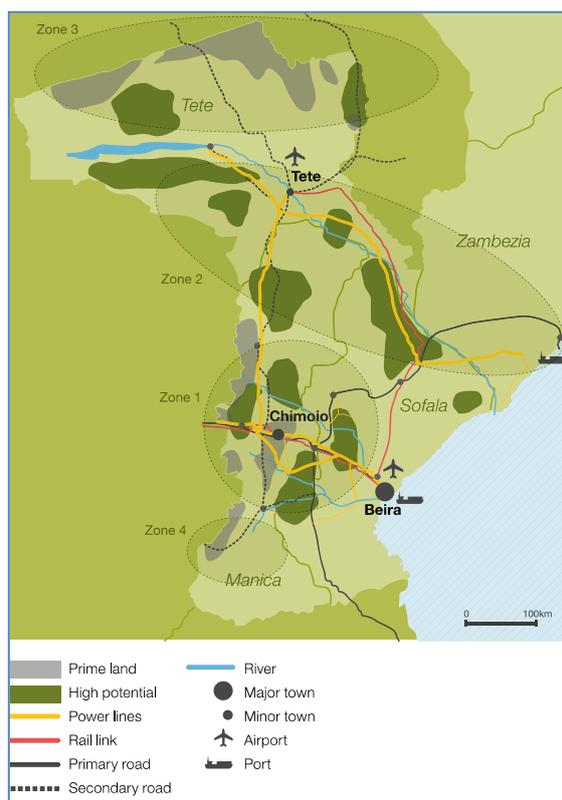


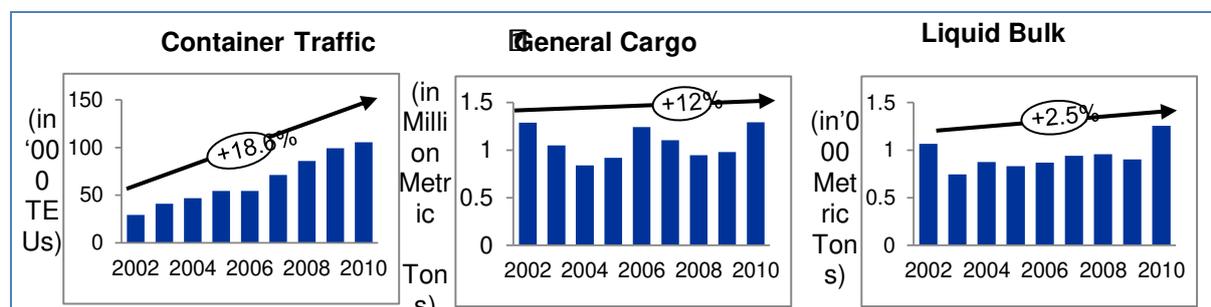
Figure 7:⁵⁷ Agriculture potential along the Beira Corridor

With increasing economic activity in Tete and Beira, it can be expected that there will also be rising demand for the passenger services that CFM is operating between the cities. Increased demand on the Sena line can also be expected if the Mutarare to Malawi railway link is re-established and if CFM goes ahead with its plans to build the Mutarare-Mutuali railway line.⁵⁸

Port

It is anticipated that the mining companies operating in Mozambique will absorb the full coal terminal capacity at Beira port if the capacity is in line with the coal transport allocation on the railway line. Apart from servicing the Sena railway line, Beira port is also the import and export port for landlocked countries Malawi, Zambia and Zimbabwe. Port throughput has increased significantly in the last years as shown in figure 8, and with the rehabilitation of the Machipanda railway line, this trend is expected to continue.

Figure 8: Beira Port throughput by type of cargo



Source: AECOM International Development (2012): Logistics Review of the Beira and Nacala Corridors

⁵⁶ “Companhia do Sena to invest US\$300 million in new mill project,” *Sugar online*, September 19, 2013, available at: http://www.sugaronline.com/home/website_contents/view/1220297.

⁵⁷ Beira Agricultural Growth Corridor, “Delivering the potential”(2010).

⁵⁸ According to CFM, the feasibility study for the US\$2.5bn project has been completed and the GoM is in discussions with the Government of China to implement this project (CFM ” Situação dos Grandes Projetos Ferro-Portuários de Moçambique” 2013).

Using past terminal throughput trends and projected growth in the agricultural sector based on the potential of the BAGC in Mozambique, Van der Meer has made rough projections of potential Beira port throughput in 2032.⁵⁹ His medium growth scenario (the most likely growth scenario) predicts that excluding coal exports, port throughput is expected to approximately treble by 2032.⁶⁰ To handle this increased demand, the port, which was operating at 86% capacity in 2012, will need to expand significantly. Cornelder Mozambique has already tabled an aggressive investment plan to increase the container terminal capacity to 400,000TEU and to expand the bulk terminal to include a new quay and a dedicated area for fertilizers, sugar, cars, coal, minerals, and a tobacco warehouse.

3.1.4. Conclusions

The Beira corridor presents the most viable short-term solution to increase coal exports from Tete province. The railway line already caters for non-mining cargo and passenger services, and therefore loading/unloading infrastructure and passenger train stations already exist. It is therefore recommended that the GoM should continue to offer multi-purpose access on this railway line and port. It is unlikely that non-coal cargo will assume a significant proportion of the Sena line capacity in the medium term, but this may increase in the long-term, especially for pig iron and sugar exports. Clear access and tariff setting mechanisms need to be defined for coal, non-coal cargo and passenger services.

To guarantee the swift upgrading of the Sena railway line and the construction of the 20mtpa coal terminal, CFM will need to clarify the ownership of the rail concession. While CFM is currently operating the line, RICON is still the majority shareholder in CCFM. This creates uncertainty for the coal mining companies and potential financiers. Furthermore, the upgrading of the Sena line and the construction of the new coal terminal will need to happen concurrently, because one project without the other does not solve the logistics constraints. The concessionaire of the new coal terminal might not want to commit to expansion, unless it is convinced that the concessionaire of the Sena railway line can fulfill its commitment. Mining companies might also not be willing to provide upfront take or pay commitments unless the tariff arrangements on both the line and the port are clear. One solution would be for CFM to partner up with the same third party entity to upgrade the railway line and build the coal terminal. This would also reduce the number of players involved in the access and tariff negotiations with the mining companies, and increase the efficiency of the coal logistics.

The main technical long-term bottleneck of the Beira corridor is the port. The geographical properties and silting problems restrict expansion plans. The proposed 20mtpa coal terminal bears the risk that it may interfere with the non-coal throughput if the access restrictions are not improved. However, the coal terminal could also provide the economies of scale needed to increase the depth and widen the access channel, as well as increasing the continuous dredging efforts. This would also benefit non-coal cargo as night and tide navigation restrictions could be lifted and larger vessels would be able to access Beira port. Furthermore,

⁵⁹ Jori van der Meer, MSc Thesis, "Port Master Plan for the Port of Beira, Mozambique," (2013).

⁶⁰ Container throughput is projected to increase from 92,000TEUs in 2009 to 300,000TEUs in 2032, general bulk cargo from 1 million tons in 2009 to 3 million tons in 2032, and fuel throughput from 1.3 million tons in 2011 to 4.5 million tons in 2032.

under current plans the coal terminal at berth 8 will be used for non-coal operations once the 20mtpa coal terminal is built. This would free up space on the general cargo terminal.

3.2. Nacala Corridor

3.2.1. Recent Developments and Expansion Plans

Railway

The existing Nacala railway line connects Nacala port to the Malawi border at Entre Lagos. It has a railway spur from Lichinga to Cuamba that has seen very little traffic in recent years, and a second railway spur from Monapo to Lombo, which is currently not operational.

Vale is investing US\$3.4 billion to connect Moatize to Nacala port via Malawi (railway line 3 in figure 4), by upgrading 583km of the existing Nacala line from the current 18.5 tons per axle wagon capacity to 22.5 tons per axle capacity,⁶¹ and by building the missing link from Moatize to the Malawian railway network. The proposed railway line will have a capacity of 22mtpa and be configured as cape gauge to be compatible with the rest of the railway networks in Mozambique's and the region.⁶²

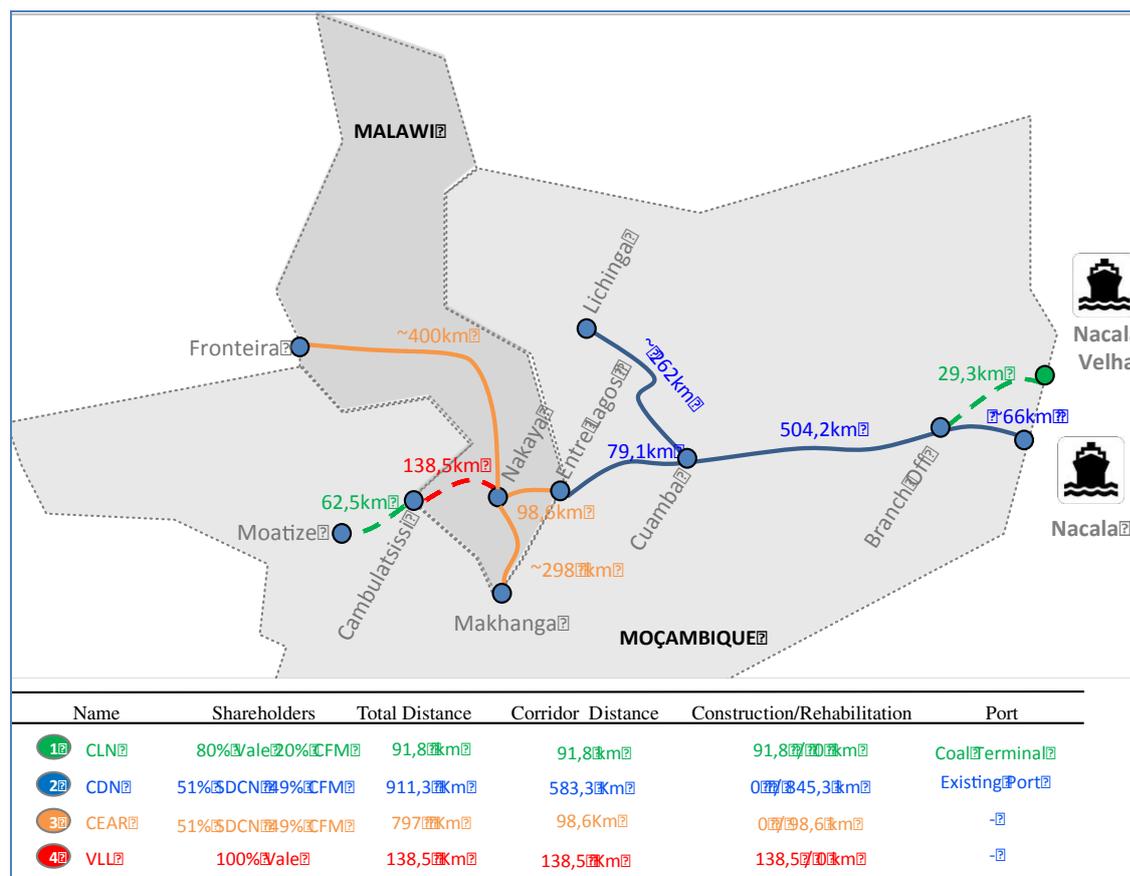
Figure 9 shows the route and ownership of the railway project. Vale has acquired 67% of the shares of the Sociedade para o Desenvolvimento do Corredor de Nacala (SDCN). In turn, SDCN has a 51% stake in the Corredor de Desenvolvimento do Norte (CDN), which is the concessionaire of the Nacala corridor. The remaining 49% of CDN is owned by CFM. SDCN is also the majority shareholder of the Central East African Railways (CEAR), which operates the Malawian rail network. Vale will upgrade CEARs existing 98.6km rail link from Entre Lagos at the Mozambican border to the rail intersection at Nakaya. For the greenfield railway investments needed to complete the connection in Mozambique, the Corredor Logistico Integrado do Norte (CLIN) has been created. It is 80% owned by Vale and 20% owned by CFM, and will be responsible for the construction and operation of the railway link from Moatize to Camulatsissi and the new railway spur that connects the existing Nacala line to the new coal terminal at Nacala Velha (total of 91.8km). Finally, the greenfield rail spur in Malawi will be 100% owned by Vale, connecting Cambulatsissi to Nakaya (136km). As part of the deal with Malawi, Vale has also committed itself to financing upgrades on the CEAR network that is unrelated to its exporting line.⁶³

⁶¹ Interview with Vale.

⁶² Fichtner Mining & Environment GmbH, "Preliminary Mozambique Coal Master Plan – Final Report" (2013).

⁶³ Ibid.

Figure 9: Nacala railway corridor development plans and ownership



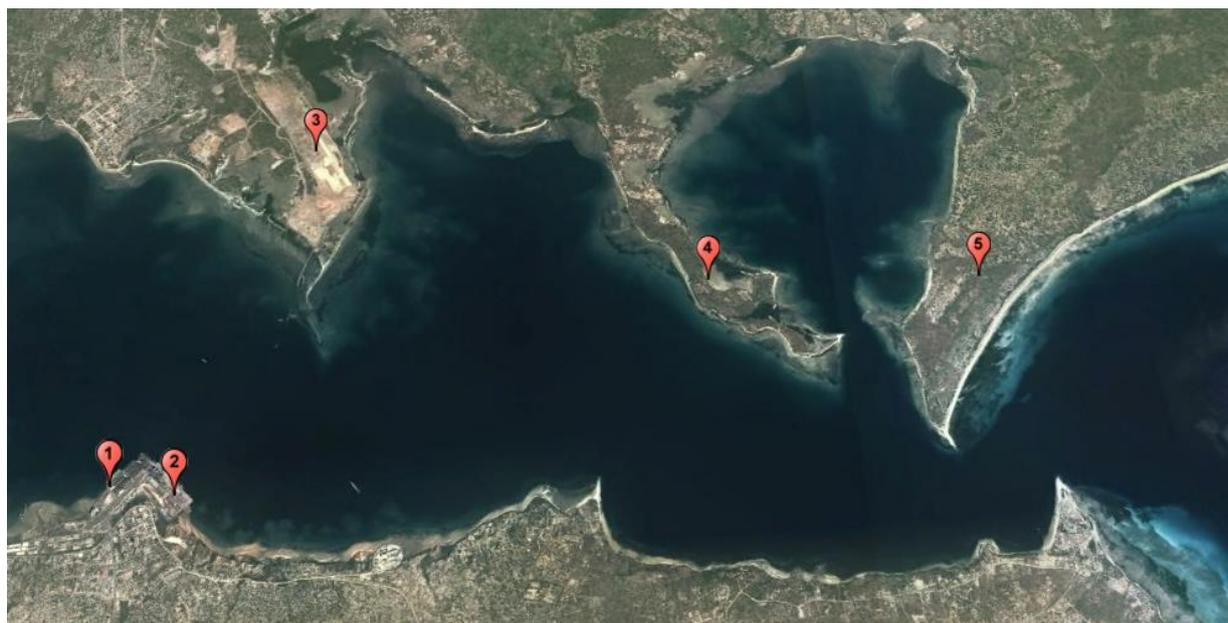
Source: Vale

While the distance from Moatize to Nacala is 336km longer than to Beira (which translates into an additional US\$10.08/tonne if one assumes that operational costs are US\$3/ton-km), Vale has chosen to pursue this option due to the competition for access on the Sena railway line and the draft limitations at Beira port, which entail transshipment operations and associated costs. By pursuing the Nacala project, Vale has also been able to position itself as the operator of the project, exerting greater control and certainty over its coal exports.

Port

Nacala port is the third largest port of Mozambique, located in the South of the Bengo Bay. With an 800 meters wide entrance and an average depth of 60 meters, the bay is considered to be the best natural harbour along the eastern coast of Africa. Navigation in and out of the port is possible 24 hours a day with vessel size currently only constrained by the quay size. The port facilities include a container terminal (1 in figure 9) and a general cargo terminal (2 in figure 10), which also services liquid bulk commodities. The Nacala port concession is operated by CDN.

Figure 10: Nacala Port and Bengo Bay



As part of Vale’s logistics project, it is currently developing an 18mtpa capacity coal terminal on the other side of the existing port (3 in figure 9). The US\$1billion dollar investment is concessioned to CLIN and will be able to berth cape size vessels. Construction is expected to be completed by the end of 2014.⁶⁴ The long-term port master plan of CDN also foresees the construction of an oil terminal (4 in figure 9) and a dry port (5 in figure 9). The construction of the oil terminal will be dependent on the development of the US\$5 billion refinery project, which has been on hold. However, it was reported in January 2013 that the Radyolla Group of Saudi Arabia have shown interest to revive this project.⁶⁵

3.2.2. *Third Party Access*

The existing northern railway network operated by CDN is open access. In 2010, approximately 270,000 metric tons of cargo and 930,000 passengers were transported along the line. The inbound cargo trains to Nacala port mainly carried cotton, sugar, beans, timber, and tobacco, whereas the outbound trains carried cement, fuel, wheat, and salt. Most of the cargo was from and to Malawi (about 80% inbound and 70% outbound) with the remainder being made up of Mozambican and a very small proportion of third country cargo. It is interesting to note, that there is a strong preference among shippers for different transport modes. Transit cargo shippers (from/to neighboring countries) prefer railways to roads (86% carried by rail) and domestic cargo shippers prefer roads to railways (7% of cargo carried by rail).⁶⁶ This shows the economies of scale that rail haulage offers with increasing distances, given that transit cargo comes from further afield.

