
East Africa Gas - Potential for Export

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Preface

In the world of upstream oil and gas, the emergence of a major new prospective area always creates a frisson of excitement. Once the discoveries are assessed and we move past the initial question of how the potential resource base was previously overlooked, attention focuses on the likely ultimate scale of the resource, the cost of development, the likely timing of first production, and the impact of the new supplies on regional and global gas markets.

David Ledesma's paper on the prospects for gas in Mozambique and Tanzania captures the excitement of the confirmation of a major new hydrocarbon play and conveys the pace at which resources were mobilised and the sheer scale of the discoveries made over a very short time period. The resources, however, are owned by two relatively poor countries with limited institutional capability and capacity. They face the challenge of making decisions on fiscal and regulatory issues which will impact their economies for several decades. Key policy issues include how to ensure that gas is available for the domestic market in parallel with the build up of the export flows necessary for viable development and how to avoid the 'resource curse' of currency appreciation, which would harm other domestic industrial sectors.

This paper is a timely description and analysis of the emergence of this major new source of gas supply which is already hailed as a future competitor for Australian and US LNG supplies to Asian markets. For researchers and observers of the natural gas market it provides a comprehensive picture of a gas supply region whose prominence will surely grow throughout the next decade.

Howard Rogers
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1. Introduction

It is truly remarkable how East Africa, and specifically Mozambique and Tanzania, have in a short space of time become the focus of attention as a source of new global gas supply. Five years ago, these countries would not have appeared in a list of potential supplies of large volumes of gas and LNG. Today both IOCs and NOCs are in intense competition to secure investment opportunities in these now resource prospective countries. Indeed, the EIA in January 2013 still reported proven reserves in Mozambique as only 4.5 Tcf and Tanzania as 0.23 Tcf¹. These figures will no doubt rise rapidly as recent discoveries are incorporated. New gas finds are reported on a regular basis and companies are making very positive statements as to when they will take investment decisions on multi-billion dollar LNG projects. To date, Wood Mackenzie estimates that recoverable reserves in Mozambique are 85 Tcf and in Tanzania 18 Tcf, with another 100 tcf yet to be found – 80 Tcf in Mozambique and 20 Tcf in Tanzania². What has particularly captured the industry's attention is the size of the "reserves per well" being reported. In Tanzania the 8 successful wells to date have found 18 Tcf (i.e. 2 Tcf/well), while in Mozambique the 12 successful wells have found 85 Tcf, which equates to an astonishing 7 Tcf/well³.

Fundamental questions are however now being asked. How quickly can the gas reserves be developed in these countries? What volume of gas will be exported from East Africa as LNG? What are the economics of the proposed East African LNG projects, in particular, as the gas is dry (i.e. does not have any natural gas liquids that add valuable revenue to projects)? How will East African gas fit into the global LNG market? How competitive will East African LNG be relative to its global competitors? Will other new entrants such as Israel want to secure their positions as a global LNG supplier ahead of East Africa? This paper seeks to answer these questions.

Mozambique is seemingly "ahead" in the technical area (i.e. more gas found) while Tanzania seemingly "leads" in progressing commercial issues (as BG/Ophir have negotiated and agreed a commercial framework for the export of gas - even though some parts of government may seek to amend it). That said, on the planning and regulatory side Mozambique is more advanced than Tanzania⁴, with some experience based on existing exports of gas to South Africa. Given the rapid progress that Anadarko and other companies have made in Mozambique the government is urging collaboration to create one initial joint Anadarko/ENI project. In Mozambique sufficient gas has been discovered to meet future domestic requirements and underpin the first LNG export project, with an FID likely by 2014. In Tanzania however, where gas reserves are smaller, the scale and timing of LNG exports is more questionable.

With the prospect of monetizing such large volumes of gas, companies are maneuvering to improve their competitive position, in both Mozambique and Tanzania. New arrivals are trying to gain entry to the development of existing discoveries as LNG or through other gas

¹ US Energy Information Administration website reserves database, <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=3&pid=3&aid=6>

² Wood Mackenzie presentation to CWC East Africa Gas Conference, Tuesday 2nd October 2012 "East Africa LNG – Transforming Exploration Success into Value"

³ Wood Mackenzie presentation to CWC East Africa Gas Conference Ibid

⁴ Source: Oxford Energy Forum, November 2012, page 12 "Mozambique's Gas Sector: Prospects and Perils", Anne Fruhauf

commercialization projects, and all this activity is straining the capacity and capability of governments, with decisions having to be made in the immediate near term, that will impact on the countries concerned for years to come. This will no doubt lead to delays, as politicians want to make sure that they are making the right decisions. Unitization issues may also slow down project developments, especially if BG/Ophir are successful in their drilling in the south of Block 1 in Tanzania, which has the same geological structure as Anadarko's Area 1 discoveries across the maritime boundary in Mozambique⁵ (see Figure 4 – East Africa Gas Map). Within Mozambique, Anadarko (Area 1) and ENI (Area 4) will need to unitise before they can be developed. While the companies in question are well versed in the process of unitization, this is a new departure for the government. Also, both Anadarko and ENI both argue that they have sufficient reserves available in fields that do not need unitization in order to launch the first LNG project.

Commercialisation of gas resources on this scale in what are relatively poor countries brings huge challenges. The most significant amongst these are the lack of infrastructure, environmental concerns and financing of projects – Mozambique and Tanzania are “frontier territories” in LNG and other gas intensive industry terms. International companies investing in these countries, will need to ensure that the necessary environmental policies are in place that meet their international company standards in order to protect their company reputation. Also, the companies will want to make sure that these environmental policies are adhered to during the whole period of the project. To put this in perspective, Tanzania's GDP is \$28.0 bn and Mozambique's \$14.6 bn (2012 est⁶) and an LNG project costs \$12-20 bn. Developing these projects will have a huge impact on the countries. The projects will have to be project financed with limited recourse financing, as these governments have limited available funds, probably insufficient to fund their equity share in developments. Governments are therefore being encouraged to sell down some of their equity to fund their remaining share of development costs. This is an expedient way for them to raise such funds but it may not be optimal for project development, as governments should have a meaningful stake to ensure their full political support and economic alignment in a project over its whole lifetime.

Furthermore, it cannot be assumed that all the planned East African LNG projects will proceed. Mozambique and Tanzania are both well located with respect to potential LNG markets, with access to Asian, South American and Indian markets but East Africa is in competition to secure a position in the high value Asian LNG markets to monetise its reserves and will have to differentiate itself from the other potential large volume sellers (USA and Australia), which are viewed by potential customers as more politically stable.

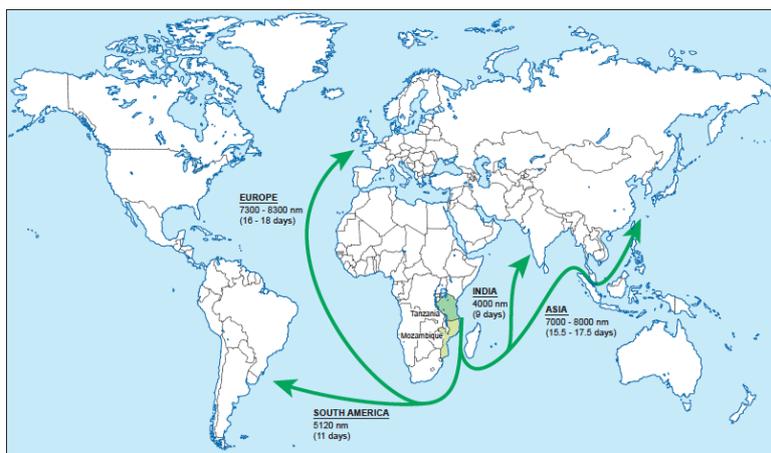
Each competing LNG supply source has its own economic advantages and disadvantages: Australia is geographically closer to the high value Asian LNG buyers, but has higher development costs (but with a high liquids content in the gas to partially offset this); the USA has low project development costs, but is further from the Asian markets; and East Africa is in between in terms of distance and has an advantage of “clean gas”⁷, which means gas processing and production costs are lower than Australia (but lacks the financial benefit of natural gas liquids credits). Securing the market is therefore key, and this “Battle for Asia” will be waged over the coming years.

⁵ See Figure 4.

⁶ <https://www.cia.gov/library/publications/the-world-factbook/index.html>

⁷ i.e. no significant impurities such as CO₂, H₂S which require an additional separation plant.

Figure 1: Shipping distances and voyage length from East Africa to key LNG markets



One must also not overlook security considerations, both onshore and offshore. An attack by Somali pirates on a Petrobras-operated exploration vessel offshore Tanzania in October 2011 shows the international nature of the problem⁸. It is not clear how international companies will respond to the tragic events in the January 2013 terrorist attack on an Algerian gas plant. But it is clear, that companies will focus even more on security issues and the potential for such attacks in frontier countries.

2. Background to Mozambique and Tanzania

Mozambique and Tanzania are both located on the East Coast of Africa (see Figure 4). They are both relatively poor countries with limited infrastructure but their physical location, as LNG suppliers, puts them within easy reach of the Asian and, potentially, the South American gas markets.

2.1 Mozambique

Mozambique's past has been chequered since it gained independence from Portugal in 1975; suffering civil war, economic mismanagement and famine. In 1992 a peace accord ended 16 years of civil war (between the Frelimo independence movement and the South Africa sponsored Renamo movement) in which nearly a million people died and millions more fled abroad or to other parts of the country. Since 1992 the country has made progress in economic development and political stability.

The country is 800,000 km² in size (of similar size to Pakistan, Chile or slightly smaller than France and the UK combined) with a population of 23.5 million of which, as with many African countries, a large percentage is young, with 46% aged 0-14 years and 51% 15-64 years⁹. The economy is still agriculture-based with some 60% of the population working on the land. Floods in 2000 and 2001 affected about a quarter of the population and destroyed much of its infrastructure, which was already suffering from years of under-investment. Poverty remains widespread, with more than 50% of Mozambicans living on less than

⁸ Heren LNG Markets 9/3/12 "Risks raise barriers to East African Export Ambitions"

<https://www.cia.gov/library/publications/the-world-factbook/index.html>

⁹ <https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html>

\$1/day¹⁰. In the 2009 presidential and parliamentary election, the Frelimo party won 75% of the poll. There are elections scheduled for 2014, but Anne Fruhauf, Senior Analyst at Horizon is of the view that, even though the Chama cha Mapinduzi (CCM) party is a growing threat, the Frelimo party is unlikely to lose power in the 2014 election¹¹. She further notes that President Armando Guebuza's term of office expires in 2014, but that in September 2012 he was again endorsed as party leader so that he could position a loyal candidate into office, leading to personnel changes inside institutions. That said, whatever party is in power is likely to remain in favour of oil and gas developments, as they will bring valuable income to the country.

In 2012 the GDP per capita is estimated to be \$1,200 (LNG exporters Nigeria & Papua New Guinea both have a GDP of \$2,700)¹². Mozambique has however emerged as one of the world's fastest growing economies, with foreign investors showing interest in oil, gas, coal and titanium. The economy grew at an average annual rate of 9% in the decade up to 2007. The decline in aluminum prices 2007-9 (which represented one-third of exports) led to a fall in GDP growth to 6.8%. In September 2010, following increases in fuel, water, electricity and food prices, there were riots in the country which resulted in fiscal changes; reducing taxes and tariffs, as well as introducing some subsidies. This resulted in economic growth increasing to 7.5% (2012 est).

But the country still has huge challenges, with only 56% of the population over the age of 15 able to read and write. 11.5% of the adult population is infected with Aids and 5% of the 2009 country budget was spent on health expenditure. Public debt is 40% of GDP but inflation that was over 10% in 2011, has fallen to 3.5% (2012 est.) and the country has a negative current account balance relying in independent donors that fund approximately 40% of its annual budget¹³. The country will no doubt benefit considerably from growth in its natural gas sector and additional exports of gas. The economic position of the country gives urgency to the government to sanction new gas and LNG export projects, so it can earn revenues at the earliest opportunity. There is however some debate as to how fast it should really move. The risk is that if it advances too quickly, without the necessary institutions in place, then it could result in domestic problems – or at the very least high levels of corruption.

Mozambique's hydrocarbon wealth will not come without its domestic challenges. Already the growing revenues from coal and oil have led to political arguments from opposition parties over continuing high poverty levels (in 2009 the poverty rate was 54.7%, virtually unchanged from 2000) and, as noted above, there has been some urban unrest. The government has emphasised employment creation opportunities and skills transfer as a means to diffuse tensions, and is targeting reduced poverty levels of 42% by 2014. The future development of the natural gas sector is key to achieving this target. The need to keep domestic energy costs low has resulted in an increase in energy subsidies and will no doubt put added pressure on the government to increase its energy revenues through exports. Development of the gas sector in Mozambique (and also Tanzania), however, must be done in a transparent manner with clear regulations and taxation. If this does not happen, there is a likely prospect of increased domestic discontent, potential unrest and demands for political change. The government can look to West African countries such as Nigeria and Equatorial

¹⁰ <http://www.bbc.co.uk/news/world-africa-13890416>

¹¹ Fruhauf (2012)

¹² <https://www.cia.gov/library/publications/the-world-factbook/geos/mz.html>

¹³ Fruhauf (2012)

Guinea, where huge oil and gas export revenues have not been distributed within the country for the benefit of the wider population.