⁶⁴“Vale/Mozambique moves 1,000 trainloads of coal,” *Club of Mozambique*, January 05, 2013 , available at: <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=mining&id=27260&tipo=one>

⁶⁵ “Nacala oil refinery plan revived,” *AllAfrica*, January 30, 2013, available at: <http://allafrica.com/stories/201301310340.html>.

⁶⁶ Interviews with representatives of the GoM.

As with the Nacala railway network, the Nacala port is open access and multipurpose. Major commodities handled at the general cargo terminal include fuel, clinker, wheat, corn fertilizer, scrap, sugar gypsum, cement and rice.⁶⁷

Vale was allowed to buy the majority share in the CDN concession notwithstanding the Government's general position of rail concessions to be independent of the mines. This is thought to be due to the complexity of the project crossing Malawi and the difficulty of finding a third party with the necessary financial backing willing to invest. This may have left Vale as the only viable project proponent to finance the US\$4.3billion project.⁶⁸ Furthermore, Vale has logistics experience of transporting passengers and non-mineral cargo along the Carajás corridor in Brazil.

The regulations about third party access on the railway concession from Moatize to Nacala are not public and it is unclear whether Vale is required to provide third party access on the coal terminal, and if so under what tariff model these will be operated. The ownership structure of the railway line, and the fact that there is currently multi-purpose access on the CDN controlled part of the line, suggests that the GoM has higher leverage to request multi-user access on this stretch of the line. According to in-country interviews, Vale has agreed to continue the general cargo and passenger services on the existing Nacala line and has reserved 4mtpa for future potential third party cargo throughput. The fact that the railway line has an announced capacity of 22mtpa, whereas the coal terminal at the port has a capacity of 18mtpa, suggests that this excess capacity is reserved for non-coal cargo (although it would be possible to export coal from the general cargo terminal as is being done temporarily at Beira port).

A new service timetable for passenger services was announced by CFM in August 2013,⁶⁹ which suggests that continued passenger services will be provided along the line. The timetable reduces the time from Nampula to Cuamba (342km) from ten to seven hours, with fewer stops being made along the way. According to CDN, these changes will increase efficiency along the line. Vale has also reportedly agreed to design the railway line in a way that capacity can be increased to 30mtpa in the future (ballast and bridge support for 30mtpa).⁷⁰ A key issue for Vale is obtaining the concessions' extensions. Currently, the CEAR rail concession expires in 2019 and the CDN concession in 2020. This is before Vale expects to break even on its general cargo operations, which is thought to be between 2020 and 2025.⁷¹

While the proposed rail and coal terminal capacity suggest that the Nacala corridor will cater for continued non-coal transport along the CDN concession, but no additional third party coal shipments from Tete province, Vale has expressed openness to collaborate with another large miner if this entails cost savings in the rail and coal terminal facilities.⁷² This is in line with

⁶⁷ Ibid

⁶⁸ Interview with Odebrecht.

⁶⁹ "CFM northern passenger timings improve," *Railways Africa*, July 23, 2013 available at: <http://www.railwaysafrica.com/blog/2013/07/cfm-northern-passenger-timings-improve/>

⁷⁰ Interview with CFM.

⁷¹ Interview with Vale.

⁷² Interview with Aurecon.

the recent announcement by Vale that it intends to sell half of its stake in the Nacala corridor.⁷³

3.2.3. *Potential future third party demand*

Railway

As the Beira corridor capacity is expected to be limited to 20mtpa in the long run due to Beira port expansion limitations, there should be sufficient demand from the coal mining companies operating in Tete province to use any excess capacity on the Nacala railway corridor (depending on the tariff that will be charged). This is even the case if the railway line capacity were to be increased to 30mtpa, which is thought to be the design limit.

Unlike the Sena line, the Nacala line is the sole link to the hinterland countries and therefore demand growth for non-coal cargo is expected to be higher, especially once the Malawian railway network is rehabilitated. Large-scale forestry concessions have been awarded in Zambezia with total production of forestry goods in the region estimated to reach 4.2 million m³/year (6mtpa) by 2025 and 7.2 million m³/year (10mtpa) by 2035. Several forestry concessions are nearby the railway line. Lúrio Green Resources S.A., for example, has been awarded concessions in the districts of Mecuburi and Ribáué. Further forestry concessions have also been awarded near the Cuamba-Lichinga branch of the CDN network. With the development of the ProSavana project, there is also potential to transport fertilizers on the inland train journey.

Finally, demand for passenger services is also likely to be high, given that Nampula is the most populous province in the country and the railway line connects the largest cities in the region (Nampula, Nacala, Lichinga, and Tete in Mozambique and Lilongwe in Malawi).

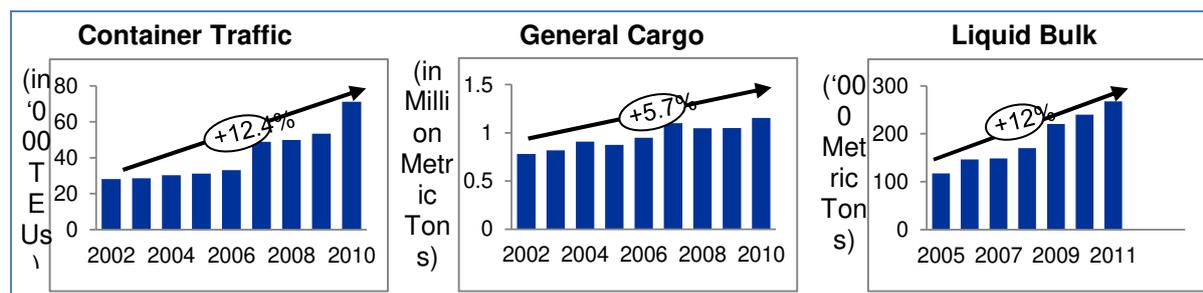
The GoM and the Japan International Cooperation Agency (JICA) is currently preparing an economic development strategy for the Nacala corridor and has estimated that cargo demand along the Nacala railway network is going to increase to 22mtpa in 2017 (with 18mtpa of coal), to 28mtpa in 2025 (with 20mtpa of coal) and 42mtpa in 2035 (with 30mtpa of coal).

Port

Third party demand for port access from coal companies in Tete province will depend on whether access is granted on Vale's railway line at competitive tariffs. Non-coal port throughput is expected to grow in the coming years. Figure 11 shows that especially the container and liquid bulk throughput have increased rapidly in recent years. Container traffic has exceeded the official terminal capacity in 2011 by an estimated 120% and CDN is proposing expansion plans for the existing terminals, as well as the construction of a new grain terminal and oil/LPG terminal.

⁷³ "Brazil's Vale wants to sell 35 pct of its stake in the Nacala Corridor," *Club of Mozambique*, December 4, 2013, available at: <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=business&id=30770&tipo=one>

Figure 11: Nacala Port throughput by type of cargo



Source: AECOM International Development (2012): Logistics Review of the Beira and Nacala Corridors

Unlike the port of Beira, the port of Nacala does not have major expansion constraints and the construction of the coal terminal opposite the existing commercial port is not expected to have significant adverse impacts on port traffic.

Long-term projections for Nacala port (including the new coal terminal, Nacala Velha) foresee throughput to reach 22mtpa (with 18mtpa of coal) by 2017, 33mtpa (with 20mtpa of coal) by 2025, and 55mtpa by 2035 (with 30mtpa of coal). The 13mtpa difference between port and rail throughput is expected to be transported by road.⁷⁴ This will also cater for the imports and exports coming through the Nacala Special Economic Zone (SEZ), which was established around the port in 2007. Total investment commitments to date in this area are estimated at US\$1.2 billion with 53 approved projects. As part of the SEZ development the Nacala airport is upgraded to cater for international long haul flights, further expecting to stimulate growth around the SEZ.

3.2.4. Conclusions

The proposed Nacala corridor solution is likely to result in higher operational costs on the railway line due to the additional 336km as compared to the Beira corridor. However, operational costs are expected to be significantly lower at the port, as cape size vessels can be loaded at berth rather than depending on transshipment operations on open sea.

From a regional and geopolitical perspective, the Nacala line is of greater strategic importance than the Sena line, as it is the sole access route to neighboring countries. The project, if successful, could provide a meaningful step towards an improved relationship between Mozambique and Malawi, and increase regional integration and trade flows. Furthermore, the Nacala railway line has higher potential to be a decisive factor in developing non-mining projects, as the line connects regions that are further away from port access. With increasing distance, railways become more cost effective as compared to road transport.⁷⁵ Especially the Niassa region, with its abundant forestry potential, could benefit significantly from access to the Nacala railway line via the Lichinga rail connection (Lichinga to Nacala is approximately 800km in distance).

The regional and non-mining related benefits from an improved Nacala railway corridor will only be felt if multi-purpose access is guaranteed at competitive prices. With Vale being

⁷⁴ Interviews with representatives of the GoM.

⁷⁵ Toledano, Thomashausen, Shah, and Maennling, “A Framework to Approach Shared Use of Mining-Related Infrastructure”, op.cit.

principally concerned about its coal exports, the GoM needs to regulate tariffs of non-coal cargo and passenger services. If these are unable to pay cost recovery tariffs, CDN and the GoM will need to come to an agreement about who will pay for the shortfall.

3.3. Macuse Corridor

3.3.1. Recent developments

The Macuse corridor is a greenfield rail and port proposal to link Moatize along a 525km railway line to Macuse, which is located 35km north of Quelimane (route 6 in figure 4). Rio Tinto developed the original concept in collaboration with other mining companies in the Tete region (excluding Vale) and CFM financed half of the prefeasibility study. The MTC launched the international tender for the project early 2013, which provides for a 30-year BOT concession for the project that is estimated to cost around US\$3.5 bn. At an initial phase, the project is set to handle 25mtpa with the potential to double that in the future.⁷⁶

According to the Minister of the MTC, 21 companies prepared proposals, including Rio Tinto, which was selected as one of the six preferred bidders that were asked to submit full bids.⁷⁷ Italthai engineering was officially announced to have been awarded the tender in December 2013⁷⁸ and will be seeking off-take agreements with the mining companies to finance the project. While the tender had initially specified a cape gauge design to ensure connectivity with the regional railway network, Italthai is thought to have designed a standard gauge railway line to increase capacity and efficiency, with solutions being provided to address connectivity.⁷⁹

It remains to be seen whether Italthai will be able to raise the financing necessary for this project, as it was reported that great difficulties were encountered by the bidding companies to provide the bank guarantees required by the GoM in the tender. Furthermore, a portion of the proposed Macuse line and port is located in the Zambezi Delta region, which is prone to flooding during the rainy season. This may explain the upward revision of the project cost to US\$5bn shortly after Italthai was announced as the winning bidder.⁸⁰

3.3.2. Third party access and potential demand

The Macuse railway line is set to be open access to carry coal and non-coal cargo, as well as passengers. The document approved by the Council of Ministers “*establishes a legal basis that allows the concession to a private operator of the construction, operation, maintenance and management of the Moatize-Macuse railway and the commercial operation of the freight and passenger rail transport service*”⁸¹. The proposed port development includes the construction of a container terminal.

Assuming that 20mtpa is exported via Beira and 18mtpa via Nacala, there is still a remaining potential demand of 18.8mtpa of the operating projects in table 1. This suggests that mining

⁷⁶ “Update 1 – Rio Tinto among main bidders for Mozambique rail project,” *Reuters* April 10, 2013, available at: <http://www.reuters.com/article/2013/04/10/mozambique-rail-riotinto-idUSL5N0CX4BT20130410>

⁷⁷ Ibid.

⁷⁸ “Terms of lease on Macuse port, railway agreed,” *Club of Mozambique*, December 5, 2013, available at: <http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=business&id=30776&tipo=one>

⁷⁹ Interview with Aurecon, August 2013.

⁸⁰ “Mozambique raises coal railway, port project cost to \$5bn,” *Mining Weekly* December 18, 2013, available at: <http://www.miningweekly.com/article/mozambique-raises-coal-railway-port-project-costs-to-5bn-2013-12-18>

⁸¹ “Terms of lease on Macuse port, railway agreed,” *Club of Mozambique*, December 5, 2013, [op](#) cit.

projects currently still in the exploration phase will need to make up 6.2mtpa to reach the capacity of 25mtpa of the proposed first phase. It remains to be seen whether Italthai can get the long-term take or pay agreements with the mining companies.

While there are forestry concessions located nearby the Macuse port, it is questionable whether these warrant multi-purpose access on the railway line if this comes at a significant cost. With its starting point in Moatize, the Macuse line is expected to run alongside the Sena line until Mutarara, and assuming that the Sena line will carry non-coal cargo and provide passenger services, the Macuse line will not have to do so on this stretch of the line. After Mutarara, the Sena line crosses the Zambezi River towards Beira. The distance between Mutarara and Macuse port is approximately 250km and with the National Road (EN7) running almost parallel to the proposed railway line it might be more cost efficient for wood from local forestry projects to be transported by road (or transported to Mutarara to access the Sena line).

The requirement for a container terminal, on the other hand, may prove valuable for regional development. Macuse port is expected to be located approximately 340km from Beira port and 520km from Nacala port. While Quelimane port is close, it can only handle small sized vessels due to draft restrictions. If large-scale forestry projects, such as Portucel's US\$2.3 billion investment north of Macuse materialize,⁸² access to a deeper export terminal could prove valuable. Even if there is insufficient foreseeable demand for the construction of the container terminal, the GoM should perform a detailed cost-benefit study of adding such a terminal, and compare this with the expansion of Quelimane port. If it proves to be more cost efficient to include a container terminal in the new Macuse port, but insufficient demand for the operation is foreseen in the medium term, the GoM could also insist on integrating the terminal in the design for future expansion.

3.3.3. Conclusions

Unlike the Beira and Nacala corridors, the Macuse corridor is entirely a greenfield project, which is designed to connect the coal mining region of Moatize to the exporting port on the shortest route possible. As such, there is a strong incentive to allow multi-user access on the rail and port infrastructure to develop as many coal mining concessions in Tete as possible. As explained in the background section, the development of these projects are closely linked to the logistics costs. This is especially the case for those concessions that have higher thermal to coking coal ratios since thermal coal prices are lower making such projects more cost sensitive. Macuse could provide a less expensive export solution in the long-run due to lower OPEX associated with the shorter rail distance (at US¢3/tonne-km, OPEX on the Macuse line would be US\$15.75/tonne compared to US\$17.28/tonne on the Sena line and US\$27.36/tonne on the Nacala line⁸³), but it will remain to be seen whether Italthai is able to reach the off-take agreements necessary to finance the project. If sufficient demand is available, the GoM and Italthai should assess the possibility of building a double track railway line, as such system would reduce operational difficulties associated with the crossing of inbound and outbound trains and maximize efficiency along the corridor.

⁸² "Mozambican government authorizes installation of paper factory by Portugal's Portucel," *Macahub*, December 23, 2009, available at: <http://www.macahub.com.mo/en/2009/12/23/8310/>.

⁸³ Total logistics costs will also depend on the capital expenditure on port and rail infrastructure, the port operational expenditure, the efficiency of the corridor, the potential cross subsidization for non-mineral traffic and the profit margin that guarantees the return on the investment for the concessionaire.

As the railway link seems to be of less strategic importance to develop non-mineral activities, especially if the Sena railway line continues to offer multi-purpose access, the GoM should consider imposing multi-user, but not multi-purpose access on the railway line. Furthermore, a detailed cost-benefit analysis should be undertaken to assess whether there will be sufficient demand for the construction of a container terminal at the port.

4. Findings and conclusions

The Mozambican ‘coal rush’ has significantly cooled in recent years and some of the coal projects proposed in the past are currently on hold. Coal production forecast figures vary widely and the GoM should reassess the production forecasts and simulate which coal projects are likely to come on stream at a set of logistics costs. This will help the Government in the decision making process on (1) how many export corridors at what capacity are needed to cater for the production forecasts, and (2) at what cost multi-user and multi-purpose access can be imposed.

The GoM should assess on a case-by-case basis whether it makes sense to impose multi-purpose access on rail and port infrastructure. Multi-purpose access can contribute to regional economic development, but it comes at the cost of higher tariff rates for the mining companies that are going to guarantee the financing of the infrastructure. Higher tariffs will result from higher CAPEX necessary to cater for non-coal cargo and may include the construction/upgrading of loading and unloading stations, passenger railway stations and separate terminals; lower corridor efficiency; and potential cross-subsidization, as passenger services and agricultural cargo is unlikely to be able to pay tariff rates that cover the average cost of the project.

Higher logistics tariffs for mining companies, in turn, may result in lower profit margins and therefore lower government corporate tax receipts. In extreme cases, mining projects may not materialize due to higher tariffs. This could especially be the case for those coal mining projects that have higher thermal to coking coal ratios. Table 2 summarizes the findings from each corridor assessment and provides suggestions as to what the GoM should prioritize going forward.