Mozambique already has a modest level of gas production from the Sasol-operated Pande and the Temane fields, which started production in 2004¹⁴. Most of the gas from both fields is exported to South Africa through an 865 km, 26 inch pipeline, and supplied to South Africa's chemical plants. In 2011 Mozambique exported 3.3 Bcm of gas¹⁵. In May 2012 the capacity of the plant was increased to 4.8 Bcm/y, with the additional production capacity being supplied 50/50 to Mozambique (for power generation) and South Africa (for industry and power). There is a small distribution network in the southern Inhambane Province, which provides small quantities of gas, 5 MMcm/y, to domestic users.

2.2 Tanzania

Tanzania was formed in 1964, following a merger between mainland Tanganyika and the island of Zanzibar, which had become independent the previous year. At present the country has limited exportable natural resources and its first president, Julius Nyerere, through the 1967 Arusha Declaration, created cooperatives of farm villages, nationalised factories, plantations, banks and private companies. This led to economic crises and Tanzania's economic woes were further compounded in 1979 and 1981 by a costly military intervention to overthrow President Idi Amin of Uganda. After Mr Nyerere's resignation in 1985, his successor, Ali Hassan Mwinyi, reduced government control of the economy and tried to attract foreign investment. In 1995 Benjamin Mkapa was elected president and the economy began to grow, though at the price of painful fiscal reforms, with tourism as an important revenue earner. The country has experienced economic problems, but has been spared the internal strife that has blighted many African states¹⁶.

The country is 947,000 km² in size (slightly larger than Mozambique). The population is 46.9 million of which 42% is aged 0-14 years and 55% 15-64 years¹⁷. In 2012 the GDP per capita is estimated to be \$1,700 (Mozambique \$1,200) with the economy growing at an average annual rate of 7% in the decade up to 2008, based on some gold production and exports and considerable tourism. The economy is agriculture-focused with 80% of the work force involved in agriculture, and 85% of exports are agricultural goods. Public debt is 34% of GDP and with inflation over 15% (2012 estimates) the country carries a negative current account balance. As with Mozambique, the country will benefit financially from growth in its natural gas sector and additional exports of gas¹⁸. Tanzania has in the past suffered from high inflation, driven by rising food and fuel prices, as well as chronic energy shortages and this has dampened Tanzania's economic growth in recent years.

Independent producer Wentworth Resources is already producing gas in the Rovuma Basin of southern Tanzania (the same subsurface formation as in northern Mozambique). The

¹⁴ Upstream shareholding: Sasol 70%, ENH 25% and the International Finance Corporation 5% in the two fields. Pipeline: Sasol Gas 50%, GOSA and Companhia Mocambicana de Gasoduto 25% each.

Natural gas production started at the Central Processing Facility at Temane on 18 February 2004, with the first gas arriving at Secunda in South Africa on 21 February 2004. [Source:

http://www.sasol.com/sasol_internet/downloads/WEF_Moz_case_study_1273134130298.pdf]

¹⁵ BP Statistical Review of World Energy, June 2012

¹⁶ <http://www.bbc.co.uk/news/world-africa-14095776>

¹⁷ <https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html>

¹⁸ <https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html>

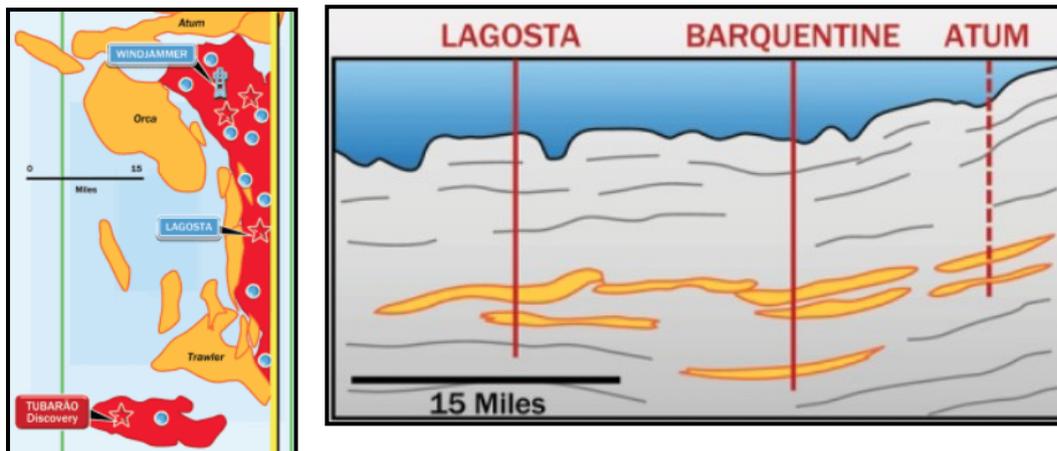
company owns and operates a gas processing plant, pipeline system, and an 18MW gas-to-electricity production facility in Mtwara, Tanzania.

3. Development of new offshore gas in Mozambique and Tanzania

3.1 History of East Africa Gas

Mozambique lies at the bottom of a fault line that runs down the East African Coast from Somalia in the North to Southern Mozambique in the south. The geological play is similar to that which provides hydrocarbon production in West Africa and comprises mainly pre-rift faults, stratigraphic traps and structural traps. The Rovuma Basin is ~ 400km long and 160km wide, spanning the southern border of Tanzania and Mozambique at the coast with offshore water depths of between 550 and 2000 metres. The sedimentary succession of the basin was developed in five stages with the Rovuma delta developed in the final stage. The gas prospects in the six blocks offshore Mozambique, and the blocks offshore Tanzania, date from the Jurassic and Cretaceous periods.

Figure 2: Offshore subsurface structure



Source: <http://www.offshore-mag.com/articles/print/volume-71/issue-4/geogr...ast-area/mozambique-wells-reveal-major-frontier-gas-province.html>



Source: <http://theelltrader.blogspot.co.uk/2012/08/rovuma-basin-basic-factfile.html>

3.2 Why now?

A fundamental question asked by many observers is why the gas prospectivity of this region has only come to the attention of the gas world in the past few years? The growth in gas reserves is remarkable (see Figure 3) and can be put down to three primary drivers:

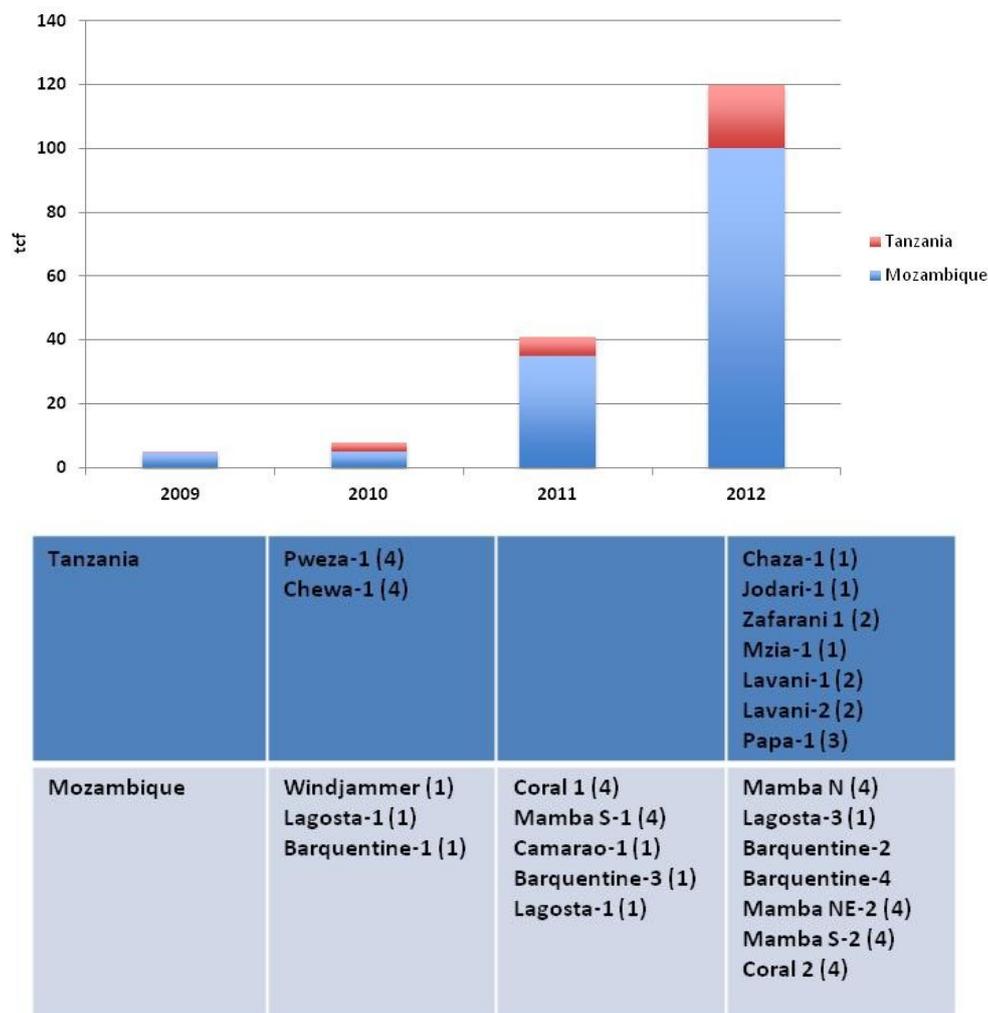
Technology – Increased industry capability in seismic and seismic interpretation, together with advanced deep-water drilling and completion technologies, has enabled drilling deep-water prospects at improved success to cost ratios. The cost of drilling deep-water wells has fallen and better seismic interpretation has improved prospect target identification over large survey areas. This has enabled companies to explore offshore East Africa in, what a few years ago, was an extensive medium to high-risk gas exploration area (Area 1, Mozambique, is 10,000 square miles in extent). Companies such as Anadarko and ENI have successfully transferred knowledge from other deep-water activities (in the case of Anadarko from the Gulf of Mexico, Liberia and Brazil and ENI West Africa, Gulf of Mexico and Brazil).

Market demand – LNG demand in the high value markets of Asia is expected to rise over the next 20-30 years, outstripping Asian regional production and pipeline gas imports. A significant proportion of this growing gas demand will be met through LNG. Limited new LNG supply from the Middle East, together with the higher cost of LNG from Australia and the willingness of Asian buyers to buy LNG from sources further afield such as the US Gulf, enhances the economics and desirability of East African LNG.

Political stability – The Mozambique civil war, then low oil prices, deterred exploration of the Rovuma Basin. Exploration by IOCs commenced only after the cessation of hostilities and the establishment of political stability. In the present day the governments of both Mozambique and Tanzania are supportive of gas and LNG project developments, as a means of attracting foreign investment and economic development to their countries.

The graph below gives an indication of the speed at which proven reserves have grown in Mozambique and Tanzania. The 2010 successes in Mozambique (Windjammer, Lagosta-1 and Barquentine-1) led to more wells being drilled and reserves being found. Success has led to success, as can be seen in Figure 3.

Figure 3: East Africa gas – Estimates of recoverable gas reserves



Source: Author's view based on research

3.3 Mozambique gas

Exploration for hydrocarbons in Mozambique started in 1904 when thick sedimentary basins were found onshore but lack of technology stopped the development of the fields. From 1948 onwards, international oil companies carried out exploration, mainly onshore with limited activity offshore and this resulted in some gas discoveries - the Pande Gas Field (1961) by Gulf Oil followed by Búzi (1962) and Temane (1967). Civil unrest in the 1970s resulted in a cessation of exploration and development activities. In the early 1980s new energy activities started once again and the national energy company Empresa Nacional de Hidrocarbonetos (ENH) was established. Esso had some drilling success in 1986 when small amounts of condensate were discovered in the onshore Mocimboa-1 block (following on from Wentworth Resources's success in its Tanzania's Mnazi Bay-1 exploration in 1982).

The peace accord in 1992 opened up the country once again to international investors. This period however was one of low oil prices when international companies would have been cutting back on exploration in new countries, so it was not until the late 1990s that 3,200km² of 2D seismic was shot offshore Mozambique and onshore it was only in 1993 that seismic data found a giant bright spot at the top of the Pande reservoir. When oil prices started to rise, international companies once again started to look seriously at Mozambique. In 2003, Sasol

carried out an extensive drilling campaign in the Pande/Temane onshore blocks, discovered new gas fields, increasing reserves to 5.5 Tcf and this was only exploited in 2004 when pipeline gas exports to South Africa began, bringing export revenues to the country. In 2006, Anadarko secured the offshore Area 1 block in 2006, as part of Mozambique's second licensing round and in 2008 3D seismic data was collected over 3,300km² and in 2009 2D over 5,000km². This identified a significant number of prospects. Anadarko drilled the Windjammer well, 30 miles east of the Mozambique coast, in the Rovuma offshore Area 1 in December 2009 and, three years later, its acreage is estimated to contain some 100 Tcf of gas. Likewise in October 2011, in the deep offshore Area 4 of the Rovuma Basin, ENI announced gas finds in 1,585 metres of water, estimating up to 22.5 Tcf of gas from both Oligocene and the deeper Eocene pays. ENI's estimates have now increased to 70 Tcf of gas in place.

As a means to reduce exploration risk companies bring third party companies into upstream exploration blocks. In 2008 Mitsui farmed into Area 1 as well as BPRL and Videocon who Anadarko had been working with offshore Brazil. Likewise Portugal's Galp Energy and South Korean Kogas farmed into ENI's Area 4 in 2007. Further activity has followed and in August 2012 the UK independent Tullow Oil farmed into Statoil's exploration blocks 2 & 5, where drilling is expected to commence in 2013 and in September 2012 Total farmed into Petronas's Areas 3 & 6.

With the scale of discovered gas to date and the prospect of more potential to come, companies are actively manoeuvring to increase their share of the prize through asset trading and positioning for future acreage awards. A high profile example was the acquisition of Cove Energy¹⁹ by the Thai state company PTT²⁰ for £ 2.40/share, equating to £ 1.22 bn (US\$1.9 bn) in July 2012. This followed a three-month battle with Shell who eventually backed out after PTT trumped its £1.12 bn (US\$1.74 bn) offer²¹. PTT's offer equates to \$3.4/bbl of oil equivalent (boe)²². Shell is now rumoured to be in discussion with Anadarko to buy a share of its Block 1 interest (as indeed are BP, Total and Asian companies)²³. Shell is also understood to be stalking Videocon (who hold 10% of Area 1). The government is keen to see Shell join the proposed Anadarko LNG project, though probably in a non-operating capacity. The government would also like to increase its stake in Area 1 and the proposed LNG project from 15%. LNG importing countries, such as China and Korea, will be looking to secure an upstream position in Mozambique (and Tanzania) and it is rumoured that Chinese companies are already in advanced discussions to secure such a position²⁴.

To date the offshore Rovuma Basin has yielded 85 Tcf of recoverable gas (46 Tcf in Anadarko's Area I and 39 Tcf in ENI's Area 4)²⁵. The tertiary reservoirs are thick, with good porosity and permeability resulting in high gas production rates and therefore lower production costs. The gas fields are close to shore, (about 50km), in relatively deep-water (1,500 metres). The gas is dry (except possibly small volumes recovered in the liquefaction process). Table 1 includes details of the six offshore areas in the Rovuma Basin and Figure 4 shows the location and shareholders of the blocks.

¹⁹ A partner of Anadarko

²⁰ PTTEP is the actual acquirer

²¹ Platts LNG Daily 26th September 2012 "Total acquires 40% of Areas 3,6 in Mozambique's Rovuma Basin"

²² <http://www.newsbase.com/newsbasearchive/cotw.jsp?pub=asianoil&issue=327>

²³ Platts LNG Daily 6th September 2012 "Mozambique could earn \$5.2 billion/yr from gas: study"

²⁴ Source: Author research

²⁵ Wood Mackenzie presentation to CWC East Africa Gas Conference Ibid

Table 1: Mozambique Offshore Gas Areas

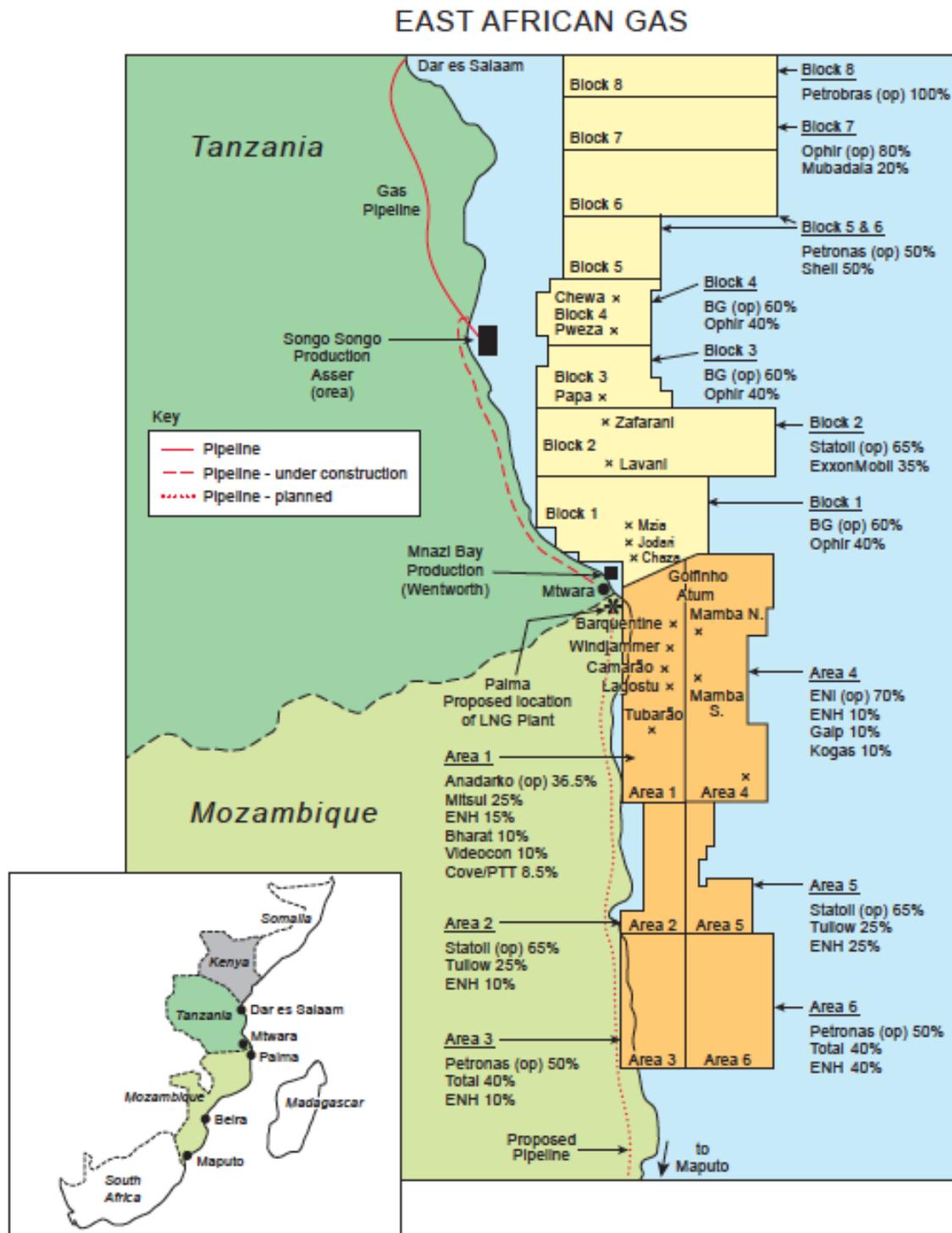
Name	Partners	Status	Discovery	Reserves		Comments			
				Low (tcf)	High (tcf)				
Offshore									
Area 1	Anadarko 36.5% (Op); Mitsui 20%; BPRL 10%; PTTEP 8.5%; ENH 15%; Videocon 10%	Discovery	Golfinho-Atum discovery Prosperidade* Complex (Windjammer-1; Barquentine 1, 2, 3 & 4; Lagosta 1 & 2; Tubaroa 1; Camarao 1)	100.00	150.00	Anadarko seeks to divest 20% once exploration is complete			
Area 2	Statoil (Op) 65%; Tullow Oil (25%); ENH	Exploration				Tullow acquired 25% in August 2012 Water depths 300-2000 metres			
Area 3	Petronas 50% (Op); Total 40%; ENH 10%	Exploration				Total acquired 40% in September 2012 Block in 2300 metres water			
Area 4	ENI (Op) 70%; Galp Energy 10%; Kogas 10%; ENH 10%	Discovery	Mamba North (15 tcf), South (15 tcf), North-East (est. 7-10tcf), Mamba South 2 (~ 3 tcf) Coral 1 - 7-10 tcf Coral 2 - (~ 3 tcf)	52.00	75.00	After a further discovery in the Mamba NE 2 Prospect, ENI in August 2012, announced potential gas in place of 70 tcf. December 2012 ENI announced that it has found an additional 6 tcf. ENI likely to divest 20%			
Area 5	Statoil (Op) 65%; Tullow Oil (25%); ENH	Exploration				Tullow acquired 25% in August 2012 Water depths 300-2000 metres			
Area 6	Petronas 50% (Op); Total 40%; ENH 10%	Exploration				Total acquired 40% in September 2012 Block in 2300 metres water			
* Anadarko Area 1 Prosperidade discovery likely stretches across into ENI Area 4				152.00	225.00				

Source: Author research

The 100 Tcf of gas found in Mozambique is significant in global terms. This is equivalent to the Carnarvon Basin off Western Australia, where the North West Shelf LNG project (16.6 mtpa) and Pluto LNG project (3.6 mtpa) are operating and the Gorgon (16.5 mtpa) and Wheatstone (8.9 mtpa) projects are under-construction. The government has publicly stated in September 2012 that it is preparing a new fourth license round for new areas south of Blocks 1 & 4, and that there are still areas to be explored in the Rovuma Basin, Mozambique Basin and in the Ultra Deep Marine Waters. They have also made it clear that new companies are welcome in the country²⁶. Clearly there is scope for additional hydrocarbon discoveries, with the exact amount depending on the prospectivity of this new acreage. Anadarko is exploring in the deeper cretaceous oil play (hoping to find easily transportable oil for the domestic market and export) as well as drilling for more gas.

²⁶ ENH presentation to CWC East Africa Gas Conference Ibid

Figure 4: East Africa gas map



Source: Author research

3.4 Tanzania gas

The history of oil and gas exploration in Tanzania, prior to the recent rush of activity, falls into four phases²⁷.

1. *1952-1964*

In the 1950s and early 1960s BP and Shell carried out extensive geological and geophysical surveys, drilling more than 100 shallow boreholes, as well as seismic surveys. Small volumes of hydrocarbons were discovered, but none were large enough to justify further drilling, as better opportunities were available to the companies in the Middle East. The concession was relinquished in 1964.

2. *1969-1979*

The second phase started in 1969 with the formation of Tanzania Petroleum Development Corporation (TPDC) and the signing of the first production sharing agreement (PSA) with the Italian company AGIP. This PSA, covered some of the former BP/Shell onshore concessions, and some blocks in the shallow offshore continental shelf to a water depth of 200m. AGIP was joined by Amoco in 1973, drilling three onshore and three offshore wells

3. *1980-1991*

In 1980, the Petroleum (Exploration and Production) Act, together with an increase in oil prices, encouraged an increase in exploration activity. Most of the drilling in Tanzania occurred between 1980 and 1991, including the delineation of the Songo Songo Gas Field and the gas discovery at Mnazi Bay (1982) by AGIP. During the period 1983-84 the attention of the international oil industry was drawn to the modern rift system in Tanzania and subsequently, exploration licenses were awarded to Amoco, who drilled two shallow wells. By the end of the 1980s, licenses were held by Shell and Texaco in the Rovuma Basin with one exploratory well drilled by each.

4. *1992-1999*

At the start of this period there were no active concessions and little activity. The authorities were spending time to finalise the fiscal and technical agreements for the development of the Songo Songo gas field. From 1995 a number of international companies acquired exploration licenses in the coastal basins and exploration agreements have been signed with small Australian and Canadian exploration companies. TPDC were also finalizing agreements to develop the Mnazi Bay gas discovery and to build a power generation plant.

In 1999/2000 TDPC and Western Geophysical speculatively acquired seismic, gravity and magnetic data for the deepwater offshore Tanzania (in water depths from 300 to 3,500 metres). Phase I (carried out in 1999) covered 6700km² and Phase II (2000) covered 4340km². Following interpretation of this data, Tanzania launched its first offshore deepwater licensing round in September 2000. Six deepwater offshore licensing areas were auctioned, with block 6 being awarded in April 2001 to Brazil's Petrobras²⁸. A second bid round was launched in June 2001, with seven new blocks on offer, but by September 2002 only two bids were received, with blocks 9-12 awarded to Shell. The third bid round in 2004 was more successful with, in 2005-2007, Petrobras being awarded block 6, Statoil Block 2 and Ophir Blocks 1, 3 & 4. In 2006 Petrobras was further awarded Block 8 and Dominion Block 7,

²⁷ http://www.tpdc-tz.com/exploration_history.htm

²⁸ <http://www.energy-pedia.com/news/tanzania/three-companies-bid-for-deepwater-oil-exploration>

which was subsequently acquired by Ophir, with 20% farmed out to Mubadala. Statoil also farmed out 35% of block 2 to ExxonMobil in April 2010.

Ophir, through its positions in blocks 1, 3 & 4 has dominated early gas exploration in Tanzania. Its three concessions cover 20,853 km² in water depths that range from 100m to 3,000m²⁹. Ophir commissioned 2D and 3D seismic during 2006-8 and in June 2010 BG farmed into 60% of each of Ophir's PSCs and assumed operatorship from Ophir, after its completion of the three discovery wells (Pweza-1, Chewa-1 and Chaza-1). BG/Ophir then acquired a further 5,000 mm² of 3D seismic over the remaining blocks³⁰. Statoil, in 2012, also announced gas discoveries in the Zafarani, Lavani and Lavani 2 fields³¹.