Table 3: Summary of the findings of the 3 most advanced logistics proposals

	Beira Corridor	Nacala Corridor	Macuse Corridor
Operator	-Rail: Government -Port: Third party	-Rail: Mining company majority shareholder -Port: Mining company majority shareholder	-Rail: Third party -Port: Third party
Strength	-Existing railway line and port -Lowest CAPEX -Leverage coal terminal investment to increase depth/width of access channel	-Deep sea port -Regional Integration -Potential to develop non-mining projects in Mozambique	-Shortest distance to port -Potential for heavy haul design
Weakness	-High OPEX at port -Expansion restrictions at port	-Distance & associated rail OPEX -Difficulty in ensuring	-High CAPEX -Unknown terrain (marshland)

	-Potential interference with non-coal shipments at the port	open access at competitive tariffs	
Significant multi-user potential in the foreseeable future	High – already the case	Moderate – Capacity for Vale exports	High – large capacity, non-mining operator
Significant multi-purpose potential in the foreseeable future	Moderate – sugar/ passengers	High – Hinterland throughput, forestry	Moderate – potential for port, less for rail
Government priorities	-Clarify the concession agreement on the Sena railway line -Consider tendering the new coal terminal concession to the same entity that will finance the Sena line expansion	-Clarify the tariff structure for multi-purpose access on the line -Build up the capacity of INATTER to monitor the concessionaire	-Do a cost-benefit analysis of multi-purpose access on the rail and port infrastructure -Assess the possibility of building a double track railway line

Apart from the corridor specific decisions, the GoM should also move ahead in staffing and building the capacity of the recently approved rail regulator INATTER. Once set up, INATTER should draft clear rules regarding third party access, tariff-setting mechanisms for mineral and non-mineral cargo, and preferential treatment of mining companies that financed the infrastructure, as these steps will reduce uncertainty to existing and future users of the rail and port infrastructure. In the long-term, it is recommended for INATTER to become independent from the MTC to guarantee an impartial decision making process in dispute settlements.

B. Scope for shared use for power infrastructure

1. Background

1.1. Key facts of the power sector in Mozambique

Installed capacity	2011: 2184 MW Hidroeléctrica Cahora Bassa (HCB) (South Bank): 2,075 MW Mavuzi (52MW); Chicamba (38.4MW); and Corumana (16.6 MW), Cuamba (1.1 MW), Lichinga (0.75 MW) ⁸⁴
Transmission	3 Grids – Northern, Central and Southern (See Section 3)
Power Destination	1460MW hydro- generation capacity is exported to South Africa & Zimbabwe by direct current lines from HCB ⁸⁵ . 1390MW of power imported from South Africa back into the Southern Grid, 950MW of which is for the BHP Mozal Aluminium Smelter. ⁸⁶
Tariffs	Industrial High Voltage tariff is \$0.036/kWh. ⁸⁷ Beyond 66kV, prices are negotiated directly with EDM. ⁸⁸
Electricity Access Rate (2010):	14% ⁸⁹
Policy Entity	Ministry of Energy (<i>Ministerio da Energia</i>)
State-Owned Utility	Mozambique Electricity (<i>Electricidade de Moçambique</i>), or EdM, a vertically-integrated state-owned company, which is responsible for the generation, transmission and distribution of electricity. Reforms in the electricity sector in 1997 under the Electricity Law opened the generation and transmission market to private enterprises.
Regulator	No independent regulator. The Ministry of Energy through the National Directorate of Electrical Energy (Direcção Nacional de Energia Eléctrica) regulates the sector. The National Electricity Council (<i>Conselho Nacional de Electricidade</i> or CNELEC), legally has administrative and financial autonomy, but has only consultative and advisory responsibilities. ⁹⁰

⁸⁴ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective”, AICD, op cit.

⁸⁵ Interview with Hidroeléctrica de Cahora Bassa, Maputo, August 9, 2013.

⁸⁶ Ncondezi Website: [http://www.ncondezicoal.com/uploads/ncl_minedfs_final\[0\].pdf](http://www.ncondezicoal.com/uploads/ncl_minedfs_final[0].pdf)

⁸⁷ EDM website:

http://www.edm.co.mz/index.php?option=com_content&view=article&id=121&Itemid=83&lang=en.

(1.08Meticas/kWh converted at \$1 = 30 Meticais).

⁸⁸ Interview with Vale, November 2013.

⁸⁹ OECD, “OECD Policy Overview – Mozambique” (April 2013), available at:

<http://www1.oecd.org/daf/inv/investment-policy/MozambiqueDraftIPR.pdf>.

⁹⁰ Helder Chambal, “Energy Security in Mozambique,” IISD, (2010), available at: http://www.iisd.org/tkn/pdf/energy_security_mozambique.pdf.

1.2. Moatize: How do the mines currently get their power?

The Mozambican power transmission network is made up of three separate grid networks. Most of the Mozambican power is generated at Cahora Bassa hydroelectric dam (South Bank)⁹¹ in Tete province, and is transmitted to Mozambican consumers through the Northern Grid, as well as to South Africa and Zimbabwe through a wheeling path from this grid.⁹² Power supply is relatively reliable. The World Bank's Enterprise Survey for 2007 reported that firms' value lost due to power outages in Mozambique was 2.4% of sales, which is close to the level of middle-income countries.⁹³

EdM has a pricing structure that sets tariffs at different rates for households, agricultural and industrial users. The industrial tariff is \$0.036 /kWh⁹⁴, which, according to AICD, is among the lowest in Africa.⁹⁵ Mining companies and heavy industrial users that depend on voltages higher than 66kV negotiate prices directly with EdM. Latest deals made by EdM with other national utility companies in the region may provide an indication of the potential range of tariffs. EdM agreed to sell electricity to Eskom in South Africa for around \$0.14/kWh and to Namibian Nampower for \$0.19/kWh.⁹⁶

Vale and Rio Tinto currently both purchase electricity from EdM. To do so, they have extended the transmission lines from the Northern Grid's Matambo substation in Tete, according to a design that involves two independent lines and two 66/22kv main consumer substations. The substations are connected to guarantee reliability and diversity to both mining companies.⁹⁷ Similarly, JSPL has built a sub-station with two 220 kv transmission lines connecting the electricity grid at the Cahora Bassa dam to its mining concession.⁹⁸ It is expected that other mining companies that will come on-stream in the region will also initially rely on electricity from the existing power grid.

2. Generation and transmission gaps

2.1. Projected demand

Power consumption in Mozambique has increased at a steady rate of 6-8% a year throughout the 2000s.⁹⁹ However, access to electricity is still very low. The AICD reports an urban

⁹¹ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective," AICD, op cit.

⁹² Ncondezi website: http://www.ncondezi.coal.com/uploads/nclinvestorpresentation_september2012.pdf

⁹³ <http://www.enterprisesurveys.org/Data/ExploreEconomies/2007/mozambique>, Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective", AICD, op cit..

⁹⁴ EDM website:

http://www.edm.co.mz/index.php?option=com_content&view=article&id=121&Itemid=83&lang=en. (1.08Meticas/kWh converted at \$1 = 30 Meticais).

⁹⁵ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective", AICD, op cit.

⁹⁶ Interview with Vale, November 2013.

⁹⁷ African Energy Journal, October 2010, available at:

<http://www.myvirtualpaper.com/doc/brookepatrick/african-energy-journal-october-2010/2010100701/18.html#18>

⁹⁸ Interview with JSPL, Maputo, August 5 2013 and "Guebuza inaugurates Jindal Operations," *Club of Mozambique*, August 2013, available at:

<http://www.clubofmozambique.com/solutions1/sectionnews.php?secao=mining&id=29629&tipo=one>

⁹⁹ OECD, "OECD Policy Overview – Mozambique" (April 2013), [op cit.](#)

electricity access rate of 26% in 2006-7, but a rate as low as 1% in rural areas,¹⁰⁰ reflecting the limited reach of transmission and distribution infrastructure. The OECD notes that many small and medium sized enterprises (SMEs), as well as households are under-served in their electricity needs.¹⁰¹

The majority of power consumed in Mozambique is used by industry. As mining operations progress, power demand will increase. It is estimated that the power demand from mining projects in Mozambique will reach 1,310MW by 2020.¹⁰² Growth and increased power demand is also anticipated in other industries, such as the cement sector. Further demand increases are expected from the development of Special Economic Zones (SEZ). To accommodate these developments, meet power demand and avoid power shortages, the GoM/EdM needs to increase generation capacity and expand electricity provision services.

Mozambique is also an important participant in the regional power market, currently selling power to South Africa and Zimbabwe through the Southern African Power Pool (SAPP).¹⁰³ The Southern African region is facing power capacity shortages, with a current shortfall estimated at 6,000MW. Demand in the SAPP is expected to increase by nearly 1,500 MW a year between 2012 and 2020.¹⁰⁴

2.2. Planned power generation projects

The five-year energy development plan (2010-2014) of the GoM sets out the priority projects in the power sector.¹⁰⁵ In this period, GoM plans to increase the capacity of the Cahora Bassa dam from 2,075MW to 3,220MW. It also plans to construct the 2500MW Mphanda Nkuwa hydroelectric dam, as well as several small-scale (25MW – 120MW) hydropower projects at Massingir, Lurio, Majawa and Malema.¹⁰⁶ Furthermore, a 150MW gas fired-power station is being built at Ressano Garcia, which is a partnership project between EdM and Sasol.¹⁰⁷

Transmission Infrastructure

It has been recognized by the GoM, that there is an urgent need for a national power grid that can more effectively distribute power across the country.¹⁰⁸ A limiting factor is the lack of transmission infrastructure connecting the Northern grid, where the energy is generated and the Southern grid, where most of the power is consumed. A large proportion of this power is currently being exported to South Africa (green connection in figure 12) and then re-imported into the country at higher prices near Maputo (yellow connection in figure 12) under long-term contracts between the national utility companies.¹⁰⁹ Mozambique imports 1,390MW

¹⁰⁰ Carolina Dominguez-Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective,” AICD op cit.

¹⁰¹ Ibid.

¹⁰² 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

¹⁰³ The common market for electricity in the Southern African Development Community (SADC) region

¹⁰⁴ Ncondezi website: http://www.ncondezicoal.com/uploads/nccinvestorpresentation_september2012.pdf

¹⁰⁵ OECD, “OECD Policy Overview – Mozambique” (April 2013), [op](#) cit.

¹⁰⁶ Ibid.

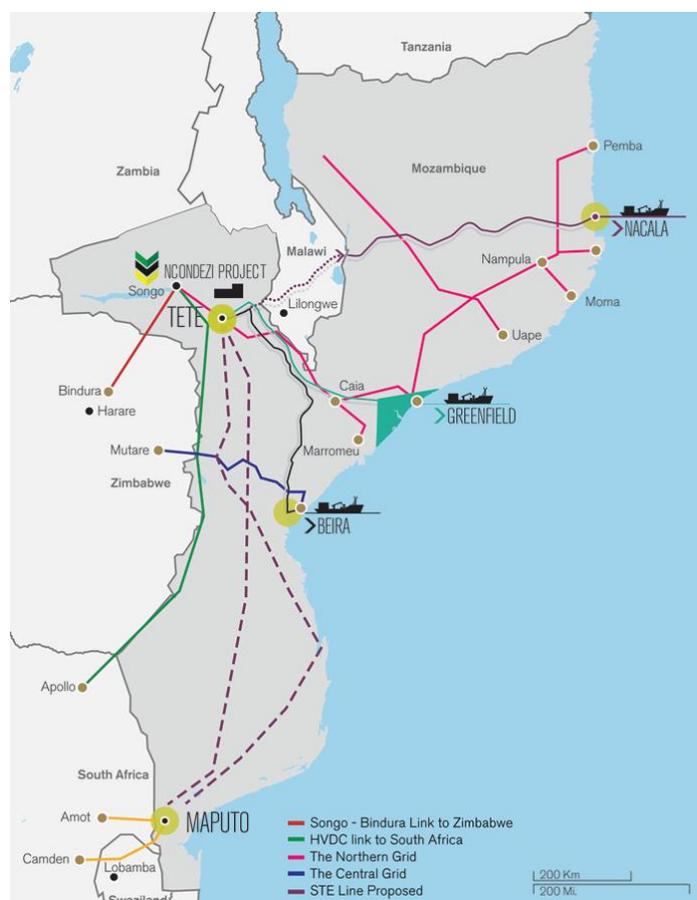
¹⁰⁷ “Mozambique: new power station to generate 150 Megawatts,” *AllAfrica.com*, August 2013, available at: <http://allafrica.com/stories/201308070321.html>.

¹⁰⁸ Interview with EdM, August 2013.

¹⁰⁹ Based on interviews in-country, August 2013.

from South Africa, with 950MW being allocated to BHP's Mozal aluminium smelter.¹¹⁰ The limited power supply acts as a constraint on economic development in southern Mozambique, where there is limited power generation potential¹¹¹ and little possibility of additional power supply from South Africa, which faces power shortages of their own.¹¹²

Figure 12: Power distribution network in Mozambique



To have an internal connection between the power producing North and Maputo in the South, the GoM is planning the Sociedade Nacional de Transporte de Energia (STE) project, which will connect Cataxa/Matambo in the Tete region to the Maputo/Moamba region. The transmission system includes two 1,300 km long transmission lines (dotted purple line in figure 12). One line is a 500 kV high voltage direct current (DC) line and the other is a 400 kV high voltage alternating current (AC) line. The system also includes DC converter stations and AC substations. This system will be owned and operated by STE, which is foreseen to be a special purpose vehicle in which EdM is the majority shareholder.¹¹³ The commissioning date is set for 2017–2020.¹¹⁴

¹¹⁰ Ncondezi Website: http://www.ncondezicoal.com/uploads/nclinvestorpresentation_september2012.pdf.

¹¹¹ Ibid.

¹¹² 'Eskom sees tight supply enduring for five years', *Engineering News*, September 2011 available at <http://www.engineeringnews.co.za/article/eskom-sees-tight-supply-enduring-for-five-years-2011-09-15>.

¹¹³ Global Transmission Report, "Mozambique invites bids for Cesul project," (January 2013), available at: <http://www.globaltransmission.info/archive.php?id=14467>.

¹¹⁴ Ncondezi Website: http://www.ncondezicoal.com/uploads/nclinvestorpresentation_september2012.pdf.

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

3.1. Leveraging mining projects for power generation

As previously outlined, the Moatize coal basin consists of coking coal, high quality thermal coal and low quality thermal coal. Thermal coal is typically found closer to the surface, its top layer being low quality, which means that for open-pit mining operations this layer has to be removed in order to access the deeper, higher grade thermal and coking coal.¹¹⁵ The presence of the low quality thermal coal in the Moatize deposits presents a commercial incentive for mining companies to build power plants, as this coal that cannot be exported profitably. Despite growing power demand domestically, there is currently no generation infrastructure to offtake this thermal coal. Therefore, the mining companies are stockpiling the coal, or depositing it in exhausted mining voids.¹¹⁶ This not only generates negative environmental impacts, but also creates additional costs to the miners. Given the high domestic demand for power generation in Mozambique, the existence of low quality thermal coal presents the opportunity for mining companies to build power plants to service their own consumption and to sell excess power to the national/regional grid.

3.1.1. Plans for thermal power plants in the Moatize region

At present, four mining companies in the region have plans to facilitate the construction of coal-fired power stations that, after servicing mine demand, would sell excess electricity to EdM or Eskom. All of these projects have plans for subsequent expansion to 1,800-2,640MW. The expansion is dependent on whether the proposed development of regional projects materialize, including the construction of the STE Backbone project, the ramp-up of existing mining operations, and the development of new mining operations in region that could offtake some of this power.

Table 4: Coal fired power plant projects in Mozambique

Vale: Moatize Power Plant	Phase 1 installed capacity of 300MW (net capacity of 270MW), ¹¹⁷ with potential expansion to 1,800MW during later phases. ¹¹⁸ During Phase 1, the mine will consume 220MW, and the 50MW remainder to be sold to EDM, transmitted via the Northern Grid or sold in the SADC region. ¹¹⁹ Development by IPP ACWA Power Moatize Termoeléctrica. ¹²⁰
Ncondezi	300MW power plant unit. 80% (230MW) to be sold into Northern grid via EDM with the remainder used by the Ncondezi coal mine (40MW) and the power plant (30MW). Design with potential expansion to 1,800MW. ¹²¹
Rio Tinto: Benga Power Plant	600MW power plant, with the potential for 2000MW in phase 2. Excess power to be sold to Northern Grid and the SAPP. Tender for IPP put out in mid-2012. ¹²²

¹¹⁵ DFID-AusAID Preliminary Mozambique Coal Master Plan - Draft, May 2013.

¹¹⁶ Ibid.

¹¹⁷ Interview with Vale, November 2013.

¹¹⁸ Acwa Power Website: <http://www.acwapower.com/project/16/moatize-ipp.html>

¹¹⁹ Interview with Vale, November 2013

¹²⁰¹²⁰ Acwa Power Website.

¹²¹ Ncondezi Website: http://www.ncondezi.coal.com/uploads/nclinvestorpresentation_september2012.pdf

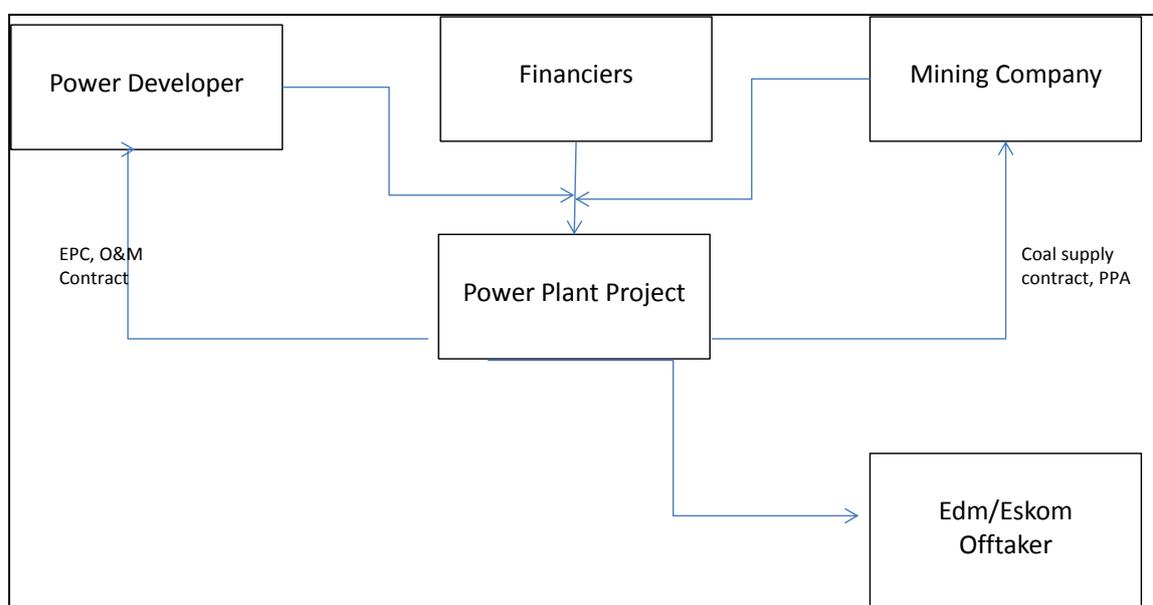
Jindal Steel & Power Ltd	250MW power plant, with potential for expansion to 2,640MW. Own consumption during the first phase will be 30-40MW. Power to be distributed to EDM and/or to Eskom. ¹²³
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Given the high capital expenditure involved in building these power plants and the economies of scale to be gained in coordinated investments, there may be a business case for mines to coordinate a joint-investment. The value of such an approach has been recognized by EdM,¹²⁴ as well as the OECD¹²⁵ and World Bank.¹²⁶

3.1.2. Deal structure: the role of the mining company

There are a number of stakeholders in a power project arrangement. As figure 13 illustrates, the power plant will need financiers, developers as well as suppliers of coal and offtakers of the power output.

Figure 13: Deal structure of power plant projects



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

- **Investment Initiator:** The mining company initiates/facilitates the investment by bringing in strong developers, EPC contractors, lenders, investors and advisers.
- **Equity Investor:** The mining company contributes to meeting the equity requirements for the project.

¹²² Global Tenders Website: http://www.globaltenders.com/free_tenders/026797-EOI-Power-Station-Mozambique.htm.

¹²³ World Bank, “The Power of The Mine: A Transformative Opportunity For Sub-Saharan Africa,” op.cit.

¹²⁴ Interview with EDM, Maputo, August 10, 2013.

¹²⁵ OECD, “OECD Policy Overview – Mozambique” [op](#) cit.

¹²⁶ World Bank, “The Power of the Mine: A Transformative Opportunity for Sub-Saharan Africa,” op cit.

- **Supplier of coal:** If the power plants are incorporated separately as an IPP project (as Vale and Ncondezi are currently planning), the mining company enters into coal supply & power purchase agreements with the power plant. This is done at arm's length and on commercial terms and are long-term contracts (Ncondezi suggests a minimum duration of 25 years)¹²⁷, giving sufficient security of supply.
- **Partial offtaker:** For all proposed project, the mining company offtakes a certain proportion of the power (See Table 3). This will help with the bankability of the deal, as the mine is a credible offtaker.

3.1.3. Challenges to overcome

Power purchase agreements

The investments require large capital outlays for the construction (US\$1-3billion) and the commercial viability will depend on the price at which the power is sold on completion. Power plant projects in Moatize benefit from the fact that they are based on discarded coal, which is not valued at world market prices – “*in economic terms it has a negative cost because if not used for power generation it will have to be disposed of at some real cost.*”¹²⁸ With an assumed discard coal price of US\$12.76/ton,¹²⁹ electricity could be produced at US\$0.0182/kWh. This could result in a power price of US\$0.0583/kWh, including the cost of transmission from the mine to the grid.¹³⁰

However, at present, in large part due to the dominance of the low cost Cahora Bassa hydropower dam as a source of electricity, power prices are low in Mozambique (US\$0.036 /kWh). AICD notes that EdM has set below cost recovery tariffs, which is unsustainable in the long run.¹³¹ Furthermore, the setting of power tariffs is politically charged. An attempt to raise tariffs in September 2010 resulted in riots in the country.¹³² It remains to be seen whether EdM, the sole offtaker of power in Mozambique, can offer the IPP a long-term PPA price that allows for the viability of the power plant projects. Ncondezi foresees that after policies of artificially low electricity prices in the past having resulted in regional short falls, power tariffs are set to increase in the region making IPP projects financially viable.¹³³

EdM as a PPA provider

An IPP will look for a long-term PPA to guarantee security of revenues. Although EdM states that it can issue long term PPAs,¹³⁴ it may not be in Mozambique's interests to tie itself into a long-term PPA if cheaper alternative power sources are going to come on-stream during the period of the PPA (if these can cover demand). The electricity price is certainly going to be

¹²⁷ Ncondezi Website: http://www.ncondezicoal.com/uploads/ncclinvestorpresentation_september2012.pdf

¹²⁸ World Bank, “The Power of the Mine: A Transformative Opportunity for Sub-Saharan Africa,” op cit.

¹²⁹ Estimated to be in the price range that the mines might charge the power plant if it is established under an IPP that will also be selling to EdM and to SAPP markets.

¹³⁰ Ibid.

¹³¹ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique's Infrastructure: A Continental Perspective,” AICD, op cit.

¹³² Mozambique reverses bread price increase, September 2010, *the Telegraph*, available at: <http://www.telegraph.co.uk/news/worldnews/africaandindianocean/mozambique/7988146/Mozambique-reverses-bread-price-increase.html>.

¹³³ Ncondezi Website: http://www.ncondezicoal.com/uploads/ncclinvestorpresentation_september2012.pdf.

¹³⁴ Interview with EDM, Maputo, August 10, 2013.

higher for thermal power projects than from the proposed hydro-power projects (Cahora Bassa Norte and Mphanda Nkuwa).

Even if EdM would enter into such long term PPAs, the financing of the project will depend on EdM's credibility as a PPA provider.¹³⁵ While AICD notes that EdM's collection ratio (100% of billings) is above the average of other low-income countries (93 %), system losses have deteriorated from 25% in 2005 to 27% in 2009, well above the international benchmark of 10% for a well-run energy utility. AICD also points out that the financial health of EdM is undermined by tariffs that are below cost recovery levels.¹³⁶

The weaker EdM is perceived as a guarantee provider, the more security will be needed through costly letters of credit from financial institutions, which are willing to guarantee payment for EdM's share of the power. The cost of such security would reduce the profitability for EdM.¹³⁷ The GoM could try to acquire partial risk guarantees from World Bank and/or multilateral agencies, but the environmental impact associated with coal powered electricity projects pose challenges to acquire World Bank and donor assistance for these projects.¹³⁸

Regulatory environment

Mozambique ranks 139th out of 189 countries in the World Bank's Ease of Doing Business index.¹³⁹ Without an institution that is able to comprehensively advise on necessary procedures, some businesses have reportedly taken as long as 18 months to become registered and comply with all necessary regulations to operate.¹⁴⁰ In the electricity sector, there is no independent regulator, which leads to uncertainty for potential investors. Currently, this task is performed by the Ministry of Energy through the National Directorate of Electrical Energy. The National Electricity Council (Conselho Nacional de Electricidade - CNELEC) has only consultative and advisory responsibilities. Recognizing the need for a regulator covering all aspects of the energy sector, legislation has been prepared to allow CNELEC to take on this role, which is expected to greatly strengthen economic regulation of the sector.¹⁴¹

Infrastructure requirements

The power plant projects will only be implemented if the mining operations can pursue its core business of exporting coking coal and high quality thermal coal. Rail and port capacity constraints have led to ramp-up delays and until the uncertainty of future rail and port capacity is solved, the power plant projects will be set on hold. Rio Tinto, for example, put out the expression of interest for the Benga Power plant in mid-2012, but with unknown

¹³⁵ It should be noted that if EDM is not perceived as a credible PPA provider, there is a risk that IPPs sell to Eskom, the South African utility instead. If these take the form of long-term agreements, Mozambique will lose power supply opportunities. Certainly some of the mining companies are already thinking of selling a portion of the power to Eskom (see Table 2).

¹³⁶ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective," op cit.

¹³⁷ Interview with EDM, August 10, 2013.

¹³⁸ "Coal at risk as global lenders drop financing on climate," *Bloomberg*, August 2013, available at: <http://www.bloomberg.com/news/2013-08-05/coal-at-risk-as-global-lenders-drop-financing-on-climate.html>

¹³⁹ Ease of Doing Business in Mozambique available at <http://www.doingbusiness.org/data/exploreconomies/mozambique>.

¹⁴⁰ World Bank, "The Power of The Mine: A Transformative Opportunity for Sub-Saharan Africa," op cit. .

¹⁴¹ Ibid.

capacity allocation on rail and port infrastructure, the company has yet to announce the contractor for the power project.

The thermal power plant projects will also depend on additional investment into the national transmission grid. Currently, there is only enough capacity for Ncondezi and Vale to transmit the power from their initial phase projects using the northern grid infrastructure.¹⁴² However, there remains a lack of sufficient transmission infrastructure to transport it through EdMs network.

If EdM cannot fund additional transmission infrastructure, there are a number of alternative ways this infrastructure could be financed, provided that the associated commercial frameworks can be implemented and enforced. 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 the prepayment is treated as a loan. This is repaid in kind through an offset in the invoicing for power purchased/sold by the IPP or the mine. An adjusted tariff during the repayment period¹⁴³ is then negotiated. Ncondezi, for example, plans to build transmission lines from its plant to the Northern Grid, which will then become the property of EdM and the investment will be recouped through wheeling charges on the power sold by Ncondezi to EdM.¹⁴⁴

3.2. Leveraging mining projects for transmission infrastructure investments

3.2.1. Connecting smaller users

Mozambique is a country in which 80% of the population is dependent on agriculture.¹⁴⁵ Of the areas under consideration in this case study, the Beira corridor, Zambezi River Basin and Nacala corridor contain huge agricultural potential. The BAGC has identified 190,000 hectares in Mozambique as having the potential to generate revenues for farmers of more than US\$1 billion per year.¹⁴⁶ The lack of irrigation and grid-connected electricity are key factors, which are preventing this from becoming a reality.¹⁴⁷ The group states that investments in "agriculture-supporting" infrastructure are necessary.¹⁴⁸ Irrigation requires a steady supply of power,¹⁴⁹ but despite the Beira corridor being located near the northern and central power grids, there has been a lack of the necessary connections, which would allow smaller users to use the national power supply. These constraints are preventing farmers from benefitting from improved yields, lower production costs and the ability to compete in regional and global markets.¹⁵⁰

It is often difficult for utilities to justify prioritizing the extension of the national grid to rural areas, which are remote and have low population densities. However, a number of mining companies have extended or plan to extend the transmission lines from the national grid infrastructure to meet their initial power needs. If these transmission lines are being extended

¹⁴² Interview with Ncondezi, September 17, 2013.

¹⁴³ Toledano, Thomashausen, Shah, and Maennling, "A Framework to Approach Shared Use of Mining-Related Infrastructure", *op.cit.*

¹⁴⁴ Interview with Ncondezi, September 17, 2013.

¹⁴⁵ OECD, "OECD Policy Overview – Mozambique," *op.cit.*

¹⁴⁶ BAGC website, <http://www.beiracorridor.com/?target=resource-centre>.

¹⁴⁷ *Ibid.*

¹⁴⁸ *Ibid.*

¹⁴⁹ Interview with the Beira Agricultural Growth Corridor, August 7, 2013.

¹⁵⁰ BAGC website, [op.cit.](#)

to previously unconnected areas, there is potential for these rural areas near substations to gain access to electricity. Smaller mining companies in the region may also benefit from connectivity.

In order to connect small scale users along the high voltage bulk power supply, additional infrastructure would be necessary (substations, transformers) in order for the power supply to step down to a voltage level which can be used by small-scale farmers.¹⁵¹ This additional infrastructure is unlikely to be financed by the mining companies. EdM will therefore need to raise funds to invest in distribution infrastructure, as well as to monitor the use and collect payments.¹⁵²

3.2.2. *Facilitating national backbone infrastructure*

Coordination between the STE backbone project and the development of new generation projects in Mozambique is critical for the success of both.¹⁵³ The STE project is divided into phases.¹⁵⁴ Phase 1 is anchored on the expansion of the Cahora Bassa hydroelectric dam (North Bank) and the Mphanda Nakuwa hydroelectric dam. While the initial anchors to the project appear to be the large hydropower projects, feasibility studies suggest that later phases which see increased capacity of the transmission infrastructure could foresee the coal-fired power plants as anchor projects.¹⁵⁵ In turn, and as noted earlier, the completion of the backbone project is necessary to justify the expansion phases of the power plant projects to 1800-2640MW.

4. Findings and conclusions

Through planning and structuring of new power generation and transmission capacity associated with the mining industry’s energy demands, Mozambique can aim at building more robust power generation facilities and electricity transmission systems. The potential options for power-mine synergies, along with their associated challenges are summarized in the table below.

Table 5: Summary of power-mine synergies

Power-Mine Synergy	Description	Challenges	Potential to leverage
Increase Power Capacity of Mozambique: Thermal power plants	Mines act as offtakers and suppliers of coal to power plant, providing power demand guarantee and	<ul style="list-style-type: none"> - Power price - EdM as offtaker - Transmission infrastructure 	High – in the interest of GoM and mining companies

¹⁵¹ Interview with Ncondezi, September 17, 2013.

¹⁵² Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective,” AICD.

¹⁵³ “Resource-Based Sustainable Development in the Lower Zambezi Basin,” Columbia Center on Sustainable Investment, June 2011 available at:

http://www.vcc.columbia.edu/files/vale/content/Zambezi_Resource_Based_Development-Final_Consultative_Draft.pdf.

¹⁵⁴ Mozambique Regional Transmission Backbone Project (“CESUL”):

Technical & Economic Feasibility Study, available at www.xitizap.com/CESUL_Feasibility%20%20Study.ppt

¹⁵⁵ Ibid.

	increasing bankability of project.		
	Rather than each mining project having its separate power plant, a larger capacity power plant is built	- Coordination among mining operations	High – Economies of scale will make coordination attractive to investors
Contribute to the construction of the transmission infrastructure	Mines finance the transmission connection from existing grid to mine operations. Potential for mining operations to share transmission infrastructure	- Coordination among mining operations	High – in the interest of the GoM and mining companies
	Mines act as anchors to backbone project	- Coordination of transmission and generation projects	High – in the interest of GoM and mining companies, but high capital costs of the project may delay implementation
Increase electricity access to small users	Small-scale users tapping into the grid at substations built by the mining companies	- EdM needs to finance the distribution infrastructure	Moderate – dependent on whether communities around mine site are already connected. This is likely to be the case for the concessions around Tete city, but might not be the case for future mining concessions that are more remote.
	Small-scale users tapping into the transmission grid built by the mining companies	- EdM needs to finance substations, transformers and distribution infrastructure	Low – There is already an existing transmission line from Songo – Matambo – Tete, (which follows many of the advanced mining concessions). Hence additional transmission infrastructure built by mining companies will run in close proximity to existing transmission lines.

C. Scope for Shared Use of Water Infrastructure

1. Background

1.1. Mozambique's water infrastructure

State of Mozambique's water infrastructure

Mozambique has a wealth of water resources. At the same time, it is also water vulnerable given its dependence on water from river basins shared with neighboring countries and a high climatic variability. This water vulnerability, coupled with a lack of water storage capacity and infrastructure to ensure a reliable water supply, has had a marked impact on Mozambique's economic growth and poverty reduction development goals. It is estimated that around 1.1% of GDP in Mozambique is lost annually due to droughts and floods.¹⁵⁶ With approximately 70% of the population relying on rain-fed subsistence farming, one third of the population is also estimated to be chronically food insecure.¹⁵⁷

Water infrastructure, including waste water treatment, water storage reservoirs and water distribution networks remain under-developed, or in need of rehabilitation. The GoM has sought to address these issues by decentralizing the provision of water services, including the participation of the private sector through partnerships with water operators such as donor-funded Vitens Evides International, and gradually rationalizing water tariffs to promote cost recovery and the financial autonomy of public water utilities. However, there is still a huge funding gap for water infrastructure investments in Mozambique.

Financing Mozambique's water infrastructure needs

According to AICD estimates, Mozambique would need to spend US\$370 million per year between 2006 – 2015 to (1) meet the Millennium Development Goals in water and sanitation by 2015 and (2) make up the backlog of sector rehabilitation following Mozambique's civil war.¹⁵⁸ However, as of 2009, Mozambique has spent an annual average of just US\$103 million on the water and sanitation sector, which leaves a gap of US\$ 219 million per year.