Offshore exploration in the country has resulted in 18-20 Tcf of recoverable reserves found to date with 10 to 20 Tcf potential upside. Table 2 shows the blocks and the ownership and Figure 4 shows the location and shareholders of the blocks.

Table 2: Tanzania's offshore gas areas

Name	Partners	Status	Discovery	Reserves		Comments
				Low (tcf)	High (tcf)	
Offshore						
Block 1	Ophir Energy 40%; BG 60%	Discovery	Chaza-1 (Tertiary) Jodari-1 (Lower Tertiary), 39 km offshore (3.4 tcf) Mzia-1 (Upper Cretaceous), 23 km north of Jodari well 4-9 tcf	11.00	21.00	Ophir sold 60% stake in Blocks 1,3 & 4 to BG in 2010 in return for BG funding 85% future exploration development costs Reserves were 2-6, were upgraded to 4-9 tcf with a mean of 6 tcf. BG made a discovery of 0.5-2 tcf at the Papa well pushing up reserves to 10 tcf.
Block 3	Ophir Energy 40%; BG 60%	Discovery	Papa-1 (Upper Cretaceous) 0.5-2.0			Ophir said that Blocks 1,3 & 4 may have 21 tcf
Block 4	Ophir Energy 40%; BG 60%	Exploration	Chewa-1 Pweza-1			
Block 2	Statoil 65%; ExxonMobil 35%	Discovery	Zafarani (5-6 tcf) Lavani (3 tcf) 2400 metres 16 km from Zafarani well	7.00	9.00	April 2010, ExxonMobil farmed-in
Block 5	Petrobras 50%; Shell 50%	Exploration				
Block 6	Petrobras 50%; Shell 50%	Exploration				
Block 7	Ophir Energy 80%; Mubadala 20%	Exploration			20.00	Company acquired Dominium Petroleum, which gave it operatorship of block 7 (and blocks L9 and L15 in Kenya's Lomu Basin). October 2012 - Ophir report a 20+ TCF find in the Mlinzi prospect
Blocks 9, 10, 11, 12	Shell	under exploration		18.00	50.00	

Source: Author research

Exploration is still in an early phase with not enough gas proven to support an LNG export project as well as domestic gas projects. An LNG project usually requires 8-10 Tcf of proven gas for an 8 mtpa LNG project over 20 years. Even though 18 Tcf seems a large amount of gas reserves, in the view of the author, the government will seek more gas to be found and proven before authorising development of an export project, to ensure that sufficient gas is

²⁹ Source: <http://www.offshore-mag.com/articles/print/volume-72/issue-3/geog...mozambique-tanzania-emerging-as-prolific-deepwater-gas-plays.html>

³⁰ Source: <http://www.offshore-mag.com/articles/print/volume-72/issue-3/geog...mozambique-tanzania-emerging-as-prolific-deepwater-gas-plays.html>

³¹ <http://www.reuters.com/article/2012/12/21/statoil-tanzania-idUSL5E8NL1J920121221> "UPDATE 1-Statoil and ExxonMobil find more gas off Tanzania"

kept in country to meet growing domestic energy demand and promote local industrial development. Ophir has been very vocal in giving updates on its reserves position in Tanzania (and other Africa countries) as a means to keep its share price up.

New wells are being drilled during 2013/4 that should firm up gas reserves, which the international companies hope will lead to a decision by the government to support FID of the first LNG project.

3.5 Other countries

Kenya

Oil exploration started in Kenya in 1954 with BP and Shell exploring the Lamu Basin, but none of the wells were fully evaluated or completed. This was followed in the 1970s by companies carrying out more drilling in the Lamu Basin, with some oil and gas being found. In 1986, following more poor exploration activity in the Lamu Basin, Kenyan legislation was revised to give incentives to attract international companies into the country. This resulted in companies, led by Amoco and Total, drilling ten wells, in the Anza and Mandera Basins.

International companies are of the view that Kenya may have similar geology to Tanzania and Mozambique and companies such as Total, Apache, Tullow and Premier are buying up stakes from smaller companies and planning drilling campaigns during 2013/14. In September 2012 ENI announced its first major gas discovery³² and at the same time Apache found oil 70 km offshore the coast of Malindi^{33 34}.

South Africa

The offshore area from Saldanha up to the Orange River Basin, off the West Coast of South Africa, shows prospects for oil and gas exploration and companies are seeking to gain a position in these frontier gas areas. Licenses for blocks on the West Coast were recently finalized and activities are likely to increase during 2013/4³⁵. In August 2012 Anadarko farmed into three PetroSA offshore blocks, taking an 80% interest³⁶ and in December 2012 ExxonMobil signed an agreement to explore offshore the East Coast of South Africa³⁷.

Currently South Africa's Mossel Bay GTL plant gets its gas from the limited offshore gas reserves, south of the country, but these are running low. If new gas is not found, then South Africa's PetroSA will have to import gas, either by increasing pipeline imports from Mozambique or potentially through LNG imports (in December 2012, PetroSA awarded a FEED contract for a planned floating LNG terminal). Eskom uses very little gas in power

³² Financial Times 10/9/12, "Tanzania: LNG on Ice?"

³³ The Mbawa well is drilled by Apache (50%) - operator, Origin Energy (20%), Tullow Oil (15% and Pancontinental Oil & Gas (15%).

³⁴ <http://uk.reuters.com/article/2012/09/10/uk-kenya-gas-pancontinental-idUKBRE8890ML20120910> "First significant gas found offshore Kenya – partners"

³⁵ <http://www.infield.com> "Offshore South and East Africa Oil and Gas Activity Map To 2017"

³⁶ <http://www.reuters.com/article/2012/08/17/us-petrosa-anadarko-idUSBRE87G0HV20120817> "South African state-owned oil firm PetroSA and U.S.-listed Anadarko Petroleum Corp (APC.N) have signed a deal for oil and gas exploration in blocks off the coast of South Africa, the companies said on Friday"

³⁷ <http://www.southafrica.info/business/investing/opportunities/exxonmobil-191212.htm#.URu2AY5YwRk> "SA in offshore oil, gas exploration deal"

generation, with Sasol and some private generators using gas in power. Gas pricing is undisclosed and the South African National Energy Regulator National Energy Regulator NERSA is understood to be reviewing gas pricing in country, though this is not confirmed.

Madagascar

Offshore Madagascar could also hold reserves of gas, centered on the fault line running from Somalia south to Madagascar. There has been limited exploration activity in the country, but since the mid 1990s, Triton Energy, Gulfstream Resources and Hunt Oil have been carrying out exploration. In 2001, Chevron found small layers of crude. ENI, Petronas and CNOOC have all moved into the region, exploring for gas and oil³⁸.

4. What will they do with the gas?

4.1 Mozambique

There are many cases in Africa where significant discoveries of oil & gas have not lead to the expected economic growth (for example Nigeria and Equatorial Guinea, where energy export revenues have not been distributed for the benefit of all the population), and the Mozambique government is clear that it wants to plan carefully to ensure it manages the growth of its energy sector in a responsible manner. It is reviewing its taxation and regulatory policies to ensure that the country enjoys a fair percentage of long-term revenues and project participation. The Draft Gas Master Plan for Mozambique, prepared by ICF International in August 2012, states that export of gas will provide government revenues through monetization of royalties and Mozambique's share of profits. The report notes further "royalties and profits can be used in-kind within Mozambique to promote value-added manufacturing that increases local employment, promotes local businesses, and creates potentially broader benefits across the country"³⁹.

Mozambique's Confederation of Business Associations (CTA) has also warned against the risks of abundance of natural resources for the economy. A study carried out by USAID⁴⁰ highlighted that resource abundance and increased revenues can lead to:

- a) volatility in income and capital growth when a large proportion of GDP comes from natural resource revenues;
- b) impact on the exchange rate, domestic labour costs, costs in the country of rapid growth ("Dutch disease"); and
- c) impact of extraordinary income growth on governance, leading to corruption and political mismanagement which could undermine growth.

Fruhauf⁴¹ notes that at the time of the Cove Energy sale to PTT (see above) the capital gains tax on the transaction was 12.8% and that the government is now seeking to increase the level of this tax. This adds uncertainty and as capital gains tax is outside the remit of the Extractive Industries Transparency Initiative (EITI)⁴² it might not bode well for transparency

³⁸ <http://www.mbendi.com/indy/oilg/af/md/p0005.htm#5> "Oil and Gas in Madagascar - Overview"

³⁹ http://www.mirem.gov.mz/relatorios/draft_executive_summary_short%208-26-12.pdf

⁴⁰ Mozambique's Coming Natural Gas Resource Boom Expectations, Vulnerabilities and Policies for Successful Management, September 2012, Tyler Biggs, USAID, Speed

⁴¹ Fruhauf (2012)

⁴² The global [Extractive Industries Transparency Initiative \(EITI\)](#), established in 2003, promotes and supports improved governance in resource-rich countries through the full publication and verification of company

in the country and has led to some industry participants being uneasy about other regulatory hurdles that may lie ahead. The Ministry of Mineral Resources has challenged this view and said that there are no conflicts of interest that will prevent Anadarko and ENI from developing an LNG project⁴³. The report also suggested the development of a sovereign wealth fund and stressed the importance that Mozambique should ensure that the billions of dollars expected from exploitation of its natural resources should be spent wisely. At a CTA seminar in August 2012 its economic adviser posed the challenging question “what does Mozambique want to be in 30 years, Nigeria or Norway?”⁴⁴

The challenge is what to do with all this gas? The domestic market in Mozambique is currently small (2011 gas consumption was 0.5 Bcm/y⁴⁵) and limited to Beira and Maputo, but is expected to grow in the future. While ENH wants to maximize the use of gas in the domestic market, this would only require a small portion of the discovered reserves to date. As analysed later in this report, if all the projects proposed under the Gas Master Plan were to go ahead, there would still be substantial volumes of gas available for export. South Korean Kogas is working with ENH to help develop gas for local use. By November 2013 ENH expects to have a grid in place in Maputo to supply gas to industry, hospitals, hotels and residential users. ENH is also looking at compressed natural gas for vehicles⁴⁶. The Mozambican government is keen to increase gas in power generation. The government is expecting demand growth from industry and with a low electrification rate of 16%, Mozambique needs to increase its power capacity and build on the growth in other power sources – hydro and coal-based power generation.

The Mozambique draft Natural Gas Master Plan (Gas Master Plan), published in August 2012,⁴⁷ identified specific markets for natural gas in the country, the number of jobs that each business sector could create and potential government revenues. It states that Mozambique could earn up to \$5.2 bn per year from LNG by 2026 (vs. an estimated GDP in 2011 of \$12.8 bn) and that the gas sector could create over 70,000 jobs. The plan estimates that LNG will contribute more than \$3 bn on average each year in royalties and income taxes, though fiscal terms still need to be adopted. It also says that the possible scale of future LNG exports could represent a significant portion of global LNG supply. The Gas Master Plan was funded by the Petroleum Governance Initiative, a collaboration between the government of Norway, the World Bank and the Public-Private Infrastructure Advisory facility, a multi-donor technical assistance facility⁴⁸. The Gas Master Plan recommends the establishment of a Norwegian-style sovereign wealth fund, which would enable the government to exploit the anticipated gas bonanza without squandering the expected windfall. These aims are noble, but can they be achieved in the country and how will decision-making delay the development of the gas & LNG export projects?

payments and government revenues from oil, gas, and mining.

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTOGMC/EXTTEXTINDTRAINI/0,,contentMDK:22268500~menuPK:4973734~pagePK:64168445~piPK:64168309~theSitePK:3634715,00.html>

⁴³ Heren Global LNG Markets, 17/1/13, page 17, “Regulatory risks arise in East Africa”

⁴⁴ <http://allafrica.com/stories/201208290484.html>

⁴⁵ <http://www.eia.gov/countries/country-data.cfm?fips=MZ#ng> “Mozambique”

⁴⁶ ENH presentation to CWC East Africa Gas Conference, Tuesday 2nd October 2012 “Oil and Gas E&P Mozambique”

⁴⁷ Natural Gas Master Plan for Mozambique: Draft Final Executive Summary, ICF International, 26/8/12

⁴⁸ www.newsbase.com, Global LNG Monitor, 13/9/12 “Mozambique forecasts US\$5.2bn. Annual earnings from LNG”

The Gas Master Plan clearly sets out the type of investment requirement that needs to be developed in Mozambique to support the large level of infrastructure and project investment that is proposed⁴⁹; namely:

1. A soundly managed and stable macro-economic environment to give investors confidence;
2. A government supportive of investment in infrastructure, that enables the delivery of suitable services to the investment projects with suitable ownership structures;
3. A legal and regulatory framework governing gas development, that gives investors the fiduciary security they need;
4. Suitable markets for the gas that makes the investment in proposed domestic and export projects worthwhile;
5. A suitable gas pricing structure that allows investors to secure an acceptable return on their investments vs. the risks involved;
6. A banking and financial sector that enables the required local investments to be made as the Mozambique economy continues to grow.

Certainly the Mozambique government is promoting its new gas finds as a way to develop the economy. On publication of the Gas Master Plan, the Minister of Mineral Resources, Esperanca Bias, said that the “use of gas must be felt all over the country, regardless of where it is extracted” and Prime Minister Aires Aly said the following day that the new resources must be used in such a way to maximize employment, training, infrastructure development and the growth of institutional capacities⁵⁰. The report identifies the potential growth of domestic gas projects and the gas prices that are required to develop the projects. Table 3 summarises the number of domestic gas projects that are being considered.

Table 3: Potential Mozambique Domestic Gas Market

	Number of applications	Total volume of gas to meet all the applications (MMscf/d)	Average Gas Price required (\$/MMBtu) ⁵¹
Power generation	1	167	4.00
GTL	1	285	5.00
Methanol	5	1630	2.35
Fertilizer	3	200	1.90
LPG	1	n/a	3.50
Pipeline	1	129	2.00
Total	12	2411	Weighted Ave: 2.72

Source: Natural Gas Master Plan for Mozambique: Draft Final Executive Summary, ICF International, 26/8/12

In addition, small and medium enterprises (SME) will be users of gas, but potentially not on a baseload basis. The total volume of gas required to support the 12 applications detailed in the table is 2,411 mmscf/day gas. This is equivalent to a gas requirement of less than 18 Tcf over the 20 years, which can easily be accommodated from current gas finds, even with the development of the large volume LNG export projects that are being considered. Due to lack

⁴⁹ Natural Gas Master Plan for Mozambique

⁵⁰ Global LNG Monitor 13/9/12, <http://www.newsbase.com/newsbasearchive/OurMonitors.jsp>

⁵¹ ICF used a netback analysis from the world market prices to determine whether the price of gas requested by the developers appears reasonable and also to estimate the maximum price of gas needed to ensure the viability of the projects. The netback prices also can be compared with the netback from LNG sales and the built up cost of gas based on production and processing costs.

of data in Mozambique, it is difficult to develop a forecast on gas use in country in the SME sector.

The Gas Master Plan also examined alternative scenarios for development of the gas sector: an LNG-only case centred at Palma in the northern Capo Delgado province of the country (see Figure 4) through to a scenario in which several gas use centres would be developed across the country. It concluded that even though a multi-centre development of the gas sector would bring the greatest economic growth prospects to the various regions, and contribute most to employment and poverty reduction, it would take the longest time to achieve the required outcomes. Focusing just on LNG at Palma would be the easiest and have the shortest lead-time to achieve the earliest gas commercialization project revenues. The location of the site is extremely remote and requires much infrastructure work, including the construction of an airstrip. The distance from Palma to the capital Maputo is 2,800km and takes 3 days to drive (with current roads) and three hours in an aircraft. In approving the go ahead of the joint Anadarko/ENI LNG project in December 2012, the government supported the development in Palma.

The Draft Gas Master Plan noted that, with at least 150 Tcf undiscovered gas resources over and above 100 Tcf of discovered reserves there would be sufficient gas to support at least 10 trains of LNG (50 mtpa of LNG). The plan calls for two LNG trains to be operational by 2018 with another two trains added every two years, with ten trains to be operational by 2026. This schedule is very aggressive and more optimistic than international companies' own timetable. The report also notes that, depending on LNG quality requirements, there may be the possibility of constructing an LPG fractionation plant, which would provide additional revenues. The report does note that LNG export plants are not without risk, as LNG is priced on a global market basis which could result in varying revenues to the government. It further notes that Mozambique will have to compete with other new supplies of LNG from North America, Australia (expansion projects) and domestic gas (conventional and in the future shale gas) in China. It noted that GTL could also be a commercialization option and may give higher value to the government.

The Master Plan provides estimates of gas extraction costs with the cost of gas from Prosperidade-Mamba estimated at \$1.70/MMBtu (including taxes and profit share), \$2.00/MMBtu from Golfinho-Atum and Tubarao higher at \$6.40/MMBtu. Assuming \$0.75/MMBtu for gas processing this increases the gas cost to \$2.45-2.75/MMBtu for the lower cost fields. It has been assumed in this paper that the gas cost will be ~ \$3.00/MMBtu, but could be higher if there are technical issues such as seawater ingress into the reservoirs. The actual costs are not known at present as the fields are being developed, but the author is of the view that ~ \$ 3.00/MMBtu is a reasonable cost estimate. The gas is dry so there are no financial liquids credits.

In January 2013, Benjamin Chilenge, Director of Planning and Development in Mozambique's Ministry of Mineral Resources stated that all concession holders are contracted to commit a proportion of their production to the domestic market. This domestic market obligation (DMO) could put additional economic pressure on projects (depending on what level the DMO gas price is). As set out in Table 3, the Gas Master Plan sets out the potential demand for gas by industry, and the gas price by industry sector. The weighted average price of these requests for gas is \$2.72/MMBtu. This is lower than the processed gas price at the beachhead in Palma (in the north of the country). If the gas has to be transported

2800km to Maputo, assuming a pipeline cost of 5.5 US cents/100km⁵², then the gas cost at the capital would be ~ \$4.50-5.00/MMBtu. Domestic buyers would therefore seek to buy gas from the upstream suppliers at levels lower than the cost at the LNG plant, or the government would need to subsidise the difference as part of its social and domestic energy market policies.

4.2 Tanzania

The Tanzania government is in the process of drafting its own Gas Master Plan and in November 2012 the first draft of Tanzania's Natural Gas Policy was released for public consultation⁵³. The policy set, at a high level, the framework for guiding the development of the gas industry in line with the government's Vision for the country. The document gave direction for potential investors, but not full details as to how the development should be carried out. This policy was summarized in a review by Clyde & Co and sets out the main challenges facing the industry in Tanzania⁵⁴; specifically,

- i. There is a need for institutional and legal frameworks to administer the industry effectively, with specific legislation to address governance of the natural gas industry through the appointment of a regulatory authority for the natural gas industry. The policy also says that the government must participate in the gas value chain and that the government's natural gas aggregator, Tanzania Petroleum Development Corporation (TPDC), will take on new roles and greater participation, but not upstream regulation, which will be carried out by a separate regulator. This effectively means that the TPDC would "purchase, collect, sell and transport natural gas in the country onshore and offshore, and marketers would have to source supplies from them;
- ii. There is a shortage of the necessary human resources with the requisite skills and knowledge in the natural gas industry;
- iii. Natural gas infrastructure needs to be developed. The policy also contemplates government ownership of natural gas infrastructure and non-discriminatory access to facilities;
- iv. Current domestic demand is very low and there is a need to develop the domestic market for natural gas;
- v. Natural gas revenues need to be managed effectively and a Natural Gas Revenue Fund must be established to ensure effective management of natural gas revenues. Investing companies must undertake community development programmes and the promotion of Public Private Partnerships (PPPs) to enable investments in the natural gas industry;
- vi. Health, safety and environment are important in developing the natural resources of Tanzania;
- vii. It will be important to manage all stakeholder expectations.

The policy, which does not need formal parliamentary approval, should have been published, following the industry consultation, by the end of 2012. This date was not achieved. In January 2013, Tanzania's deputy energy and minerals minister, George Simbachawene, told African power ministers that some "irrationally gullible local politicians" had become "easy

⁵² The author has used a pipeline cost of US\$ 2/M³/100km (the same transit fee as in Eastern European countries).

⁵³ http://www.wavuti.com/uploads/3/0/7/6/3076464/the_tanzania_natural_gas_policy_draft_-1.pdf

⁵⁴ Clyde & Co, "Draft Natural Gas Policy for Tanzania", November 2012, http://www.clydeco.org.uk/uploads/Files/Draft_natural_gas_policy_for_Tanzania.pdf

puppets” of foreign conglomerates⁵⁵. He was commenting that foreign companies were focusing on exporting gas rather than developing the local market. He noted that if local infrastructure was constructed and gas used domestically, rather than exported, it could reduce Tanzania's power problems. This statement supports the construction of a pipeline to Dar es-Salam from Mtwara but, there are concerns from local residents near the gas fields that gas should be used in their region, and the Lindi community has already disrupted a gas project public hearing. They argue that gas should not be transported to other areas of the country until local resource needs and industry potential have been met. These statements and concerns give additional uncertainty, and may explain why the Tanzanian Ministry of Energy and Mineral missed its own end-2012 deadline for publishing the Natural Gas Policy⁵⁶.

These statements and concerns give additional uncertainty to the quick development of natural gas resources in Tanzania and it is now expected that the Natural Gas Policy will be published in March/April 2013, which means that the required bill will not be passed until the third or fourth quarter of 2013. The revised bill is expected to include some changes from the original draft after the consultation phase, in which a particular area of concern to international companies was the role of the state-owned TPDC⁵⁷ in that it was going to own all the gas infrastructure and buy/sell all gas in the country. The timetable may be delayed further as opposition legislators seek to slow down the process. The effect of this could be that any changes to Tanzania's PSC terms that are set out in the bill may be applied retroactively, and this uncertainty (together with concerns over ownership of the gas in the country) may mean that companies could slow down operations ahead of the PSC terms being finalised.

Ahead of publication of the draft Natural Gas Policy, some of the terms in agreements with project developers already include a Domestic Market Obligation of 5-10%. BG has stated however that, in its view, the local market will be supplied from onshore and shallow water projects while deep-water gas would be used for LNG exports⁵⁸. But, key to developing an LNG project is having the full support of all parts of the sponsoring government and stability in fiscal terms. In July 2012 the Energy and Minerals Minister Sospeter Mohongo said that royalties on gas production would rise from the existing level of 12.5% to an unspecified level and a new signing fee would be introduced under a new gas policy⁵⁹. In early September 2012, there were reports that the government was not in agreement with TPDC and that roadshows for potential investors, which were due to take place in quarter 4, 2012 were to be cancelled. The opposition Shadow Minister of Finance at that time, Zitto Kabwe, said that the Ministry of Finance was looking for an “outright moratorium” on all gas developments and a week later, Tanzania's energy minister announced that it had ordered a review of all contracts with oil and gas exploration companies⁶⁰, with Energy and Minerals Minister Sospeter Mohongo saying that “some of the agreements are really shoddy and they need to be revoked” and “I can't tolerate agreements which were not in the country's interests but they benefit a few individuals”. At an East African gas conference in London on October 1-2, Ophir's CEO Nick Cooper said that the Tanzania government's review of PSCs ‘is not

⁵⁵ <http://www.dailynews.co.tz/index.php/local-news/13862-foreign-firms-linked-to-gas-row> “Foreign firms linked to gas row”

⁵⁶ <http://www.dailynews.co.tz/index.php/local-news/13862-foreign-firms-linked-to-gas-row>

⁵⁷ Heren LNG Markets, 17/1/13 Ibid

⁵⁸ Heren LNG Markets 27/7/12 “BG Group starts Tanzania LNG location search”

⁵⁹ Reuters 28/7/12 “Gas-rich Tanzania plans to raise royalties”

⁶⁰ Reuters 16/9/12 “Tanzania orders review of all oil and gas exploration contracts”

rewriting the rules, just ensuring compliance with what has been agreed' and this was a process he fully supported⁶¹. TPDC has a PSC with Ophir (signed in 2005) but still remains in PSC negotiations with Statoil⁶². These disagreements between Ministries and an unclear process will no doubt slow down developments in Tanzania.

The Tanzanian gas market is very small and in 2011 was only 0.8 Bcm/y, for use in power generation⁶³. In September 2011, the Tanzania government signed a \$1.2 bn. loan agreement with China to construct a 36 inch 532km pipeline (with one 24" spur line) from Mnazi Bay in the south of the country to Dar es Salaam, and construction started in July 2012. The pipeline is expected to take 12-14 months to complete and will encourage domestic gas demand growth and could ultimately link into a trans-East African pipeline from Kenya to South Africa. This pipeline is unlikely to be fully utilized and local communities are demonstrating about gas being moved away from their source of supply (as they want industrial development in that area). A concern is that if the pipeline is not fully used, Chinese investors may seek more gas or involvement in other infrastructure projects in exchange for this infrastructure expenditure.

The World Bank and International companies, as they seek to promote their projects in Tanzania, are pushing the economic benefits of developing gas resources and exporting gas to international markets. In August 2012 the World Bank was reported saying, "a host government can be expected to get around 40% of total revenues depending on the tax regime and the production sharing agreement (PSA). This means for Tanzania around 7 per cent of its projected GDP or about a third of its current fiscal revenues, if all above reserves can be exploited"⁶⁴. Companies also are vocal with their concerns about financial transparency in the country. In August 2012, Statoil said that revenues earned by Tanzania from gas "while considerable, will not be sufficient to transform Tanzania". Statoil further noted that if Tanzania wants to avoid the famous curse⁶⁵ associated with natural resources, the lesson from experience is straightforward - transparency. All negotiated contracts with producing companies, the selection of projects, and payments must be monitored and audited by an independent body and ultimately disseminated to the public at large⁶⁶

Tanzania is therefore not helping itself and internal political argument will result in delays in the development of LNG projects. The country, in the eyes of several vocal politicians, does not have large enough proven reserves to meet all potential domestic gas demand and to develop a large scale LNG export project (which Mozambique does). More gas must therefore be found ahead of LNG export project plans being approved.