Private sector investment in water infrastructure could help to plug this gap. However, obtaining financing on a project finance basis has traditionally been difficult for the following reasons:

- I. *State of the banking sector in Mozambique:* With high interest rates and relatively short loan tenors, the cost of debt service and principle repayment may increase the water tariff to unacceptably high rates if passed to customers in the tariff structure.
- II. *Water subsidies:* Financiers do not look favorably upon heavily subsidized water tariffs as that increases the country risk to the financiers to the extent that debt service and repayment of principle are not reflected in a realistic and affordable water tariff. Financiers therefore require some certainty that the water tariff charged to customers will be sufficient over the tenor of the loan to repay them.

¹⁵⁶ Carolina Dominguez-Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective," AICD, op cit.

¹⁵⁷ Ibid.

¹⁵⁸ Ibid.

III. *Reliable demand data*: Financiers require reliable data on demand management and water consumption in relation to the water infrastructure they will be financing. Such data would typically include estimates on the size of the population, the coverage area, and the average water consumption of the population, which could, for example, be achieved by obtaining data on household water consumption based on population census information relating to the number of members in a household, the size of the house and the number of toilets and showers.¹⁵⁹ Such data is challenging to obtain in the Mozambican context, where census figures are not regularly updated (the last census dating back to 2007), there is high economic and social mobility, and many potential future users are obtaining their water directly from boreholes and other underground or surface water sources.

It is in this context that the growth of the coal-mining sector in the Tete region could present an opportunity to leverage mining-related investments in water infrastructure and waste-water treatment facilities for the promotion of Mozambique's development goals in the water and sanitation sector in Tete province.¹⁶⁰

Access to clean drinking water and sanitation

Mozambique has one of the lowest rates of access to clean drinking water and sanitation in the world, with large discrepancies between access to water supply in the urban areas and rural areas. While there are data discrepancies in the water and sanitation sector in Mozambique, an extensive household survey carried out for UNICEF in 2008 estimates that around 47 % of the population has access to safe drinking water, while 17% of the population has access to sanitation facilities.¹⁶¹ In rural areas, the figures are considerably lower with an estimated 29% of the population having access to clean drinking water and 4% to sanitation facilities, and only around 1% to piped water facilities to their homes.¹⁶² Most rural water is provided through piped village systems and low cost technologies such as wells and boreholes with hand pumps. These systems have helped to reduce the population's reliance on surface water.¹⁶³ At any given time, an estimated 35% of the rural systems and water points are non-operational, in large part due to underinvestment and poor management.¹⁶⁴ Rural water supply is also particularly unreliable during the dry season when surface and underground water sources dry up.¹⁶⁵ While most urban areas do have waste-water treatment facilities, such facilities are limited in rural areas, where low cost solutions such as septic

¹⁵⁹ Interview with Bigen, South Africa, September 30, 2013.

¹⁶⁰ Mozambique is committed to meeting the UN Millennium Development Goals for water and sanitation by 2015 – that is, 70% of the rural population have access to safe water supplies and 50% of the rural population having access to sanitation by 2015. The GoM's commitment to improving access to improved water supply and sanitation is also set out in its third Poverty Reduction and Strategy Paper (PARP 2011-2014).

¹⁶¹ UNICEF: "The One Million Initiative Mozambique: Rural Water, Sanitation and Hygiene Programme," October 25, 2011 available at: http://www.unicef.org/mozambique/media_9849.html.

¹⁶² OECD, "OECD Policy Overview – Mozambique" (April 2013), available at: <http://www1.oecd.org/daf/inv/investment-policy/MozambiqueDraftIPR.pdf>. All figures are taken from a 2007 population census.

¹⁶³ Reliance on surface water declined from 27% in 1997 to 16% in 2008, a level comparable to that of an average middle income country in Sub-Saharan Africa. Source: Carolina Dominguez-Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective," op cit.

¹⁶⁴ USAID, "USAID Country Profile: Property Rights and Resource Governance: Mozambique," February 2011, available at: <http://www.usaidlandtenure.net/mozambique> (last visited on September 11, 2013).

¹⁶⁵ African Development Bank Group, "Republic of Mozambique: Country Strategy Paper – 2011-2015," August 2011.

tanks and latrines are being installed. Open defecation is also still widely practiced in rural areas at almost three times the level of middle-income countries.¹⁶⁶

Water storage

Mozambique’s water storage infrastructure to mitigate the effects of its water vulnerability is limited. While nearly all river basins in Mozambique are estimated to have a surplus of annual runoff compared to foreseeable water demand, serious water shortages occur in certain parts of the country, during the dry season.¹⁶⁷ This is also the case in Tete province. According to a 2005 World Bank study, the water storage capacity of Mozambique is estimated to be approximately 5% of annual runoff (excluding Cahora Bassa dam), whereas the minimum water storage capacity is recommended to be 40% of annual runoff to provide 50% of such runoff with 80-90% reliability.¹⁶⁸ The average water storage per person in Mozambique is estimated at 330m³,³ compared with 746m³ in South Africa and 6,150m³ in North America. Significant investment is required in water storage capacity to ensure a more reliable water supply to water users for domestic use, industrial use, and irrigation for farmers.

1.2. Institutional and regulatory framework of water supply

Institution	Role
AIAS	Water asset manager for urban sanitation and secondary town water supply
ARA	Regional water administration charged with river basin management, planning and development.
CRA	Water regulatory authority – sets water tariffs. Reports directly to the Executive
DAS	Water and Sanitation Departments in the Provincial Directorates of Public Works (DPOPH). Manage the rural supply of water and sanitation in Mozambique’s 110 provinces under the oversight of the DNA.
DNA	National Water Directorate in the Ministry of Public Works and Housing. Responsible for: <ul style="list-style-type: none"> • National planning and management of Mozambique’s water resources • Overall responsibility for provision of water supply and sanitation services in rural and urban areas • Liaises with neighboring countries and the SADC water sector division on the transboundary management of water basins
DPOPH	<ul style="list-style-type: none"> • Provincial Directorates of Public Works manages selected urban and rural water supplies.
FIPAG	Water asset holding company that delegates water operation services to private companies in 20 major cities in Mozambique
ZamCom	The Zambezi Water Commission. Responsible for the transboundary management of the Zambezi River basin

At the national level, the National Water Directorate (DNA), a division of the Ministry of Public Works and Housing (MOPH) is in charge of national planning and management of Mozambique’s water resources as well as the provision of water supply and sanitation services in urban and rural areas. At the provincial level, the Water and Sanitation Departments (DAS) manage the rural supply of water and sanitation in Mozambique’s ten

¹⁶⁶ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective,” AICD, p. 26.

¹⁶⁷ “The Role of Water in the Mozambique Economy– Identifying Vulnerability and Constraints to Growth,” World Bank, (May 24, 2005).

¹⁶⁸ Ibid.

provinces under the oversight of the DNA.¹⁶⁹ Pursuant to the GoM strategy to decentralize the provision of water services, some of the DNA's core activities have been devolved in the area of river basin management, urban water supply, and rural sanitation and water supply.¹⁷⁰

Urban water supply has largely been delegated to the Water Supply Investment Fund (FIPAG).¹⁷¹ From 2009 to 2012 FIPAG contracted Vitens Evides International and the Netherlands' Ministry of Development Cooperation to set up an autonomous regional water company to provide technical and management assistance for potable water infrastructure in eight towns in Mozambique including Tete and Moatize.¹⁷²

More recently, the Water Sanitation and Infrastructure Management Unit (AIAS), was established as an asset manager for urban sanitation management and water supply to secondary towns in Mozambique. FIPAG and AIAS are regulated by the Water Regulatory Council (CRA).¹⁷³

All other urban and rural water supplies are managed through the DPOPH and the DAS under the strategic guidance of the DNA.¹⁷⁴ The principles underpinning the GoM's rural water management policy include: (1) highest priority for the satisfaction of basic water needs, taking into account the circumstances of the poor, (2) the supply of an average of 20 liters per person per day from a water point (well or borehole with handpump) no further than a thirty minutes' walk away, (3) at least one water point for every 300 people, (4) a water tariff that reflects the economic value of water, and (5) direct community participation in the ownership of community water infrastructure and the payment of operation and maintenance costs.¹⁷⁵

Given severe capacity and financial constraints of the DNA in the rural areas, donors have led the rural water and sanitation initiatives, implementing community-led total sanitation programs, constructing, rehabilitating and maintaining water points and conducting capacity building. However, these initiatives have often occurred in an uncoordinated fashion with insufficient follow up and maintenance.¹⁷⁶

River basin management

River basin management, planning and development has been delegated to five Regional Water Administrations (ARAs).¹⁷⁷ The ARAs have administrative, organizational and

¹⁶⁹ Municipalities and district administrations are by law responsible for piped water systems in the smaller urban centers. Given severe funding and human capacity restraints, the operation of these systems is being contracted to private operators by the DNA.

¹⁷⁰ Gallego-Ayala J. and Juízo D., "Strategic implementation of Integrated Water Resources Management in Mozambique: an A'wot analysis" in "Water Resources Management", 11th WaterNet/WARFSA/GWP-SA symposium, Victoria Falls, Zimbabwe, p.31.

¹⁷¹ See the "Sobre Nós" section of the FIPAG website, available at: www.fipag.co.mz.

¹⁷² See Vitens Evides International website, available at: www.vitensevidesinternational.com.

¹⁷³ ISF - UTS, "Mozambique : WASH Sector Brief", WASH sector briefing papers, prepared for AusAID by the Institute for Sustainable Futures - University of Technology Sydney, October 2011, available at: <http://www.irc.nl/docsearch/title/178544>, p.3.

¹⁷⁴ "More than water: Impact evaluation of drinking water supply and sanitation interventions in rural Mozambique," Mid-term impact evaluation: UNICEF – Government of The Netherlands Partnership for Water Supply, Sanitation and Hygiene 'One Million Initiative,' Mozambique, 2011, p. 39.

¹⁷⁵ Ibid.

¹⁷⁶ "Mozambique Water and Sanitation Profile," USAID, 2009, available at: <http://usaid-suwasa.org/index.php/contact-us/our-staff/item/199-mozambique-water-and-sanitation-profile>.

¹⁷⁷ Article 18 of the Water Law gives jurisdiction over water management to the ARAs. The five ARAs include (1) ARA Sul, which is responsible for the Save River basin and all river basins South of the Save River, (2) ARA Centro, with responsibility for the basins between the Save and Zambezi River basins, (3) ARA Zambeze, which is responsible for the Zambezi River basin in Mozambique, corresponds to the Zambezi basin, (4) ARA

financial autonomy, but report to the DNA.¹⁷⁸ They are also charged with gathering hydrological information, controlling irrigation systems and collecting water fees within their jurisdictions. Tete province falls within the jurisdiction of the ARA-Zambeze, which was established in 2005 and is based in the city of Tete.

The ARA-Zambeze is responsible for ensuring the rational usage of water resources, safeguarding surface water sources, controlling the flow to the ocean by promoting the construction of dams to store water, reducing water wastage with cooperation of other institutions, raising awareness about the value of water, collecting fees for water usage, and protecting ground water resources against pollution.

Source: Decree 26/91 of November 14, 2005

The DNA has also established an International Rivers Office (*Gabinete de Rios Internacionais*), which is charged with liaising with neighboring countries and with the SADC water sector division regarding the transboundary management of water basins.

On an international level, the Zambezi Watercourse Commission (ZAMCOM) was established in 2004 with the objective promoting the equitable and efficient utilization of water resources along the Zambezi River Basin by the eight riparian states in which the Zambezi River Basin is located.¹⁷⁹ However, it only recently became operational in June 2011, after the requisite six of the eight signatories finally ratified the agreement establishing ZAMCOM.¹⁸⁰ Trans-boundary management of the Zambezi River Basin still poses considerable challenges due to competing riparian state interests, inadequate river basin level institutional structure, institutional, legal, economic and human resource constraints, poor data collection, poor communication, and inadequate training.¹⁸¹

1.3. How mines source their water requirements

Water is a critical input in each stage of the coal mining process from dust suppression to washing the coal. Companies mining coal therefore require a reliable source of water to service the mine.

Water licensing

Mining companies are required to obtain a water license to be allowed to extract and appropriate water.¹⁸² The ARAs have the authority to grant and monitor water licenses and concessions, and are required to create and manage a water user registry of such water

Centro-Norte, which covers the basin from the Zambezi River to the Lurio River, including the Lurio basin, and ARA Norte, which covers all the basins north of the Lurio River basin.

¹⁷⁸ IS Academie, "Mozambique: Food Security and Land Governance Factsheet - 2012", available at:

<http://www.landgovernance.org/content/country-factsheets-land-governance-policy-institutional-contexts>, p. 7.

¹⁷⁹ See "About" section of ZAMCOM website, available at: <http://www.zambezicommission.org>. ZAMCOM was established pursuant to a 2004 ZAMCOM Agreement and in accordance with the revised SADC Protocol on Shared Watercourses of 2000.

¹⁸⁰ Ibid.

¹⁸¹ Kirchhoff, C and Bulkley, J. "Sustainable Water Management in Zambezi River Basin," the Journal of International Institute, 2008.

¹⁸² Articles 15(4) of the 2002 Mining Law, Law no. 14/2002 of June 26, 2002. Council of Ministers Decree no. 43/2007 of October 30, 2007. Article 21 of the 1991 Water Law, "Waterlex Mozambique", FAOLex, available at: <http://faolex.fao.org/faolex/waterlex.htm>.

licenses and concessions.¹⁸³ Water licenses for use in mining operations are granted for a fee for up to 50 years.¹⁸⁴ Once granted, the water concession may only be altered or revoked in certain circumstances, namely (1) in case of a repeated violation of the rights set out in the relevant water license, (2) when it is in the public interest to do so, and/or (3) in the event of a force majeure.¹⁸⁵ In relation to the force majeure provision, the 2007 water regulation provides that provincial governors are authorized to temporarily appropriate water rights to ensure that the domestic water needs of a population can be satisfied in cases of droughts, floods, or other disasters.¹⁸⁶ Compensation is to be paid to the water license holder if such an appropriation occurs. There is no mechanism in the water licensing system to allow for the ARA to review the terms of the water license and quantity or source of the water allocated.

While river water levels in the Zambezi river basin fall under the jurisdiction of the ARA-Zambezi, water infrastructure and ground water extraction are the purview of FIPAG.¹⁸⁷ A mining company must therefore separately negotiate with this agency if it wishes to be connected to an existing water system. Most large-scale mines have opted to build their own water infrastructure, as FIPAG's water infrastructure is insufficient to supply mining companies with their water requirements.

Water management at the mine sites

To meet the water supply demands for their mining operations, mines require water infrastructure including water pumps to pump water from a water source, pipelines to transport the water to the mine site, water storage facilities, and water treatment facilities to treat waste-water before it is released back into the environment.

Vale contracted the engineering and environmental services firm Golder Associates to conceptualize and implement a detailed design for water management at Vale's Moatize mine.¹⁸⁸ Although the Zambezi River runs across Vale's concession, it was decided that Vale should rather pump fresh water for its mining operations from an alluvial aquifer along the Revuboe river 23km from the mining operations. This decision was taken because of the seasonal flooding of the Zambezi River and instability of the Zambezi River's banks, which would make water extraction from this source more costly.¹⁸⁹ Water is therefore extracted from a series of well points and low lift pumps from the aquifer and then transported above ground in 500mm diameter steel pipes along the main access road to the mine site (at a rate of 600 l/s). Expansion joints had to be included in the pipeline to accommodate the huge

¹⁸³ Article 18 of the 1991 Water Law. Also see Article 2 of the Ministerial Decree 70/2005 of March 23, 2005, which established the ARA Zambeze. Ministerial Diploma no. 7/2010 of January 6, 2010 provides a form for Water Licenses and Concessions.

¹⁸⁴ Article 61(3) and 67(4) of Ministerial Decree 43/2007 of October 30, 2007— Regulation of Water Licenses and Concessions, translated for USAID/ Agrifuturo. The consent of the Minister of the MOPH is required for a water concession that is 25 years or longer. The Ministries of the Environment, Agriculture, Mineral Resources, Planning and Development, and Fisheries must also be consulted before awarding a water license.

¹⁸⁵ Article 34 of the Water Law 1991. Under Article 59(2) of the 2007 water regulation, an appropriation of water rights "in the public interest" includes (a) when such rights could be better harmonized with the area's development plans and programs, or (b) represents a greater economy of use of the water, without harmful environmental effects."

¹⁸⁶ Article 59(4) of the 2007 water regulation.

¹⁸⁷ Interview with Vitens Evidenz International.

¹⁸⁸ "Golder provides specialist services to Moatize," *Civil Engineering*, June 2012, p. 5.