⁶¹ Source: Author research and notes from attending the CWC East Africa Conference. London, 1-2 October 2012

⁶² Heren LNG Markets, 7/9/12, "Tanzania resource holders consider joint LNG project"

⁶³ Source: Natural gas in Africa The frontiers of the Golden Age, Ernst & Young, 2012

⁶⁴ <http://www.africanliberty.org/content/tanzania-local-production-liquified-natural-gas-underway> 30/8/12

⁶⁵ By saying "the famous curse" the author refers to countries where rapid increase in revenues, following development of gas, oil or minerals has led to rapid inflows of money. This in turn has led to corruption and a lower level of business transparency.

⁶⁶ www.allafrica.com, "Tanzania Local production of LNG Underway" quoting Vice President of Statoil, Mr Tim Dodson

4.3 Regional gas and power exports

There are limited opportunities for gas pipeline exports from Tanzania or Mozambique. Gas demand in the neighboring countries is very low as set out in Table 4. Burundi, Kenya, Malawi, Zambia and Zimbabwe have no natural gas demand, relying in part on LPG. Gas demand in Congo is very low, 3.3 bcf/y (0.1 Bcm/y, based on domestic production). South Africa has the highest gas demand. This is expected to grow (see Section 3.5) and South Africa is looking to import more gas by pipeline from Mozambique to meet that growing gas demand. It is possible that gas could therefore be exported to neighbouring countries, but the distances are very significant. Harare (Zimbabwe) is 1,200km away and Lusaka (Zambia) is 1,400km in a straight line and by road considerably more. It is unlikely that such a pipeline could be constructed without substantial third party aid as the destination market would be unable to make the long-term contractual commitments to underwrite it. This would be the case for most of the neighbouring countries (except South Africa). Export of gas as LNG seems to be the only realistic solution in the short to medium term.

Table 4: Gas and power in East African countries

Country	Year of Data	Gas			Electricity		
		Reserves	Production	Consumption	Net Generation	Net Consumption	Installed Capacity
		tcf	bcf	bcf	GW	bn. KWh	bn. KWh
Burundi	2009	0	0	0	0.12	0.19	0.05
Congo	2009/10	3	3.3	3.3	0.52	0.58	0.15
Kenya	2009	0	0	0	6.67	5.61	1.68
Malawi	2009	0	0	0	1.9	1.77	0.29
Rwanda	2009/10	2	0	0	0.24	0.28	0.06
South Africa	2009/10	0.6	34	142	232	206	44
Zambia	2009	0	0		10.3	7.4	1.7
Zimbabwe	2009	0	0	0	7.16	12.54	2.04
Tanzania	2009/10	1.3	28	28	4.05	3.2	0.84
Mozambique	2009/10	5	110	3	16.79	10.19	2.43

Source: www.eia.gov/countries (Cedigaz 2011 for Tanzania and South Africa gas reserves)

Power demand and generation is also low in neighbouring countries (see table 4). Burundi, Congo and Rwanda have power consumption of less than 1 bn. KWh while the others, apart from South Africa, are low in global terms (UK power consumption is 330 bn. KWh). This represents an opportunity for Mozambique and Tanzania to become a regional power exporter, developing power stations for exports once they have satisfied their domestic power demand. This may become a regional political goal but, as with gas, it is unlikely that without substantial aid such a power grid will be constructed, as the destination market would not be able to make the required contractual commitments.

4.4 Mozambique gas export options

Mozambique pipeline exports to South Africa

South Africa imported 3.3 Bcm/y of gas from Mozambique in 2012⁶⁷ and is looking to increase gas in power generation, as a means to curb carbon emissions and increase energy security through greater imports of gas from its neighbours. There have therefore been calls in South Africa for the country to reconsider its energy policy and in March 2012 Michael Bagrain, president of the South African Cape Chamber of Commerce said: “The significance for South Africa is that these discoveries [in Mozambique] should wipe the nuclear [power] option off the table. We now have enough gas on our borders to generate all the electricity we could ever use. It will be the easy way to reduce our carbon emissions”⁶⁸. Sasol dominated Mozambique’s energy sector in the 2000s, but the huge finds made by international companies over the past three years have sidelined Sasol to a certain extent. South Africa and Mozambique have enjoyed strong diplomatic ties for many years and a South Africa Institute of Foreign Affairs policy briefing in August 2012 said: that the vision is that these energy products will be used locally and exported to neighbouring countries, thereby contributing to job creation, export revenue and economic growth in Mozambique⁶⁹. In December 2011 PetroSA signed a “strategic partnership agreement” with its Mozambican counterpart Petróleos de Moçambique (Petromoc), to examine the possibility of a gas to liquids facility in Mozambique. Sasol is also seeking to secure additional gas fields in Mozambique. It is clear that some additional gas will therefore be made available to South Africa as the large offshore Mozambique reserves are developed.

Mozambique LNG exports

The momentum to lead East Africa’s first LNG export facility is “hotting up” with mixed messages from the different participants. Anadarko is ahead in the race – it simply has more gas closer to shore - and in September 2012 said it was in discussions with ENI to combine efforts on the offshore and onshore development of a liquefaction plant (and that the cost of a two train LNG plant would be around \$15 bn.⁷⁰). At the same Anadarko was forging ahead with its own LNG project, saying that it had enough gas to develop its own two-train project without involving other groups. ENI likewise was claiming leadership in Mozambique LNG by virtue of its superior experience in LNG and company size – but, ENI’s reserves are further offshore and in deeper water. The government was trying to push the two companies to work together.

At the end of December 2012, Anadarko and ENI announced that they had signed a Heads of Agreement to coordinate development of their upstream activities (though operating the blocks separately) and to work together to develop a single onshore LNG project, near Palma, in Cabo Delgado province in Northern Mozambique (close to the Tanzanian border). The companies wanted initially to develop their projects in parallel, but the intention of the government was that the two companies should jointly develop an “LNG park” and pooling their resources would reduce project development costs. In mid December 2012 Anadarko awarded the front-end engineering and design (FEED) contract for a four-train 20 mtpa LNG

⁶⁷ BP Statistical Review of World Energy, June 2012

⁶⁸ <http://www.howwemadeitinafrica.com/why-mozambique’s-gas-discovery-is-a-big-deal/15603/>

⁶⁹ AIIA, Policy Briefing 53, August 2012 “Mozambique’s Gas: An Opportunity for South Africa?”

⁷⁰ Global LNG Monitor 13/9/12 ibid

plant to three competitive consortia: JGC and Fluor; CB&I and Chiyoda; and Bechtel. Each group is to deliver a full engineering, procurement and construction plan, and a lump-sum turnkey price for an initial two-train, 10 mtpa, LNG project⁷¹. Whilst Anadarko may prefer using Bechtel's cascade liquefaction process, different shareholders in the project may push for a preferred technology. Mitsui, for example, will probably push for using APCI's technology from Japanese companies. Mitsui, 25% shareholder in Area 1, will no doubt lobby for Japanese companies to carry out FEED and ultimate construction, offering Japanese export credit agency finance as a carrot. This could mean that the LNG plant is developed using either technology, or potentially both – though this would be a first in LNG project developments and potentially add additional complexity to the project.

The block 1 partners are numerous, which also adds complexities compared to the smaller consortium of other Mozambique and Tanzania blocks. Anadarko has said that it seeks to divest 20% once exploration is complete⁷² and given its high level of company debt and its need to finance further development of the project⁷³, it is likely that this will happen. There should be no shortage of potential buyers. ENI is also likely to sell part of its 70% stake in Area 4, and Statoil part of its 65% interests in Area 2 & 5, where it is currently exploring, to finance further development and further exploration. As noted earlier, it is rumoured that Chinese companies are already in advanced discussions to secure such a position and other companies are likely to be interested in these stakes in large gas resources in East Africa.

The government still has to agree a range of fiscal and royalty policies and finance remains a big challenge. A two-train development will cost in the region of \$15 bn. (liquefaction plant only) plus upstream development costs. Assuming it can be third party financed with a gearing of 70%, if the Mozambique state participant ENH maintains its 15% share in Block 1, and assuming this share applies to the LNG plant as well, it will still need to inject \$600-700 million equity. As noted above, ENH is also seeking additional equity in the offshore and potentially the LNG projects. This could cause ENH some financial challenges if it lacks the available capital to make its initial equity investment in the projects. That said, with potential future revenues from LNG exports, it is likely that it could raise funds to meet the required equity investments, though in doing so, it may have to forgo some equity to a third party, thereby reducing government shareholding in the projects. This would be counter to the government's stated aims to enjoy project revenues for the benefit of the country, and may cause some political issues.

The big question is when will the first LNG export projects reach FID? Anadarko is stating that it will take FID in 2013, but the author views this as difficult to achieve as government approvals will take time and the project development location is so remote, and lacks any infrastructure. Wood Mackenzie is assuming that first LNG will be in 2019 (i.e. FID 2014)⁷⁴, with which the author would concur. There are planned presidential and parliament elections in Mozambique in Q1 2014, which may cause some delays (especially if Mozambique's main opposition party leader, the former rebel Renamo, boycotts it, which he has threatened, as he is demonstrating against the results of the 2009 presidential and parliamentary polls⁷⁵). In

⁷¹ Source: Platts LNG Daily, 21/12/12, "Mozambique's Area 1 partners award FEED contracts"

⁷² Heren LNG 20/6/12 "Thailand's PTT is primed to join the East African race"

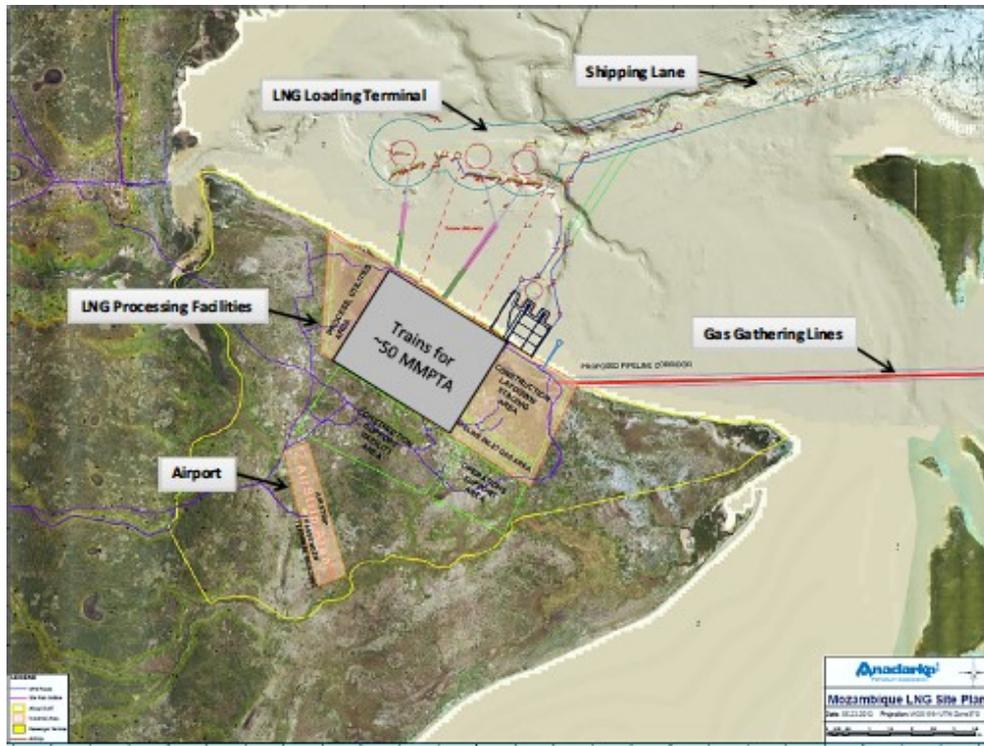
⁷³ <http://www.nasdaq.com/article/a-closer-look-at-anadarko-and-enis-agreement-to-develop-mozambique-gas-fields-cm203082>

⁷⁴ Wood Mackenzie presentation to CWC East Africa Gas Conference Ibid

⁷⁵ <http://allafrica.com/stories/201204021372.html>

reality, as the ruling party is unlikely to change, this should not delay the government’s decision-making unless the elections themselves cause unrest.

Figure 5: Diagram of the planned Anadarko LNG project “MzLNG”, Palma, Mozambique



Source: Anadarko Presentation to the CWC World LNG Conference, Barcelona 28/12/12

There is a wider concern for all the East African developments, and that is security. Onshore companies will have high security costs, especially with the arrival of high numbers of expatriates in the workforce. Offshore there is a risk of collateral damage to exploration vessels posed by the threat of Somali pirates. These pirates have been operating as far south as Mozambique; in October 2011 seven Somali pirates attacked a Petrobras-operated exploration vessel, 82 nautical miles offshore Dar es Salaam, in the Tanzania Offshore Area 6. The International Maritime Bureau has estimated that the number of Somali piracy attacks rose from 219 in 2010 to 236 in 2011. Even with greater military presence having an impact on reducing piracy attacks, insurance premiums for offshore exploration and production vessels operating in the region have risen accordingly⁷⁶. The terrible terrorist attack in Algeria in January 2013 further raises concerns for companies who seek to develop projects and locate staff in developing countries.

A key factor facing both Mozambique and Tanzania is the wish to maximise local content in the construction and operation of new LNG export projects. Companies will no doubt prefer a modular approach to offshore construction and sourcing, but will this be acceptable to the Mozambique government? In December 2012 ENI’s CEO suggested that floating liquefaction technology could be used to commercialise Mozambique’s gas reserves⁷⁷.