¹⁸⁹ Interview with Golder Associates, September 16, 2013.

temperature fluctuations, with temperatures as high as 65 degrees Celsius in the summer. The design and construction of the water facilities cost Vale approximately US\$ 30 million.¹⁹⁰

Vale's strategy for water management at its Moatize operations includes recycling and re-use of the water extracted during dewatering¹⁹¹ of the open pit as a supplement to fresh water sources, treatment of dewatered water¹⁹² in sedimentation tanks, construction of dikes to control surface water and flooding, and diversion of the Moatize river across the concession to prevent it from flowing into the open pit.¹⁹³ Vale envisages that after a few years, there will be a large enough water surplus on-site of dewatered water for it to carry out its mining operations at the current coal extraction levels without additional water being extracted from the Revuboe river.¹⁹⁴ A water treatment plant to neutralize the acidity of the processed water through reverse osmosis has been planned. However, these have not yet been implemented.¹⁹⁵

Rio Tinto obtains its water directly from the Zambezi River for its mining operations by means of an existing water supply facility under a contractual arrangement with FIPAG.¹⁹⁶ There is no treatment facility for either biological waste or processed water. Sewage is placed into on-site containers and subsequently pumped into a landfill. Overburden and the course waste from the coal washing process are also deposited into a landfill. The remaining liquid from the coal washing process is deposited into tanks for five years, following which it is dumped into a landfill.¹⁹⁷ Rio Tinto is considering the construction of a water supply facility with other mining companies in the area to facilitate increased water supply.¹⁹⁸ However, plans for such collaboration are currently on hold.

JSPL is currently using water from boreholes to meet the needs for its mining operations at Changara, which depletes the underground water sources from which municipal water is extracted.¹⁹⁹ Plans are underway to construct the requisite water infrastructure to pump water from the Zambezi River to the mine site for industrial use. JSPL was also in discussions with FIPAG and ENRC to pipe water from the Zambezi River to supply fresh water for both the mine sites and nearby villages, or along the route of the water pipeline.²⁰⁰ No details were available as to the estimated cost or terms of this project and it is unclear whether it is going ahead given ENRC's pending mining project.

¹⁹⁰ Ibid.

¹⁹¹ Dewatering is the process of draining water that has collected in an open pit – either from rainfall, or because the pit has been excavated to below the water table level.

¹⁹² Dewatered water is the water that has been drained from the open pits.

¹⁹³ Estêvão A. J. Pondja, "Treatment methods for water pollution from coal mining in Moatize (Mozambique)," Examenarbete TVVR 13/5008, Division of Water Resources Engineering Department of Building and Environmental Technology, Lund University, May 2013, p. 43.

¹⁹⁴ Interview with Golder Associates, September 16, 2013.

¹⁹⁵ Ibid.

¹⁹⁶ Interview with Rio Tinto, August 8, 2003.

¹⁹⁷ Estêvão A. J. Pondja, "Treatment methods for water pollution from coal mining in Moatize (Mozambique)," Examenarbete TVVR 13/5008, Division of Water Resources Engineering Department of Building and Environmental Technology, Lund University, May 2013, p. 38.

¹⁹⁸ Interview with Rio Tinto, August 8, 2003.

¹⁹⁹ Interview with Vitens-Evides International on October 2, 2013.

²⁰⁰ Interview with JSPL Mozambique Minerai LDA, August 5, 2013.

2. Impact of coal mining on the water requirements of neighboring communities

As Mozambique's economy continues to grow, there is increasing pressure on the country's water resources.²⁰¹ In addition to the rising domestic consumption levels, which are expected to increase 35-45% between 2003 and 2015, industrial use is set to increase by around 60-70% during the same time period mainly due to the growth of the mining sector.²⁰² Planned irrigation schemes are also expected to increase demand for fresh water. This is felt even more strongly in Tete province, where towns and communities obtain most of their water from underground sources such as boreholes and wells. With the rapid expansion of coal mining activities since 2004, considerable pressure has been placed on water supplies and availability in the area – both for the mining operations themselves and for the accompanying population increase in the surrounding areas. In 2012 alone, an additional 21 boreholes were built in Tete city for domestic consumption purposes, but these investments were insufficient to keep up with water demand.²⁰³

The coal mining activities have also had an impact on the water quality. Since their commencement, some underground water sources have been contaminated with mine effluents.²⁰⁴ While there are water treatment facilities in Moatize, the communities who are reliant on boreholes do not have access to treated water. In addition to contamination from the coal mining activities, a number of the tributaries from the Zambezi River upstream of Moatize are being polluted from effluent (mercury) of artisanal gold mining activities. Therefore FIPAG may need to look for alternate borehole locations to replace those that are being contaminated.

The largest media coverage related to water scarcity resulting from mining activities has been on the communities that were relocated from the concession areas of Vale and Rio Tinto. The communities have been relocated to settlements in Cateme and Mwaladzi respectively, which are considerably further away from the Revobue river, the original water source on which they relied upon.²⁰⁵ The lack of water and irrigable land on the relocated sites has caused considerable social tensions. Addressing the needs of these and other communities being relocated by mining operations will require a strategy that ensures reliable, sustainable and affordable water supplies to these communities for both domestic consumption and irrigation purposes.

3. Sustainable shared use of water resources

No discussion of shared use of water is complete without first addressing the water footprint of the mining sector. Coal mining operations, if not properly managed, can place severe strain

²⁰¹ In 2000, the largest water user was agriculture, accounting for an estimated 550 million m³ (87%) of the 635 million then being withdrawn, followed by the municipal sector consuming 70 million m³ (11%), and industry using 15 million m³ (2%). By 2013, industry, and particularly the mining sector is likely to comprise a larger proportion of water use. "WWF Water Risk Filter, Country Profile – Mozambique," available online at: <http://waterriskfilter.panda.org/Maps.aspx#c=50>.

²⁰² Carolina Dominguez-Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective," AICD, op cit., p. 26.

²⁰³ Interview with Vitens-Evides International on October 2, 2013.

²⁰⁴ Ibid.

²⁰⁵ Human Rights Watch, "What is a house without food: Mozambique's Coal Mining Boom and Resettlements," 2013.

on available water resources by using large quantities of fresh water, while also contaminating and altering the course of flow rate of existing water sources. Strict regulations, coupled with regular monitoring for compliance is required to ensure that mining companies are minimizing their fresh water use, recycling and re-using water and properly managing waste water effluents from their coal mining operations to minimize the impact on surrounding water sources and communities. Implementing and enforcing such regulations will also incentivize mining companies to consider the scope for shared use of mining-related water infrastructure, as will be shown below.

3.1. Water allocation

Needs assessment and monitoring capacity

To ensure the sustainability of the Zambezi River basin's water supplies for competing water users, the ARA-Zambeze must be in a position to make an informed assessment of each water license application, taking into account the available water resources, the current and projected water demands, and the *actual* needs of large-scale water users such as mines. To estimate the actual needs (as opposed to the requested water amounts), the water saving measures should be taken into account based on international best practices. For mining companies these include a more efficient water management system and the recycling of water in their operations. Once a water license has been granted, the fresh water usage of each large-scale water licensee also needs to be monitored to ensure that no water source is over-exploited and can meet the needs of all water users over the course of the water license period.

To do so, the ARA-Zambezi requires:

- I. Hydrological information to understand existing water resources and cumulative impact of water use over time:** The ARA-Zambeze currently lacks the requisite information regarding the state of the Zambezi River basin to assess each water license application on the basis of available sources and competing demands. For informed decisions to be made, a baseline study on the available water table balance of the Zambezi River basin must be completed. It is understood that such a study is underway. Hydrological investigations also need to be conducted on a periodic basis to monitor the river basin's water levels. Given that the Zambezi River basin is shared with several neighboring countries, such monitoring should be done through ZamCom and/or in collaboration with the relevant counterparts in those countries.
- II. Capacity and financial resources:** The ARA-Zambeze needs the capacity to be able to assess the amount of water a water licensee requires, taking into account reasonable water minimizing strategies. It also needs the expertise and financial resources to monitor water usage.

Minimize the allocation of fresh water to mines

Unlike other water users, mining operations do not require fresh water for all their mining operations. Mining companies can reduce their fresh water demand by implementing more efficient water management systems, and the use of lower quality and recycled water. However, these measures will not be implemented without fresh water access restrictions.

This could be achieved if the ARA-Zambeze would only grant a water license to a mining company for the amount of water the mining operation actually requires over and above its

ability to manage water efficiently, recycle water and use dewatered water. Once a water license has been granted, the fresh water usage of each large-scale water licensee needs to be monitored to ensure that no water source is over-exploited and can meet the needs of all water users over the course of the water license period.²⁰⁶

Require mining companies to re-use water obtained from dewatering

Water in the open pits, whether from rainfall, or underground water flows, needs to be drained for mining operations. If recycled, this water can be used for coal washing or dust suppression, which do not require fresh water. Mining companies should be required by law to recycle this dewatered water to minimize the need for fresh water.

Provide for a periodic review mechanism of water allocations in the water concession regime

The GoM may also wish to consider introducing a periodic review mechanism into the water concession regime to allow authorities to assess the quantities of water allocated to mining operations and their cumulative impact on river basin levels over time.²⁰⁷ While long, fixed-period water concessions with fixed water allocations may allow a specific mining company to plan water resource management for the lifespan of its mining operations it reduces the leverage the ARA-Zambeze have to require mining operations to implement more water efficient systems once a water license or concession has been granted. In addition, it limits the GoM's ability to alter water resource allocations as other users begin drawing water from the same resource, or the water needs of local communities increase.²⁰⁸ A periodic review mechanism of water allocations, guided by clear and transparent guidelines on the basis of which adjustments to water allocations can be made, would provide the ARA- Zambeze the flexibility to monitor and regulate water usage without deterring investments in the mining sector.

If megaprojects continue developing in Tete at the current rate, a water concession approved today may not be environmentally sustainable in the near or medium-term future.²⁰⁹ Limiting the length of water concessions, or building in some flexibility to periodically review their terms, would allow the ARA-Zambeze to re-evaluate a mining company's water allocation based on the competing needs for water in the Zambezi River basin area over time on a more regular basis, and be in a position to allocate a smaller quantity of water to a mining operation that could be reducing its fresh water usage by, for example, adopting more efficient technology, or recycling all water used in its operations and obtained by dewatering.²¹⁰

²⁰⁶ A study is currently underway on the water balance of Tete province to be in a better position to assess how to meet the growing demands in the province for water.

²⁰⁷ "Sustainable Groundwater Management: Concepts and Tools" Briefing Note 5, Groundwater Abstraction Rights: from theory to practice, World Bank, (2003).

²⁰⁸ Lisa Sachs and Perrine Toledano, "Resource-Based Development in the Lower Zambezi," Columbia Center on Sustainable Investment, June 2011, p. 87, available at: <http://www.vcc.columbia.edu/content/reports>.

²⁰⁹ According to USAID, the water availability per capita is expected to decrease by 20% from of average 10,500 m³/person/year in 1960-2007 to 8,500m³/person/year in 2015 as the population increases and migrates to urban areas:\ USAID Country Assistance Strategy, 2009-2014.

²¹⁰ The 2007 water regulations do currently provide for an ARA to assess competing requests for water licenses/ concessions that are applied for within 10 days of each other, but not for competing users of the same water sources over a period of time as new water concessions are granted.

3.2. Water tariffs

Allow for a water tariff that incentivizes mining companies to internalize the economic value of water and minimize its use

Mozambique is struggling to ensure sustainable cost recovery in the water tariff currently charged to water users. While all users are required to pay a water tariff for water use, CRA has set different bands of rates for different categories of water users. These rates do not yet appear to cover the costs – especially not for domestic consumption. For example, in rural areas where donors are funding community-led water supply systems, the water tariff charged usually only reflects a portion of the operation and maintenance costs, and not the capital cost of water supplies, as the true economic cost of water provision would generally render water unaffordable for such communities.²¹¹

The water tariff charged to mining companies [and other industrial users] should reflect the full economic cost of water in the district in which they operate. Where mining companies build their own water infrastructure, the water charge they pay should be charged on a per liter estimate of water used by the mining company and could include, in its charge, (1) an amount to reflect a proportion of the operating costs of the ARA-Zambeze in monitoring water usage and (2) a notional tariff to reflect the opportunity cost of such water being diverted from other water users, which could be used to cross-subsidize water use for domestic consumption and incentivize collaboration with FIPAG.

Higher water costs may also serve the purpose of incentivizing mines to manage their fresh water needs more efficiently and minimize their fresh water usage.

3.3. Water treatment/ discharge

Update environmental regulations to implement a zero waste policy in terms of all harmful waste effluents

There are gaps in Mozambique's current environmental regulations that need to be addressed. For example, while the environmental regulations specify the admissible limits of wastewater discharge for coal mining in terms of pH, total suspended solids, oil and fat and mercury, no information is required to be provided in respect of sulphates, cyanates and certain other metals that are released during the coal mining process.²¹² Specific environmental regulations to impose environmental standards on Mozambique's coal mining sector in accordance with international best practices are required.

At a minimum environmental regulations should include a zero waste policy in relation to: (1) the treatment of all mine effluents, including cyanates, sulphates, leaching metals and dewatered water before release, (2) a flood control management plan and (3) the post-mine closure plan including the restoration of land, replantation of vegetation, and management of acid mine drainage. High penalties should be set for a breach of environmental regulations,

²¹¹ "More than water: Impact evaluation of drinking water supply and sanitation interventions in rural Mozambique – midterm impact evaluation," UNICEF – Government of The Netherlands Partnership for Water Supply, Sanitation and Hygiene 'One Million Initiative,' October 2011, available at: http://www.unicef.org/evaldatabase/index_61812.html.

²¹² Estêvão A. J. Pondja, "Treatment methods for water pollution from coal mining in Moatize (Mozambique)," Exsamenarbete TVVR 13/5008, Division of Water Resources Engineering Department of Building and Environmental Technology, Lund University, May 2013.

particularly in relation to the unlawful release or seepage of any wastewater into the surrounding environment.

Monitor and enforce environmental regulations

The ARA-Zambeze is responsible for the monitoring of the Zambezi River basin in Mozambique. It needs to regularly monitor water quality and enforce penalties for non-compliance. Given that the water quality of the Zambezi River may already be adversely impacted by the upstream agricultural and industrial users before it reaches Mozambique, the ARA-Zambeze needs to take water samples upstream and downstream of coal mining operations.

The ARA-Zambeze should also consider closer coordination with other government agencies. While the ARA-Zambeze is tasked with monitoring water levels, it is FIPAG that monitors underground water sources and ensures the continuation of underground water supply for domestic consumption. Given that surface waters are connected with underground water sources, no monitoring of the one is complete without an understanding of the other.

Other government agencies such as the National Institute for Fishing Investigation of Songo, are also monitoring water quality in the Zambezi River to monitor the effect of water quality on aquatic life. Greater collaboration with this institute could be beneficial – especially given the sensitivity of certain aquatic life to, for example, changes in pH levels in the water, which can be caused by AMD.

Finally, mining companies are carrying out their own environmental audits. These should be made publicly available.

4. Leveraging mining related water infrastructure

There may be several ways in which the mining companies' water needs and investments in water infrastructure can be leveraged to expand access to a reliable and safe water source in neighboring communities in and around the Moatize district. The overriding pre-requisite to encourage such an arrangement is water scarcity – either due to a physical lack of available fresh water sources, or, as could be the case in Tete, because of a water licensing regime that limits the fresh water availability to mining companies. Tete already suffers from water limitations from underground sources to supply water for residential and drinking water purposes.²¹³ However, so long as mining companies can tap directly into the Zambezi river, they will not necessarily seek to minimize their fresh water intake requirements.

4.1. Excess supply of water for irrigation purposes and drinking water

Excess supply from dewatered water

As mentioned in the previous section, ground and rain water needs to be pumped out of the open pits to allow coal mining to take place. Water extracted by de-watering can and should be recycled in the coal mining process, and/or can be treated and re-used for other purposes. Given the seasonal rains in Tete province and the considerable amount of dewatering required in each open coal pit operation, there may be scope for excess water, over and above

²¹³ Interview with Golder Associates on September 16, 2013.

the water required for a mining operation's needs, to be treated and shared with non-mining users.

Excess supply from treated residential waste-water

Mining companies may also be able to meet some of its water needs by recycling the residential wastewater of neighboring communities in Moatize or Tete city after some primary treatment carried out by the mining companies. Such an arrangement, along with the infrastructure investments made to implement it, could improve sanitation levels of these communities. To the extent that there is any excess treated residential waste-water from this process, such water could be supplied back to such communities for drinking or irrigation purposes.

Requirements and Negotiation Points

To explore the scope for the provision of the recycled/ 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, the DPOPH, and, to the extent additional water infrastructure is required, or existing water infrastructure needs to be upgraded, FIPAG.

For an operating model, it would need to be decided whether: (1) 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, (2) water is supplied to the relevant local government authority that would then distribute the water, or directly by the mine to the identified community, and (3) whether the water is provided as part of a CSR initiative, or whether the mining company is paid a small water tariff for the provision of water. In relation to the latter point, such an arrangement is likely to be more sustainable post mine-closure if a tariff is charged for the treatment and/ or provision of clean water.²¹⁴

4.2. Mines as anchor projects for investment in water supply, storage and treatment infrastructure

There may be scope for collaboration with FIPAG and/or other mining companies to share costs, or attract financing for the construction of water treatment and water distribution infrastructure to serve both mine sites and neighboring towns and communities. This is particularly so if mining companies are by law required to limit their fresh water intake, recycle dewatered water and minimize their waste water effluents.

There is evidence that large-scale mining companies are considering collaborations for the shared use of water infrastructure. For example, Vale entered into a memorandum of understanding with FIPAG on September 22, 2010 to improve water treatment and distribution capacity in Tete city and the town of Moatize.²¹⁵ Unfortunately no progress on this collaboration seems to have been made. JSPL's proposed collaboration with other mining concessionaires and FIPAG to source and transport water from the Zambezi tributary to their

²¹⁴ For more information on points that need to be addressed when negotiating water related infrastructure, please see: Toledano, Thomashausen, Shah, and Maennling,, "A Framework to Approach Shared Use of Mining-Related Infrastructure," op.cit.

²¹⁵ "Mozambique: FIPAG and Vale sign Memorandum,"AllAfrica, September 22, 2010.

mine site and supply local communities along the way could be a good example of shared water use.

While collaborations are feasible from a technical perspective, interviews with water operators and financiers in Mozambique and South Africa highlighted the following challenges:

- a) The mining sector requires reliable and regular water supply.²¹⁶ The experience from shared water provisions in South Africa suggests that mining companies mistrust local authorities to provide a reliable water supply. To get around this concern, mining companies can be granted step-in rights, which allow the mining companies to take over the management of water supply from the local authority if the latter fails to deliver water within certain parameters. Given that the ownership of assets has been transferred to FIPAG, and this entity aims to contract the operation of water systems to private companies, mining companies (and their financiers) may be more amenable to relying on a supply of water that is not operated by them. They are, however, likely to require some form of step-in rights to ensure the security of reliable supply.
- b) Mining companies demand certainty over the water tariff they will be paying. Attempts to include a pass through charge for future capital investments in water infrastructure so that the water tariff payable by the mining companies increases as the amount of capital investment increases, has been strongly resisted by mining companies. This in turn, limits the ability of local authorities to leverage their offtake agreements with mining companies to cross-subsidize water tariffs of low-income households. In Mozambique, the national water regulator CRA, is required to approve all water tariffs and would need to be included in any discussion seeking to alter the water tariff in this regard.

Ensuring bankability of water tariff for financing purposes

As mentioned in section 1, at present, the financing for the upgrade, rehabilitation and expansion of water facilities in Mozambique largely comes from donors.²¹⁷ Obtaining financing on a project finance basis has traditionally been difficult given the state of Mozambique's banking sector (though this is changing with the expansion of foreign banks), the heavily subsidized water tariff and the lack of reliable demand data. Obtaining financing may be easier for projects where the [coal] mining sector is the anchor customer, as it will be able to pay tariff rates that cover the sunk capital infrastructure investment and financing costs. Donor-funding could also be sought to extend and upgrade the water infrastructure and distribution network, or to build storage reservoirs, to facilitate shared use. For this to occur, the concerns of the mining companies regarding (1) reliability of supply, (2) certainty of the water tariff and (3) timing of the availability of the water supply would need to be addressed.

²¹⁶ Interview with Bigen, South Africa, September 30, 2013.

²¹⁷ From 2009-2013, 85% of all water sector investments came through official development assistance. Source: Water and Sanitation Program – Africa Region, the World Bank, and others, “Water Supply and Sanitation in Mozambique: Turning Finance into Services for 2015 and beyond,” An AMCOW Country Status Overview, 2010, p. 18.

4.3. Provision of water infrastructure 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 GoM's development goals in the area of water and sanitation, not least because of the coal mining sector's footprint on the surrounding water supply and to obtain a social license from surrounding and/or relocated communities. Possible initiatives include investing in low cost technologies such as boreholes and hand pumps, coupled with community-led testing of water quality to improve the sustainability of such an initiative.

It is important that any CSR initiatives in the water and sanitation sector is undertaken in collaboration with FIPAG and the relevant local authorities and community representatives to ensure that efforts are not duplicated, investments are sustainable, and local capacity in water management is built. In particular, the provision of any water or sanitation infrastructure in neighboring rural areas should be planned in accordance with the Rural Water and Sanitation Program (PRONASAR) in collaboration with both the local DAS and relevant donors.

5. Findings and Conclusions

Water is a vital input in the coal mining process and each mining company is therefore required to ensure it has a reliable source of adequate water to service the mine. Shared water schemes have shown that water infrastructure can be optimized on a technical level to supply water to both mining operations and surrounding communities in the types of shared use arrangements detailed above. By limiting the amount of fresh water available to mines, and enforcing a zero waste discharge policy, mining companies are more likely to be amenable to shared use schemes to source water, which in turn could benefit Mozambique by channeling needed investments into its water and sanitation sector. The possible synergies for shared use are set out in table 5.

Table 6: Summary of water-mine synergies

Option	Description	Challenges	Potential to leverage
Excess supply from dewatered water	A portion of the excess water that collects in the open pits is drained (dewatering), treated and supplied to surrounding communities	Regulations requiring companies to limit their fresh water usage and treat dewatered water before it is discharged into the environment. Coordination with FIPAG and/ or local water supply company Lack of water infrastructure connecting mine sites to water supply system	High for mining companies to re-use dewatered water in their mining operations. Moderate-low for mining companies to provide treated dewatered water to surrounding communities because of a lack of piped water infrastructure connecting the mines

		in Tete province	to community water systems.
Excess supply from treated residential waste water	Mining companies use treated residential wastewater to meet the water supply needs of their mining operations. Excess treated water from this process can be supplied back to communities.	Same as above	Medium-to-low given the abundance of alternative water sources and limited piped water infrastructure
Mines as a demand anchor for investment in water supply, storage and treatment infrastructure	Mining company provides guaranteed demand for water supply infrastructure (for FIPAG), overcoming the traditional barriers to financing investments in water infrastructure.	FIPAG and local water authorities' capacity to operate and maintain water infrastructure Coordination between mining companies and FIPAG.	Medium-to-high given that the water management sector has already attracted private investment and several mining companies have entered into discussions with FIPAG to do so.

D. Scope for shared use in the context of ICT

1. Background

1.1. Key facts of the ICT sector in Mozambique

Policy Entity	Ministry of Transport and Communications / Ministério dos Transportes e Comunicações
Regulator	Telecommunications Institute of Mozambique/Instituto Nacional das Comunicações de Moçambique (INCM),
National Operator	Telecommunications of Mozambique/Telecomunicações de Moçambique (TDM)
Mobile Operators	Mcel (owned by TDM), Vodacom and Movitel
Access Rate (Mobile Phone)	31.7 % ²¹⁸ (2011) – 45% (2013) ²¹⁹
Access Rate (Internet)	4.2% ²²⁰ (2010) – 7.4% (2013) ²²¹

1.2. Mobile Telephony

In 1992, the Government began partial liberalization of the ICT market, transforming the national telecommunications operator into the state owned enterprise Telecommunications of Mozambique (TDM)²²², and TDM-owned operator Mcel. Subsequently, two private players have entered the mobile telephony market. Vodacom was awarded a license in 2002, and Movitel began operations in 2012.²²³

At the end of 2011, there were an estimated 7.8 million mobile subscribers in Mozambique, which is equivalent to a mobile penetration rate to 31.7%. This compares to a pan-African average mobile penetration rate of 76.4%.²²⁴ Although liberalization of the sector has pushed down the cost of mobile phone services, they remain costly, with voice calls charged at around US\$0.25/minute.²²⁵

²¹⁸Hope Varnes, “Mozambique: A look at its ICT landscape,” *TechnologyBanker*, available at <http://www.technologybanker.com/editors-corner/mozambique-a-look-at-its-ict-landscape#.Umjj91CTg-c>.

²¹⁹“Mozambique - Telecoms, Mobile, Broadband and Forecasts,” *BuddeComm*, (March 2014), available at <http://www.budde.com.au/Research/Mozambique-Telecoms-Mobile-Broadband-and-Forecasts.html>.

²²⁰ Varnes, “Mozambique: A look at its ICT landscape” op cit.

²²¹ Mozambique - Telecoms, Mobile, Broadband and Forecasts

²²² OECD, “OECD Policy Overview – Mozambique” (April 2013), [op](#) cit.

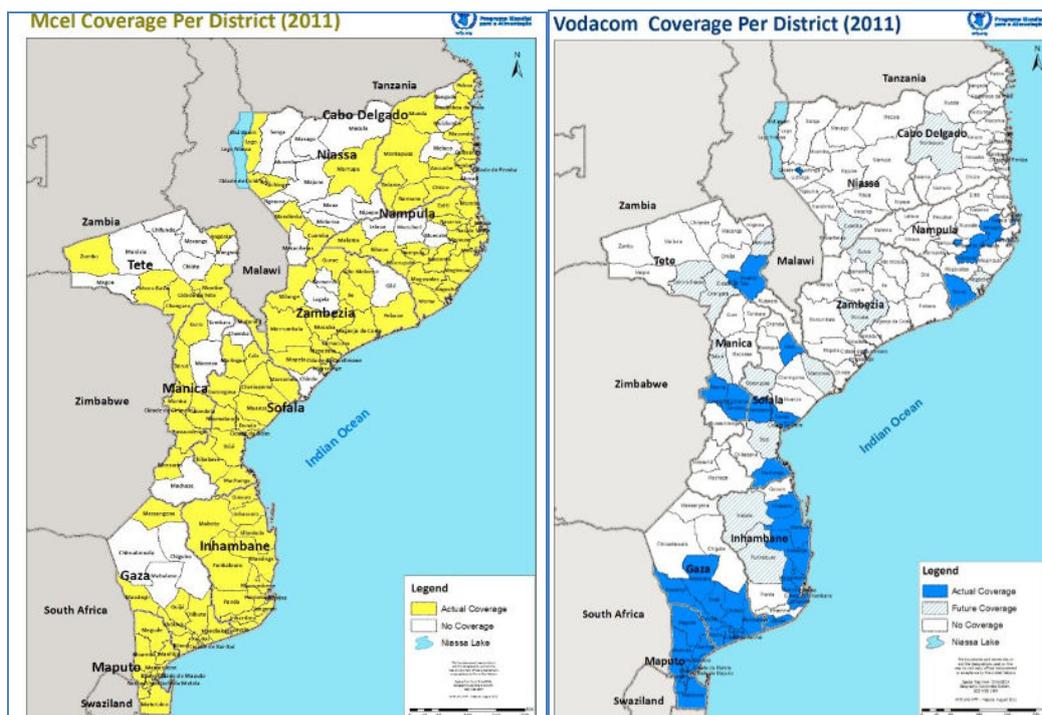
²²³ Ibid.

²²⁴ Varnes, “Mozambique: A look at its ICT landscape,” op cit. Reports suggest that penetration increased to 36% in 2013: “Mozambique - Telecoms, Mobile, Broadband and Forecasts,” op cit.

²²⁵Varnes, “Mozambique: A look at its ICT landscape,” op cit.and “Zimbabwe most expensive voice tariffs,” *AfricanSeer*, August 27, 2013, available at: <http://www.africanseer.com/business/305102-zimbabwe-most-expensive-in-voice-tariffs.html>. According to this benchmark, Mozambique is at the level of Togo which has the second highest voice charges in Africa.

Figure 14 shows the patchy coverage of Mcel and Vodacom. An estimated 70% of mobile service subscribers in Mozambique are concentrated in the capital city Maputo.²²⁶ Mobile signals rarely extend beyond urban areas. Although it appears that Mozambique’s 128 administrative districts have network coverage, it only extends within a 5km radius of the town where the district headquarters are located. Therefore, in reality few people in remote areas have signal.²²⁷ Quality of service is also reportedly unreliable.²²⁸

Figure 14: Mcel and Vodacom mobile coverage in Mozambique²²⁹



Source: Infoasaid Mozambique Media and Telecoms Landscape Guide, 2012

There exists some duplication of infrastructure amongst operators in Mozambique. Mcel and Vodacom do share certain infrastructure, namely TDM’s fiber-optic cables and antenna towers.²³⁰ However, in 2008-9, serious connection failures occurred with TDM’s fiber optic cable, after which Vodacom opted to invest \$63 million in building its own network.²³¹ Movitel is also expected to invest US \$465 million in establishing its own network in the first five years of operation to meet its contractual obligation of guaranteeing mobile coverage of

²²⁶ “Mozambique: A look at its ICT landscape,” op cit.

²²⁷ Ibid.

²²⁸ Francisco Mabila, José Mário Nhabinda Mboane and Avelino I. Mondlane, “Mozambique ICT Sector Performance Review,” Research ICT Africa, (2009/2010), available at http://www.researchictafrica.net/publications/Policy_Paper_Series_Towards_Evidence-based_ICT_Policy_and_Regulation_-_Volume_2/Vol%202%20Paper%2016%20-%20Mozambique%20ICT%20Sector%20Performance%20Review%202010.pdf.

²²⁹ Source notes that network coverage may only be available in some parts of the districts shown.

²³⁰ “OECD Policy Overview – Mozambique” (April 2013), op cit.

²³¹ Ibid.

60% of Mozambique's national territory.²³² In the absence of a clear and coherent infrastructure-sharing policy (further discussed below), towers from different telecommunications companies are often located next to each other, resulting in unnecessary expenses, higher than necessary environmental impacts and ultimately higher service costs.²³³ However, there are signs of "passive infrastructure sharing," or "cross-infrastructure" sharing. In May 2011, Movitel signed an agreement with the state electricity company EdM in order for Movitel to run fiber optic cables alongside EdM's national grid.²³⁴

1.3. Fixed Line Telephony

Penetration of Mozambique's fixed telephone line system remains very low with only 88,100 landlines in the country,²³⁵ and only 0.4% of the population subscribing to a landline service.²³⁶ TDM remains the sole operator. This is due to the large investment requirements to expand the system and the low-cost competition from the mobile sector. Over time, the cost of fixed line telephone services has increased while mobile service costs have fallen, making it cheaper to call from a mobile phone than from a landline.²³⁷

1.4. Internet

Internet connectivity is still low in Mozambique when compared to neighboring countries. As of 2010, 4.2% of individuals had access to the internet, compared to 6% in Botswana and 11% in Tanzania.²³⁸ This number increased to 7.4% in 2013.²³⁹

The OECD notes that there have been a number of ICT innovations that have led to increased agricultural development in Africa. For example, it is possible for small-holder farmers to get access to real-time information on commodity prices, weather forecasts, and pests and disease control. However, the report concludes that the role of ICT in agriculture has not been apparent in Mozambique, partly due to constraints of low internet accessibility.²⁴⁰

TDM's asymmetric digital subscriber line (ADSL) internet service, delivered through copper fixed line infrastructure, is expensive, making it unaffordable for the majority of the Mozambican population. Therefore, most ADSL customers are corporate entities. The number of ADSL users in 2008 was only 10,191.²⁴¹

In regions where there is no copper fixed line infrastructure, TDM offers fixed wireless or microwave technology solutions. While TDM and its subsidiary Teledata have three competitors for these services, the prices are still very high when compared to international rates.²⁴² In addition, the current coverage of their networks is limited to Maputo and

²³² Infoasaid Website: <http://infoasaid.org/guide/mozambique/organisation/movitel-mozambique#sthash.I7DfYHWn.dpuf>.

²³³ "Research ICT Africa: Mozambique ICT Sector Performance Review," op cit.

²³⁴ Infoasaid Website: <http://infoasaid.org/guide/mozambique/organisation/movitel-mozambique#sthash.I7DfYHWn.dpuf>

²³⁵ Varnes, "Mozambique: A look at its ICT landscape," op cit.

²³⁶ Carolina Dominguez-Torres and Cecilia Briceno-Garmendia, "Mozambique's Infrastructure: A Continental Perspective", AICD, op cit.

²³⁷ "OECD Policy Overview – Mozambique," op cit.

²³⁸ Ibid.

²³⁹ "Mozambique - Telecoms, Mobile, Broadband and Forecasts," op cit.

²⁴⁰ "OECD Policy Overview – Mozambique," op cit.

²⁴¹ "Research ICT Africa: Mozambique ICT Sector Performance Review," op cit.

²⁴² Ibid.

surrounding areas. Although some of the competitors expressed an intention to expand their respective networks to other provinces, there is no evidence to suggest that this has taken place.²⁴³ As a result many private entities rely on VSAT²⁴⁴ infrastructure.²⁴⁵

Mozambique is developing a network of fiber optic cables. Since 2009, it has been connected to the South Atlantic 3 (SAT-3) submarine cable, reducing reliance on VSAT.²⁴⁶ When completed, around 7,000km of fiber optic cable will be deployed. As of today, although the fiber optic backbone infrastructure covers all 10 provincial capital cities, 43 district centers and 31 villages, a large proportion of the country remains unconnected.²⁴⁷ Figure 15 illustrates the existing and planned reach of the national fiber optic backbone.

Figure 15: National ICT backbone infrastructure



Legend:

- blue lines indicate the existing fiber coverage;
- yellow lines indicate the planned fiber links;
- green lines indicate the existing microwave links;

²⁴³ Ibid.

²⁴⁴ VSAT stands for Very Small Aperture Terminal, which are small antennas in communication with the satellite to satisfy lower-bandwidth requirements. This system is used in remote areas where terrestrial solutions are expensive.

²⁴⁵ Based on CCSI Interviews in-country, August 2013.

²⁴⁶ Carolina Dominguez- Torres and Cecilia Briceno-Garmendia, “Mozambique’s Infrastructure: A Continental Perspective,” AICD, op cit.

²⁴⁷ “Research ICT Africa: Mozambique ICT Sector Performance Review,” op cit.