⁷⁶ Heren LNG Markets 9/3/12 “Risks raise barriers to East African Export Ambitions”

⁷⁷ <http://www.nytimes.com/2012/12/06/business/energy-environment/eni-announces-major-gas-find-off-mozambique.html?src=twrhp>

Whereas sponsors may in theory like floating LNG (FLNG), the big question is will offshore FLNG be acceptable to governments? The primary concern of governments is that liquefying and exporting LNG using FLNG will reduce the development of domestic infrastructure, which is against the interests of developing country governments.

Mozambique Gas to liquids

Following publication of the draft gas master plan for Mozambique, ENI announced in October 2012 that it was considering a gas to liquids (GTL) project as part of its plan to develop its Mozambique gas reserves⁷⁸. In the same report it was noted that ENI's priority was to find development solutions for gas exports as well as the small, but growing domestic market, noting that the reserves are of such magnitude that all different means to exploit the reserves are being examined. As yet, there have been no firm plans for GTL plants.

In April 2012, South African State owned PetroSA announced that it was in discussions with Mozambique to develop a \$ 4 bn. 40,000 barrels/day GTL plant, to supply the growing diesel demand in Mozambique and South Africa. PetroSA noted that Mozambique is a net importer of fuel, with imports of 900,000 tonnes/year of fuel products. GTL could reduce the country's import bill and, with such large gas reserves, there was scope for GTL as well as LNG exports⁷⁹. The government of Mozambique may find this proposal difficult to refuse, as it wishes to maximize domestic content and investment in domestic infrastructure as part of the development of its domestic gas reserves. The author would concur with the view of the Mozambique government.

4.5 Tanzania gas export options

Tanzania LNG exports

LNG exports from Tanzania are in a far earlier stage of development than Mozambique.

As with Mozambique, there is considerable lobbying for position between the international companies in Tanzania. BG/Ophir are deemed to be ahead but Statoil is trying to influence the government, with very public statements, to prioritise its projects, following its Zafarani (5-6 Tcf) and Lavani gas finds (3 Tcf). Statoil has said that the 9 Tcf of gas already discovered is not large enough to source a viable LNG project and cooperation between Statoil and BG would be best. At the end of 2012 it was reported that the Ministry of Energy and Minerals had asked Statoil "to convince" BG to see if they could build a single LNG plant⁸⁰ and this was confirmed by BG in a conference presentation in October 2012⁸¹. BG is the manager of the main supply base in Tanzania on behalf of all the companies and has started a search to find a suitable location for an LNG export facility. It is also planning to firm up more gas resources⁸² to support the development of the LNG export project. In early October it issued a tender to engineering companies to support this activity⁸³. BG has

⁷⁸ Platts LNG Daily, 17/10/12, "ENI eyes GTL option for Mozambique gas finds"

⁷⁹ Reuters, 25/4/12, "PetroSA says in talks with Mozambique for GTL plant"

⁸⁰ allafrica.com/stories/28/8/12, "Tanzania "Local production of LNG Underway"

⁸¹ Source: Author research and notes from attending the CWC East Africa Conference. London, 1-2 October 2012

⁸² Heren LNG Markets 27/7/12 "BG Group starts Tanzania LNG location search"

⁸³ Source: Author research

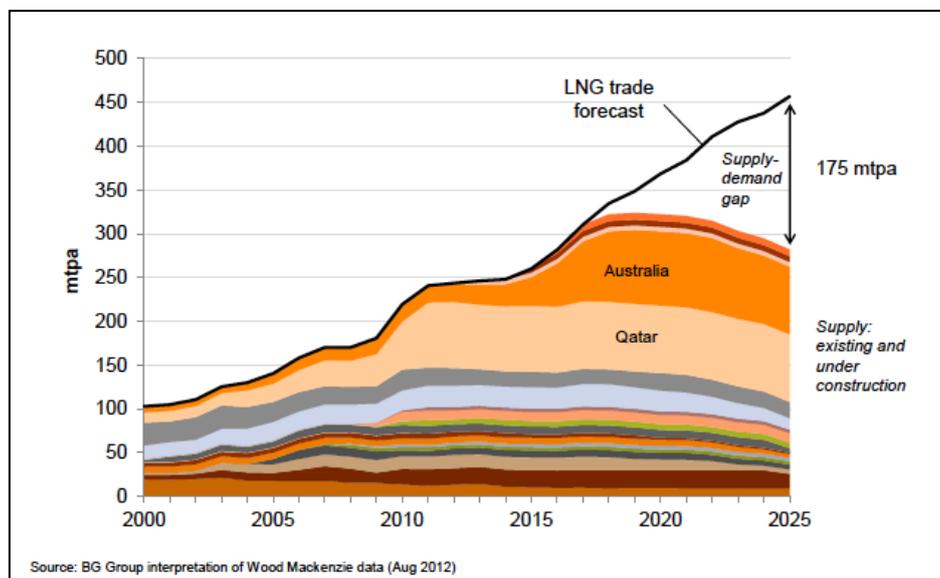
confirmed that it has an implementation agreement signed with the government and has the Metro-1 drillship on charter to be used exclusively to drill more wells for BG/Ophir in Tanzania as it seeks to firm up more gas reserves.

In early October 2012 BG announced that it would go for dual FEED on an LNG export plant in early 2015 with FID not until 2016, which would indicate a plant start-up in late 2020/21⁸⁴. Statoil in February 2013 also indicated that Tanzania is unlikely to see first LNG before 2020⁸⁵. This is later than the announcements from developers of projects in Mozambique, but probably more realistic. There are no unitization issues in Tanzania (unlike Mozambique), and the gas is dry, so there are no liquids credits but there are lower gas processing costs. BG has several capital intensive projects under development globally and, putting FID on a Tanzania LNG export project back until after 2015 would enable it to start operations of its Australian Curtis Island LNG project that is currently under construction, before it incurs major expenditure in Tanzania.

5. Global LNG demand - Comparing different supply sources

With rising global gas demand, especially from Asia, and the growing importance of LNG in global gas supply (BG forecasts that LNG as a share of global gas supply will increase from 6% in 2000 to 14% by 2025⁸⁶), it can be concluded that there will be demand for LNG from East Africa, at the right price. BG in the same presentation estimated that there is an LNG supply shortfall of 175 mt by 2025 (see Figure 6), which is supported by the author’s own forward LNG supply-demand estimates. East Africa however is not alone in its plans to develop new LNG export facilities and will face stiff competition from other supply sources primarily US Gulf brownfield projects and Australian projects.

Figure: 6 “The LNG Supply Challenge”



Source: BG presentation to CWC World LNG Conference, Barcelona 28/12/12, “The outlook for LNG: Are the dynamics changing?”

⁸⁴ Wood Mackenzie presentation to CWC East Africa Gas Conference Ibid

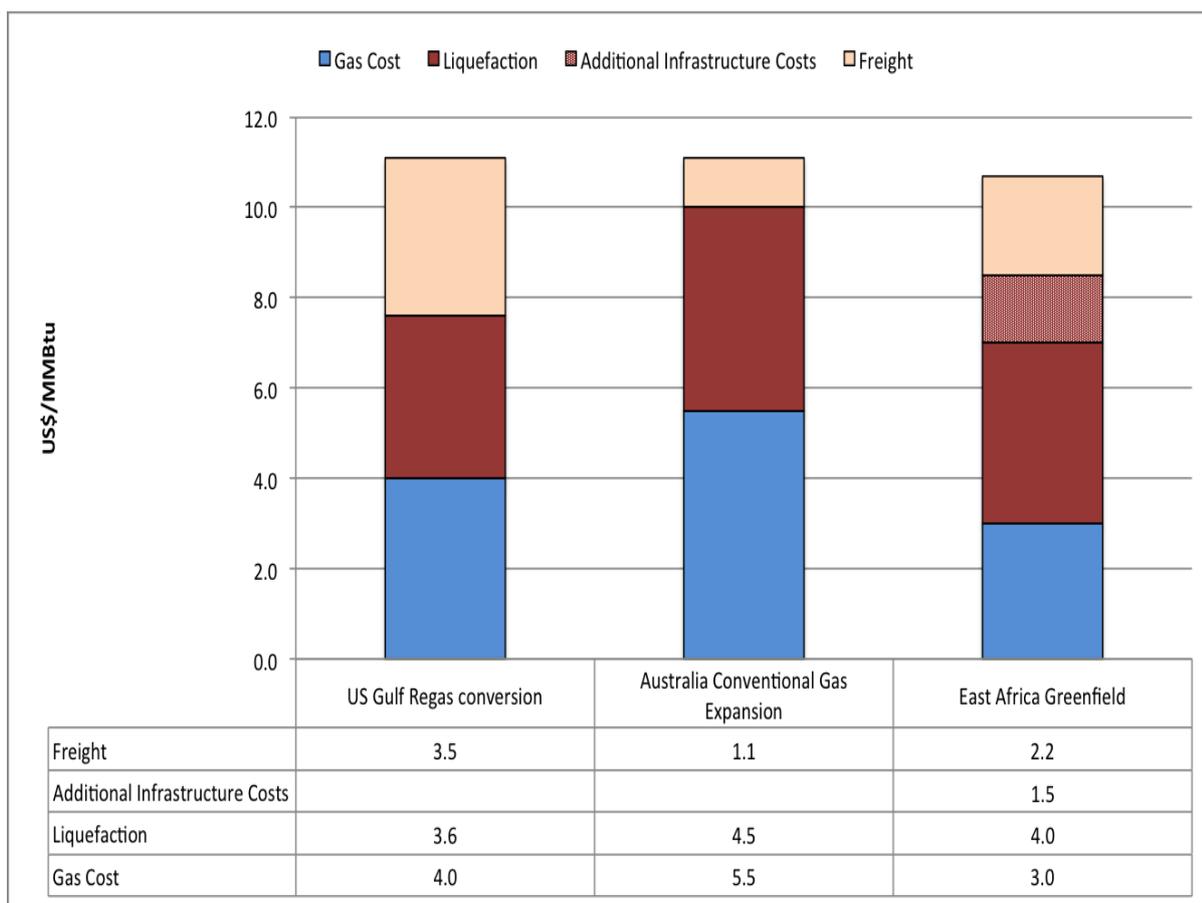
⁸⁵ <http://norwegianafrican.no/news/east-africa-welcomes-oil-and-gas-investments>

⁸⁶ BG presentation to CWC World LNG Conference, Barcelona 28/12/12, “ The outlook for LNG: Are the dynamics changing?”

Figure 7 sets out the author’s view of comparative supply costs for new supply into the Asian market. Exact costs of East African and Australian projects are not known, and are therefore estimated by the author. Table 5 includes the assumptions used in calculating the costs. It should be noted that the author has included an additional \$1.50/MMBtu cost for LNG from East Africa to reflect the need for additional investment in infrastructure, when compared to the costs for new LNG from the US Gulf and Australian expansions.

It can be seen from the analysis that all these supply sources can supply into the Asian market at similar levels and will therefore be in competition to secure part of the market. East African LNG projects can also sell to South America and North-West European markets but, based on current pricing, these markets would give lower netbacks. In order to be competitive, the East African and Australian projects will have to be creative with their LNG pricing. US Gulf LNG sellers can offer Henry Hub-related pricing structures, and the new Pacific projects will have to do the same, and offer a hybrid of hub and oil pricing structures with, say, 10-20% of the price related to NBP or Henry Hub and the balance on an oil formula, maybe Brent, to facilitate hedging. India will also look to secure LNG from East African LNG projects, and the Indian shareholders in Area 1, will no doubt seek to lobby for some of the LNG volume.

Figure 7: Comparison of delivered costs of LNG to Japan



Source: Author analysis

The assumptions made for Figure 7 are summarised in Table 5.

Table 5: Assumptions for the comparison of delivered costs of LNG to Japan

Assumptions	Gas Cost	Liquefaction	Additional Infrastructure Costs	Freight
US Gulf Regas conversion	\$4/MMBtu Henry Hub	115% Henry + K55Hub + 3/MMBtu	Nil	Freight cost using a 170,000 m3 vessel at a charter rate \$85,000/day via Panama Canal assuming \$700,000 Panama Canal fee (same as Suez)
Australia Expansion	Gas cost for conventional gas is ~ \$5.5/MMBtu	Brownfield cost of 60% \$2400/MT i.e. \$1500/MT @ \$0.35/\$100/MT giving an IRR of 12-15%	Nil	Freight cost using a 170,000 m3 vessel at a charter rate \$85,000/day
East Africa Greenfield	\$3/MMBtu average wellhead cost + gas processing + contingency	\$1000/MT @ \$0.40/\$100/MT giving an IRR of 15%	Investors in East Africa greenfield will incur additional costs due to the greenfield nature of the project. The additional \$1.50/MMBtu assumes an additional cost of \$500/MT @ \$0.30/\$100/MT giving an IRR of 12%	Freight cost using a 170,000 m3 vessel at a charter rate \$85,000/day with an additional 2 days voyage to avoid piracy areas

Source: Author research and analysis

The landed costs in Asia for gas from East Africa, US Gulf and Australia expansions are therefore very similar. Australia Greenfield will be more expensive, as projects are not able to enjoy the economic benefits of using the existing infrastructure, so this will make them uncompetitive vs. East Africa. Likewise, Western Canada LNG export projects and US Gulf greenfield projects will be similarly disadvantaged, and even with the shorter shipping distances between West Canada and Japan, due to higher plant and feedgas costs (as a result of high feedgas pipeline costs), the competitiveness of the West Canada projects vs. East Africa is also questioned. LNG from East Africa is therefore economically competitive, but will face considerable competition from other LNG suppliers and this may limit the pace of development of the proposed LNG export projects. Actual volumes of LNG from East Africa will depend on the commercial offering (price and contract terms) as well as the political relationships between the supplier and buyer countries.

The impact of this market competition is that where one would expect the first two train LNG project in Mozambique by end 2019/2020, the second project, and further trains, will be developed on a slower basis. The Mozambique government has called for the second two trains to start by 2022 and the next two trains by 2025/6, with a total of ten trains operational by 2028. The timetable will depend on the pace of development of the first project, political stability and support within the country, but it is unlikely that the government's fast track timetable is achievable. Another limiter could be the view of Asian LNG buyers on the security of supply of LNG from East Africa. If the projects experience piracy attacks, there may be a slower uptake of LNG from Mozambique and Tanzania in favour of other, more secure LNG supply sources.

6. Importance of East Africa LNG projects to the companies involved

Major companies operate a portfolio approach to energy project development, focusing on several projects at once, usually with differing priorities, with the aim of managing their options and optimising capital allocation. In reviewing the investor presentations of several key companies involved in East Africa, one can gain an insight as to how important these gas assets are to the companies compared with other gas and LNG development options that they are considering.

<p>Anadarko</p>	<p>In its Q3/2012 investor presentation, the New Golfinho/Atum estimate of 15 - 35 Tcf was a highlight of the report. It was described in detail, one of three major projects in the presentation (the US domestic projects Wattenberg and Eagleford being the other two).</p> <div data-bbox="352 680 940 1106" style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Creating Value Through Exploration</p> <ul style="list-style-type: none"> • 4+ BBOE Net Discovered Resources 2004 - 2011 • \$7.5 Billion Exploration Capital • \$8 Billion Exploration Monetizations <p style="text-align: center;">And ... Transitioning Discoveries Into \$25+ Billion of Value</p> <p style="text-align: right; font-size: small;">Sanctioned Appraising</p> <p style="text-align: right; font-size: x-small;">National First Sales Date</p> <p style="text-align: left; font-size: x-small;">Anadarko Petroleum Corporation 15</p> </div> <p>In a presentation to the Goldman Sachs Global Energy Conference in 2013, the CEO again stressed the importance of Mozambique to Anadarko, as well as the developments in Ghana, West Africa and the Gulf of Mexico. It is clear that Mozambique is of primary importance to the growth strategy of Anadarko.</p>
<p>ENI</p>	<p>In October 2012's quarter three results presentation ENI does not specifically mention Mozambique. In a presentation in November, ENI's CEO identifies Mozambique as an emerging basin and with 6 wells drilled to date; discoveries have identified 70 Tcf, 20 Tcf standalone and with unitization talks ongoing for gas in straddling blocks. Further exploration and appraisal wells planned.</p>
<p>BG/Ophir</p>	<p>BG's investor presentations have identified Tanzania as an area of activity. The rig returned to drill in Q 4 2012 for Jodari appraisal, and its lease has been extended into 2013. The presentation does not identify Tanzania as a current top focus in BG's strategy. Its partner Ophir however, stresses the reserves successes in Tanzania, primarily as it seeks to potentially sell all or part of the company and its interests.</p>
<p>Statoil</p>	<p>In its investor presentations, Statoil not really focused on Tanzania (not mentioned by the CEO in the Q3/2012 results presentation). In February 2013, it announced that first LNG production would not be before 2020⁸⁷.</p>

Source: Company website investor presentations

Commercialisation of the East Africa gas resources is obviously of importance to all the companies involved. That said, Anadarko really needs success in the region to support its development as an international gas player, and as an enabler to expand into the LNG business. In its 2011 financial statements, Anadarko reported that it had 8.3 Tcf of gas reserves in USA and none outside USA⁸⁸. Booking large reserves in Mozambique is therefore of great importance to the growth of the company internationally. ENI, in its 2011

⁸⁷ norwegian.african.no lbid

⁸⁸ http://www.anadarko.com/SiteCollectionDocuments/PDF/SEC%20Filings/APC_2011-Annual_10-k.pdf

financial statements, said that its estimated proved reserves of hydrocarbons were 7.086 mmboe at the end of 2011. If ENI's 70% share of the 70Tcf estimate is equivalent to 8,800 mmboe – Mozambique gas is therefore key to the growth of the company – if the gas can be commercialised.

7. Conclusions and way forward for East Africa LNG

It is clear that there is sufficient gas in Mozambique to meet domestic demand as well as exports. (This paper notes that even with high domestic gas demand estimates of ~ 20 Tcf over twenty years, it still has at least 100 Tcf of gas reserves available for export). The position in Tanzania is different, as more gas reserves need to be firmed up before the government will feel comfortable to proceed with LNG exports. This position is being played out domestically through political debate between different individuals. It is the author's view that in order to feel comfortable to export some of the nation's precious gas resource, Tanzania would need to have proven reserves in the region of 25-30 Tcf as this would allow one third to be allocated to the domestic market, a second third for export with the balance being kept for future generations. This is a similar rule to that which has been adopted by Egypt as part of its gas policy.

The speed and volume of LNG exports from Mozambique and Tanzania will be a function, not only of the amount of gas, but also of domestic politics and policies, the economics of the proposed export projects and global demand for LNG.

Promoters of projects should expect delays as authorities establish fiscal and regulatory regimes. Both Mozambique and Tanzania have started this process, which will take time and is politically contentious as different individuals and political parties within the countries seek to assert their positions. In drafting oil and gas revenue legislation, based on their respective gas master plans, both countries must consider how it will impact on the economics of the projects. While Mozambique's basic regulatory framework is anchored in the 2001 Petroleum Law, in Tanzania populist pressures have delayed the development of the gas policy framework⁸⁹. Also, recent changes in capital gains tax rates in Mozambique send an uncertain message to international investors that the regulatory and taxation regime could change over time. As is well known in the LNG business, from previous LNG developments in other countries, uncertain and changeable fiscal regimes, together with a lack of consensus amongst the country's leaders / political parties / government departments can lead to delays (e.g. Nigeria, Oman), and where there is strong leadership and direction LNG projects can be developed remarkably fast (e.g. Qatar). In both Mozambique and Tanzania it is important therefore that the fiscal and regulatory terms are agreed as soon as possible to show clear leadership and direction to push through what will be fundamental investments in infrastructure projects and change in the country.

It is also important that the governments in both Mozambique and Tanzania do not seek to over-leverage the revenues from gas export projects as a means of advancing the domestic gas sector and wider industrialization in the country. While it is critical that countries establish investment conditions that protect their domestic position (e.g. measures to protect domestic employment, requirements for domestic companies to have ownership of assets, domestic suppliers to be preferred for supply of goods and services), such measures must not slow down the development of the proposed LNG export projects. It is accepted that the

⁸⁹ Fruhauf (2012)

government must receive its fair share of revenues, but getting the first project up and running is key and the government may need to assist investors through fiscal incentives, provision of infrastructure and clear planning and regulations to ensure that the first project starts producing revenues as fast as possible. Once this first project is under construction, even before revenues start to flow, expansion projects can always be developed on different terms.

There is no doubt that the government will receive substantial revenues from the LNG projects. The Gas Master Plan for Mozambique estimates that it could earn \$5.2 bn./year by 2026 from LNG⁹⁰. The key issue is one of transparency: in both countries there is a clear wish to use the revenues for the long-term good of the countries, and both governments are considering the establishment of sovereign wealth funds. Statements from politicians also refer to how windfall revenues from energy exports in other countries, specifically Nigeria, have not been fully transparent. Both the Mozambique and Tanzania governments will face challenges similar to other newly developing countries – financing, corruption and participation by inefficient and under-capitalised local partners⁹¹. These challenges are ones that the governments must respond to in an open and transparent manner.

The global LNG market is entering a period of intense competition as buyers, especially in Asia, seek to secure new LNG supplies from 2018-20. Analysis in this paper shows that the cost of supply from each of the primary competing suppliers (USA, Australia and East Africa) is similar. Other LNG supply projects, existing and new, will also be keen to secure development of their projects. East African LNG projects will therefore have to be nimble in their marketing, offering some price and contractual flexibility in order to secure the necessary long-term buyers. LNG projects must also be selective on who buys the LNG, selling to those who can assist in securing finance to underpin project development, both through accessing ECA (Export Credit Agencies) funds but also selling to high credit-rated buyers. In order to achieve this, the Mozambique and Tanzanian government must actively support all the LNG marketing efforts. International project partners must also help the government fund its share of the project cost without, if possible, letting it sell down too much equity. Within these constraints, it is very likely that Mozambique will start LNG exports by 2019/2020, unlikely before. Tanzania, will follow with its LNG exports starting 2021/2 at the earliest, unless substantial new reserves are found during 2013. Following development of the first project, others will move forward rapidly, but it is unlikely that, as envisaged in the Mozambique Gas Master Plan, ten LNG plants will be in operation by 2028. That said, one could reasonably expect Mozambique to be exporting 30-40 mtpa by 2028, which would represent 8-10% of global LNG supply.

In monitoring progress in East Africa, critical milestones to watch out for include:

- Finalization of the regulatory regimes setting out the taxation and revenue sharing terms. Taxation must be transparent; otherwise it will add additional uncertainty.
- Agreements for land and regional revenue-sharing arrangements.
- Award of FEED and construction contracts.
- Signing of binding LNG sales agreements.
- Development of a financing package.

⁹⁰ www.newsbase.com, Global LNG Monitor, 13/9/12 Ibid

⁹¹ Fruhauf (2012)

This region, with its huge gas potential will become a major player in the LNG business, but before it gets there it has to face up to many challenges and internal politics. Transparency with no perceived corruption, clear regulation and decision making from governments is vital to the prompt development of the gas resource and LNG export projects. The world of global LNG is ever changing and Mozambique, and later Tanzania, will form a part of it - the question is when and by how much.

Glossary

BCM	Billion cubic metres
BCMA	Billion cubic metres per annum
Billion (or bn.)	1,000,000,000
Dry Gas	Dry gas means that there are no, or limited, Natural Gas Liquids (NGLs), (see below), in the gas.
Export Credit Agency (ECA)	Export Credit Agencies are government-funded bodies who advance funds and provide risk cover in return for selling their country's goods and services (e.g. US Exim, Japan Exim, SACE, Italy).
Farm in	A farm-in is where the new entrant earns an interest in an exploration block in exchange for paying a disproportionate share of an incumbent's share of future expenditure, agreed through negotiation.
FEED	Front end engineering and design
Final Investment Date (FID)	The date on which the project sponsors decide to make a binding financial decision to proceed with the project. Usually the key agreements related to the project are signed on this date (e.g. plant construction, gas purchase, LNG sales and financing agreements) Also known as FID date.
GDP	Gross Domestic Product
Gas to Liquids (GTL)	GTL - Gas to liquids is a refinery process to convert natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons such as gasoline or diesel fuel. Methane-rich gases are converted into liquid fuels either via direct conversion or via syngas as an intermediate.
LNG	Liquefied Natural Gas is gas cooled to minus 161 degrees centigrade.
Mmscf	Million standard cubic feet of gas
mtpa	Million tonnes per annum (of LNG)
Natural Gas Liquids (NGLs)	The heavier hydrocarbons found in natural gas production streams, normally extracted for disposal as separate income streams. Ethane, propane and butane may be left in the gas to enrich the Calorific Value, within contractual quality limits. It is normally a commercial decision whether to extract liquids or not with the heavier fractions, which are liquids at normal temperatures and pressures, being removed prior to or as part of the liquefaction process. The terms Natural Gas Liquids and Condensates are in practice used virtually interchangeably. Rather confusingly, there is no agreement on whether the term NGLs includes or excludes LPGs and both usages are current.
Project Financed	Financed using third party debt
Proven/Recoverable Gas Reserves	The amount of gas underground that can be commercially recovered is quantified in trillion cubic feet (Tcf) or billion cubic metres (BCM). The amount of gas that can be commercially recovered is normally defined probabilistically. Proven reserves are normally defined as having a 90% probability of being in place.
PSA/PSC	Production Sharing Agreement/Production Sharing Contract
Tcf	Trillion cubic feet (of gas) 1 Tcf of gas is equivalent to 28.3 Bcm of gas
TPDC	Tanzania Petroleum Development Corporation
Unitization	Unitization is an arrangement to jointly develop a gas field straddling two or more different contract areas. Governments may require companies to unitize, either by incentives or by regulatory instruments. If a single oil or gas reservoir straddles the boundaries of two or more areas in respect of which different contracts or authorizations exist, unitization is an agreement to develop and produce the gas as a single unit. This means that instead of the holders or group of companies holding the respective rights or contracts engaging in competitive drilling, their activities are integrated. Unitization is

	the legal framework for such an integrated development and reduces production costs by avoiding duplicity of infrastructure (Source: Unitization of Contract Areas, Anozie Ikechukwu Awambu, University of Dundee).
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