- light blue lines indicate cross border links; and
- pink lines indicate the planned cross border links

Source: Research ICT Africa: Mozambique ICT Sector Performance Review 2009/2010

In addition to the high prices of internet bandwidth, the lack of computer ownership is a major obstacle to internet use. There were an estimated 100,000 computer users nationwide in 2007, with the number of internet users concentrated in higher status groups.²⁴⁸

2. Leveraging mines to extend the national ICT infrastructure

ICT is employed in all phases of a mine's life, increasing efficiency and reducing costs for the mining company. These benefits are associated with, for example, better logistics allowing virtual operations, grade optimization and improved exploration analyses. Instantaneous access to video, voice and data communications provides the mining company with the ability to use materials and human resources more efficiently. As a result, delays are reduced and logistical coordination is strengthened. ICT can also help to mitigate security risks and improve the safety of their employees.²⁴⁹

Few companies in Mozambique were available to comment on their ICT infrastructure. Rio Tinto stated that it does not rely on the national ICT infrastructure, but uses its own satellite communication system, which links to its global company communication network.²⁵⁰ Ncondezi uses mobile phone service from Vodacom, but has its own satellite for internet.²⁵¹ Other companies are also likely to use the national mobile phone infrastructure where available and rely on satellite phones in remote areas. For internet access, it is likely that other mining companies operating in Mozambique have installed private VSAT connections, as this presents the most reliable and least expensive system.²⁵²

The notion of ICT infrastructure and service provision by the mines to surrounding areas may not be appropriate in Mozambique, because where companies make their own ICT arrangements, they typically would use private satellite infrastructure, rather than investing in a capital intensive mobile phone or fiber optic network, which could be extended to other users. It is unrealistic to expect mines to provide ICT infrastructure and services as part of a voluntary CSR initiative due to the complexities associated with service provision. 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.

²⁴⁸ Panos Brief "The challenge of digital inclusion in Mozambique," available at: <http://panos.org.uk/wp-content/files/2011/01/mozambique-policy-brief-english-final.pdf>.

²⁴⁹ 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>

²⁵⁰ Interview with Rio Tinto, Maputo, August 8, 2013.

²⁵¹ Interview with Ncondezi, September 17, 2013.

²⁵² From in-country interviews.

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

2.1.1. Opportunity

Since most of the costs of building a fiber optic network are related to civil works, joint infrastructure building can result in significant savings for the telecommunications companies. Fiber optic cable can be integrated in power transmission lines, railway lines and pipeline infrastructure. In the remote areas where mines are generally located, the cost savings resulting from such economies of scope²⁵³ will prove crucial and significant enough to make telecommunication services economically viable while bringing fast and efficient telecommunication technology to the mines that typically rely on expensive VSAT technology.

In the context of Mozambique, because of the planned expansions of both rail and power infrastructure to serve the needs of the mines, there is scope for mining companies to share in the costs of extending a fiber network to the mine. Both, the construction of the Nacala and Macuse railway corridors will require excavation to build the right of way. TDM and other operators could capitalize on this work by laying the cable alongside the railway lines, thereby expanding their networks to reach mine sites and surrounding communities. While laying cable underground provides a more protected route, fiber optic cable can also be hung overhead, alongside power lines for example. As a number of mining companies are extending transmission infrastructure to source power from the national grid, or to supply power to the grid (e.g. Vale, Ncondezi), the opportunity could be taken to facilitate the extension of the national ICT fiber optic backbone at the same time, to areas that are currently not connected.

In addition, mines sometimes build radio signaling systems, fiber optics or copper fibers to ensure safety and control for their railway operations. This is also sometimes done for their transmission lines. It then becomes economical for telecommunications companies to add telecommunication capacity to this infrastructure. For the planned Nacala Railway line, for example, Vale and CFM have contracted Siemens to implement a €70m investment in a Positive Train Control system. This is a train monitoring system and a telecommunications network based on a microwave signaling for track-to-train data transmission.²⁵⁴ The possibility for telecom companies to finance additional capacity on this network to service surrounding communities should be explored.

2.1.2. Regulation

Having considered the benefits of shared infrastructure access in the Mozambican context, we can consider the regulatory conditions in place in Mozambique and how they might facilitate such infrastructure sharing.

²⁵³ 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.

²⁵⁴ “PTC chosen for Mozambique coal corridor,” *International Rail Journal*, November 5, 2013, available at <http://www.railjournal.com/index.php/signalling/ptc-chosen-for-mozambique-coal-corridor.html> .

Decree n° 32/2001²⁵⁵ establishes the regulator Telecommunications Institute of Mozambique (*Instituto Nacional das Comunicações de Moçambique*), or INCM. Its role is to monitor and enforce infrastructure sharing in the telecommunications sector, including determining open access, setting the tariffs, monitoring the quality, and ensuring transparent and efficient licensing and spectrum management, which generally facilitates mines' involvement in the ICT sector. Reports suggest that the INCM needs to create adequate internal expertise to improve its efficiency and react to the regulatory challenges of the sector. To address these needs, there have been considerable efforts in human resource development and institutional capacity building in recent years²⁵⁶.

While the Telecommunications Law of 2004 sets the basis for a liberalized telecommunications market,²⁵⁷ there are still many aspects of an ICT system awaiting further regulation. These include (but are not limited to) a consolidated licensing regime (the current regime is based on a vertical approach,²⁵⁸ which acts as a disincentive to ICT market players) and infrastructure sharing (discussed further below).²⁵⁹

Box 2: Telecommunications Law Article 41 – Access and Sharing of Infrastructure²⁶⁰

1. Co-location and a shared infrastructure network should be promoted in order to encourage competition and reduce the investment required for the construction of telecommunications networks.
2. The sharing of network infrastructure should be ensured at the time of construction of new infrastructure, as compared to the existing infrastructure.
3. In the process of planning the provision of telecommunications services in the future, operators with significant market position should cooperate with other operator networks and providers of public telecommunications services in order to share facilities, eligible groundwater and other means.
4. The conditions for co-location and infrastructure sharing are subject to specific regulations.

The proposed revision of 2004 Telecommunications Law sets some more detailed principles for access and sharing of telecommunication infrastructure. This revision would be particularly important should the mines develop ICT infrastructure to monitor their railways and power lines.

It is important that the regulatory environment allows for open access to passive infrastructure, in order to ensure that civil works for other infrastructure types, such as railways and power lines, are capitalized on to lay fibre optic cables. In 2010, the INCM did

²⁵⁵ INCM Website: <http://www.incm.gov.mz/web/guest/licenciamento>

²⁵⁶ Ibid.

²⁵⁷ Lei n° 8/2004 de 21 de Julho de 2004 (Lei das Telecomunicações), available at: http://www.wipo.int/wipolex/en/text.jsp?file_id=206556.

²⁵⁸ A vertical approach means that for each service a different license is required.

²⁵⁹ “Research ICT Africa: Mozambique ICT Sector Performance Review,” op cit.

²⁶⁰ Proposta de Revisao da Lei 8/2004 (lei de Telecomunicacoes), available at: http://www.incm.gov.mz/c/document_library/get_file?uuid=38b9fdd3-a0b6-4004-b270-e14c358b5245&groupId=10157 - Translation is authors' own.

issue a regulation mandating that all network operators provide open access to passive infrastructure. The regulation requires the operator to publish a reference-sharing offer and then negotiate individual sharing agreements with licensees. The regulation also includes requirements regarding the capacity to be made available and the quality of service. In addition, it requires pricing to be fair and reasonable, based on pre-defined costing principles.²⁶¹ The INCM has also issued a proposal for “Regulations on the Installation of Telecommunications Infrastructure in Buildings and Public Works,” which sets out very detailed provisions for the right of way. It states how such infrastructure works should be publicized, the use of public infrastructure and the applicable access fees, and the basis for a register of infrastructure suitable for the use by telecommunications networks.

Box 3: Proposed Regulations on the Installation of Telecommunications Infrastructure in Public Buildings - Chapter 3, article 10²⁶²

1. Operators and providers of telecommunications services have a right of access to infrastructure suitable for the accommodation of telecommunications networks owned or operated by the state, municipalities, and entities related to the areas of roads, bridges, railways, electricity, gas and petroleum products.
2. The access referred to in the preceding paragraph shall be provided on terms of equality, transparency and non-discrimination through tariffs that reflect costs.
3. The procedures for obtaining the right of access should be timely, transparent and advertised, and cannot exceed the maximum period of 30 days after receipt of the demand for access.

The following Articles under this Chapter stipulate the prohibition of exclusive use of public infrastructure, the conditions for the denial of access to public infrastructure, the procedures in the event of denied access, the obligations of the entities owning or managing public infrastructure, the fees for access and use of public infrastructure, the procedures and conditions for access and use of public infrastructure, the details of the request for access to public infrastructure, the conditions of use of public infrastructure and co-location.

If the proposed Telecommunications Law and the Regulations on the Installation of Telecommunications Infrastructure in Building and Public Works are passed and properly enforced, Mozambique appears well equipped to take advantage of the mine - ICT synergies through cross-infrastructure sharing.

Cross-border mining transport routes and regional power lines could also help in the expansion of the regional ICT network. The planned fiber optic interconnection with Malawi, for example, could be integrated into plans for the Nacala corridor. In order to facilitate regional connections, regulators would have to work together in order to ensure an appropriate level of international and regional harmonization with respect to infrastructure sharing. In this situation, the regional organizations such as the SAPP will have an important role to play to ensure that best practice regulatory policies on infrastructure sharing are

²⁶¹ International Telecommunication Union, GSR 2011 Discussion Paper “Open Access Regulation in the Digital Economy,” (2011), available at <http://www.itu.int/net/ituneews/issues/2011/07/43.aspx>, <http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR11/documents/02-Open%20Access-E.pdf>.

²⁶² Article 10 of the “Proposta de Regulamento sobre Instalação de Infra-Estruturas de Telecomunicações em Edifícios e Projectos de Obras Públicas,” MTC (May2013), available at http://www.incm.gov.mz/c/document_library/get_file?uuid=88429f5e-129e-4ee0-a52a-e52b0addabb9&groupId=10157. Translation is authors’ own.

widely spread, since national regulators alone cannot resolve significant cross-border issues. SAPP is already requiring that new power lines include optical ground wire that has the additional use of providing telecommunications services.²⁶³

2.2. Mines provide anchor demand

In remote and sparsely populated areas the costs of installing ICT infrastructure may be substantial and difficult to justify with insufficient demand. A mining operation acting as an anchor investment could make such ICT infrastructure investments feasible for the telecommunications company.

Ncondezi explained that it has entered into an agreement with Vodacom for the provision of mobile phone service around its site. Vodacom has constructed a telecom tower and installed a satellite, based on a minimum guaranteed demand from Ncondezi. This has allowed Vodacom to expand its footprint in the area, enabling access to users in a 10km radius around the tower. This arrangement has generated 3000 additional contracts with users who otherwise would suffer from limited or no mobile phone coverage.²⁶⁴

To facilitate such arrangements, an off-take agreement must be negotiated between the mining company and the telecommunications company, stating the ownership, responsibilities and obligations of each party under the agreement, the level of guaranteed mining demand, as well as provisions regarding priority access to the ICT services to the mines. If guaranteed demand is not enough to make the extension of ICT infrastructure economically feasible for the telecommunications company, the mining company could share the initial capital cost. This could be split according to relative magnitudes of the potential additional market for the telecom company in the region and the scope of the services being provided to the mining company.²⁶⁵

If the demand provided by the mines is not sufficient to generate a commercially viable deal, the government could also take measures to create a sufficient anchor demand by providing subsidies to subscribers or coordinating for broadband access for public administration, public safety, local schools, and health care facilities.²⁶⁶

3. Conclusions

With more than 65% of the Mozambican population living in rural areas,²⁶⁷ rural ICT connectivity is a clear government goal and is part of the Telecommunications Law. To finance this goal, the Universal Access Fund was established. According to the law, the fund is to be managed by INCM and sustained by the contributions of the operators, who are obliged to contribute 1% of their post-tax income.²⁶⁸ Although INCM claims this percentage is very low, operators are resistant to paying their contribution.²⁶⁹ Moreover, the number of universal access projects that have been implemented since the creation of the fund is

²⁶³ Toledano, Roorda, “Leveraging mining demand and investment in ICT for broader needs,” op.cit.

²⁶⁴ Interview with Ncondezi, September 17, 2013.

²⁶⁵ “Shared Use in the context of Information and Communications Technology - How to approach the issue?” Columbia Center on Sustainable Investment,” op cit..

²⁶⁶ Ibid.

²⁶⁷ “Research ICT Africa: Mozambique ICT Sector Performance Review,” op cit.

²⁶⁸ “OECD Policy Overview – Mozambique” op cit. [op](#) cit.

²⁶⁹ Ibid.

reported to be insignificant.²⁷⁰ The use of mining demand and infrastructure therefore provides a complementary and promising route for the GoM to achieve higher rural connectivity. However, the sustainability of such investment will have to be planned in advance, including whom is in charge of the maintenance and whether the services will be sustained after the closure of the mine.

If sound regulations, efficient coordination and planning mechanisms are put in place in Mozambique, synergies between the ICT and the mining sector could be realized. The potential options for ICT-mine synergies in Mozambique, along with their associated challenges are summarized in the table below.

Table 7: Summary of ICT-mining synergies

Option	Description	Challenges	Potential to leverage
Telecommunication capacity integrated in the construction of mine service corridor	Synergies with mining related infrastructure investment in railroads and/or power transmission lines when extending optical fiber network	Insufficient <i>current</i> regulatory framework to mandate shared infrastructure use. This should be addressed if INCM's proposals for new regulations are passed.	High for the planned interconnection with Malawi if integrated in the construction of the Nacala railway line Moderate/low along the Beira and Macuse lines as fiber optic network is already in place
Mines as a demand anchor for telecommunication companies	Mining company provides guaranteed demand for telecommunication company, making investment in remote, otherwise unconnected area economically viable	Coordination between mining and telecommunication companies.	High – in mining companies' and telecommunication companies' interest

²⁷⁰ Ibid.

Summary and Conclusions

The Mozambican ‘coal rush’ has significantly cooled in recent years and some of the proposed coal projects are currently on hold. This is largely due to the lack of rail and port infrastructure in place to transport the coal from pit-to-port. Hence, it should be the GoM’s first priority to find the right balance between requiring shared use on the proposed transport infrastructure investments and guaranteeing that these requirements do not render the anchor investments unviable. To maximize the welfare gains from proposed rail and port projects, the GoM should assess the costs and benefits associated with open access on a case-by-case basis and require multi-user and/or multi-purpose access accordingly.

Once a viable logistics solution is in place and mining companies ramp up production, there will be significant potential to leverage these projects for additional power capacity.²⁷¹ The mining companies have proposed several thermal power plant projects to make use of the low-quality thermal coal that is unprofitable for export. These projects may help to satisfy rising energy demand in Mozambique and the region, and could prove important as anchor projects for the construction of the North-South transmission project that the GoM is proposing to build. The GoM should also coordinate the construction of power transmission lines by the mining companies to connect their mine sites to the national grid. By ensuring that mining companies share transmission infrastructure, cost-savings can be achieved by the mining companies, which in turn should lead to higher corporate tax payments. While the mining companies are unlikely to finance distribution networks to small-scale users, the GoM can leverage the transmission lines if these are in areas that are currently unconnected to the national grid, and finance the distribution network in these regions.

Currently operating mining operations have already put pressure on water availability and water quality in Tete province. With the foreseen expansion of mining activities, these problems are likely to intensify and the GoM has to put in place stringent rules and regulations to guarantee that the local communities are not adversely affected from the mining activities. With restricted access to fresh water resources, the mining companies would be incentivized to recycle the water obtained from the dewatering process as some mines such as Vale are already doing. The excess water obtained from this process could be supplied to neighboring communities for drinking and/ or irrigation purposes after some treatment. High water demand from coal mining operations also provide FIPAG with the opportunity to expand its distribution network.

Where mining companies are the anchor project, there may also be a key opportunity for telecommunication companies to expand their cellular network. There is a strong business case for telecommunication service providers to coordinate with mining companies, and therefore the GoM has a smaller role to play. The construction of rail and power infrastructure that service mine sites also provide a unique opportunity to reduce the civil works costs associated with laying fiber optic cable. The Nacala railway line project, for example, could be used to install the proposed fiber optic link to the Malawian fiber optic network. If the proposed revisions of the 2004 Telecommunications Law are passed and

²⁷¹ With the exception of the Ncondezi Energy project, which is not focused on exporting the coal from its mining concession, but rather to power its integrated thermal power plant.

enforced, Mozambique appears well equipped to take advantage of the mine - ICT synergies through cross-infrastructure sharing.

A cross cutting necessity to regulate and leverage mining related infrastructure in Mozambique is the need for a stronger independent regulator in each sector. In the railway sector INATTER has recently been created under the MTC, which raises questions about its independence; in the power sector CNELEC has yet to be assigned its regulatory role; in the water sector CRA has set below cost-covering tariffs, which has meant a slow expansion of the water distribution network; and in the ICT sector INCM has not been able to collect the necessary funding from the operators to expand the telecommunications network. The GoM should continue to build the capacity of these institutions and create procedures that guide the regulator decision process to guarantee impartiality and build the trust of companies operating in Mozambique.