Natural Gas Master Plan for Mozambique

Draft Report Executive Summary

August 26, 2012

Submitted to:
Government of Mozambique Steering Committee

Submitted by:
ICF International
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This work has been funded by the Petroleum Governance Initiative (PGI) and the Public-Private Infrastructure Advisory Facility (PPIAF) The Petroleum Governance Initiative (PGI) is a bilateral collaboration between the Government of Norway and the World Bank. Its aim is to achieve cooperation on petroleum governance issues and to support to developing countries in the implementation of appropriate petroleum governance frameworks, including resource and revenue management and linkages to environmental and community issues. The Public-Private Infrastructure Advisory Facility (PPIAF) is a multi-donor technical assistance facility aimed at helping developing countries improve the quality of their infrastructure through private sector involvement. For more information on the facility please see: www.ppiaf.org.

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1. Introduction

"GMP will not be a complete technical plan for gas sector development, rather, it will provide a detailed roadmap for strategic, policy and institutional decisions upon which investments can be designed and implemented in a fully coordinated manner." World Bank, Scope of Work

In developing our proposed Gas Master Plan (GMP), ICF has been mindful of the fundamental realities of the Mozambican economy and energy sector. Mozambique is a poor country, with limited infrastructure and a large unskilled workforce and which, nevertheless, appears to be on the verge of becoming a major world player in the natural gas and coal markets due to the significant discoveries of these resources in the country. Lacking the internal capabilities to exploit these resources or an internal market for natural gas, the country continues to rely on outside developers to explore and produce coal and gas for export.

In 2010 -2011 Anadarko Petroleum and ENI (the international oil companies or IOCs) announced discoveries of between 33 and 38 Tcf of recoverable natural gas in Mozambique's Rovuma basin offshore of the northern province of Cabo Delgado. Recent exploration has suggested that upwards of 100 Tcf of recoverable natural gas may be in the basin. Two other companies, Statoil of Norway and Petronas, Malaysia's national oil company, hold leases to the south of those of Anadarko and ENI and expect to begin exploratory drilling soon. The Anadarko/ENI discoveries have taken place under exploration and production concession contracts (EPCC) signed in 2006 between the IOCs and the Government of Mozambique (GoM). With these discoveries confirming the presence of commercial quantities of natural gas, the next step in their development is finalizing a Project Agreement between the GoM and the IOCs that will govern the development and operation of LNG liquefaction and export terminal facilities. These negotiations are about to commence with the expectation that production could begin by 2018.

These discoveries follow earlier finds by Sasol in the Pande and Temane fields of Inhambane province in the early 2000s.[1] Production began in 2004 after construction of an 865 km 26 inch pipeline between Temane and Secunda, South Africa. Raw gas is processed through the Central Processing Facility (CPF) in Temane with a capacity of 120 million GJ per year. The pipeline, Republic of Mozambique Pipeline Company (ROMPOC), has a capacity of about 147 million GJ per year (about 400,000 GJ/day). A small distribution network was developed in Inhambane province, providing gas supply to several localities totaling less than 200,000 GJ per year (about 550 GJ per day). In 2010, production from Pande Temane was 125 million GJ, of which 118 million GJ were exported.

The Rovuma gas development is not the only major development of Mozambique natural resources aimed at world export markets. In the last 10 years mining companies have identified large, world-class

[1] A potential third gas resource has recently been identified around Tete as coal bed methane. The extent of these reserves is unknown; however, it is believed that they are potentially of commercial size and production potential.

coal deposits the Moatize Basin that have attracted major investment, where about 112 coal licenses have been issued to 45 national and international companies for the Tete province. Exports of coal have begun from Beira. The United States Geological Survey expects total exports to reach 40 million tonnes (MT) per year by 2015 and long term estimates are in the range of 100 MT per year.

While these gas discoveries are an additional economic windfall for Mozambique, they present serious challenges to the GoM in the broader political economy. These challenges lay in how to encourage development of the resources in a way that brings the greatest benefit to Mozambique. On the one hand, promoting the development of export-centered LNG projects will greatly add to government revenues through monetization of royalties and Mozambique's share of profits. This is revenue that Mozambique can use internally for development. On the other hand, 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.

ICF proceeded under the Scope of Work through the following steps to evaluate alternative development options.

- Estimate the gas supply and production costs over 20 years
- Identify key markets for natural gas, based in part on applications submitted to ENH and GoM for gas supply. These industries include methanol, gas to liquids (GTL), fertilizer, power generation, cement, iron and steel.
    - For each industry estimate the price of the output in the world market, the cost of production and the resulting netback value of gas
    - Assess the market situation for each industry and the likelihood of ongoing, viable industrial development based on market outlook
- Develop a model to evaluate alternative development options. The model takes the production supply curves, and develops optimal resource development scenarios.
    - Generate alternative development scenarios for the various markets for gas (above) that include different plants located in different regions. The model allocates gas and infrastructure to support the plants.
    - Calculate employment
    - Identify multiplier effects
    - Identify environmental and non-monetary effects
    - Develop the model to turn over to GoM and train GoM personnel
- Evaluate financing and fiscal issues related to gas development.
- Assess how other countries have used gas to promote local development and address "resource curse" issues.
- Develop a Gas Master Plan, taking into account the development scenarios, financial and fiscal issues, socioeconomic and environmental effects and experiences in other countries.

The analysis and recommendations developed in this report are preliminary and the recommended elements of a GMP ICF has developed should best be considered a "work-in-progress" due to changes taking place in Mozambique that are rapid and far reaching such that any plan must be adjustable to reflect new developments. World gas markets are evolving as are the markets for many of the potential products that could be made in Mozambique from natural gas, e.g., methanol.

Our proposed **Vision Statement** for the GMP follows this theme.

GMP Vision Statement

Develop natural gas resources in a manner that maximizes benefits to Mozambique society by supporting --

- ***growth in domestic public and private sector institutional competencies;***
- ***growth in domestic industry and businesses, especially small and medium scale industries;***
- ***increased employment across the country, especially in the less-developed provinces;***
- ***infrastructure to support expanded economic activities, especially in less-developed provinces; and***
- ***expanded access to training and education***

in order to improve the quality of life for the people of Mozambique, while minimizing adverse social and environmental impacts.

2. Gas Supply Outlook

As the first step in developing a GMP, ICF was tasked with developing a gas supply outlook for Mozambique. A major uncertainty facing GoM in developing future plans for natural gas is the size and economics of the gas resource base. Only so much can be gleaned from geologic information; real data on the size of the resources and the cost to produce depend on drilling and the information developed from exploration wells.

ICF's assessment of Mozambique's conventional oil and gas resources for the purposes of modeling and forecasting uses in-house economic models that use a field size distribution for each ICF region, and assumptions about hydrocarbon makeup including percentage of oil fields *versus* gas fields and various hydrocarbon ratios. The field size distributions reflect our understanding of geologic potential for each area, and reflect the size distribution of what has been discovered to date. We analyzed the potential in seven regions as shown in ES 2-1. Exhibit ES 2-2 presents our estimate of the discovered and undiscovered resources.

Exhibit ES 2-1. Map of ICF Supply Regions

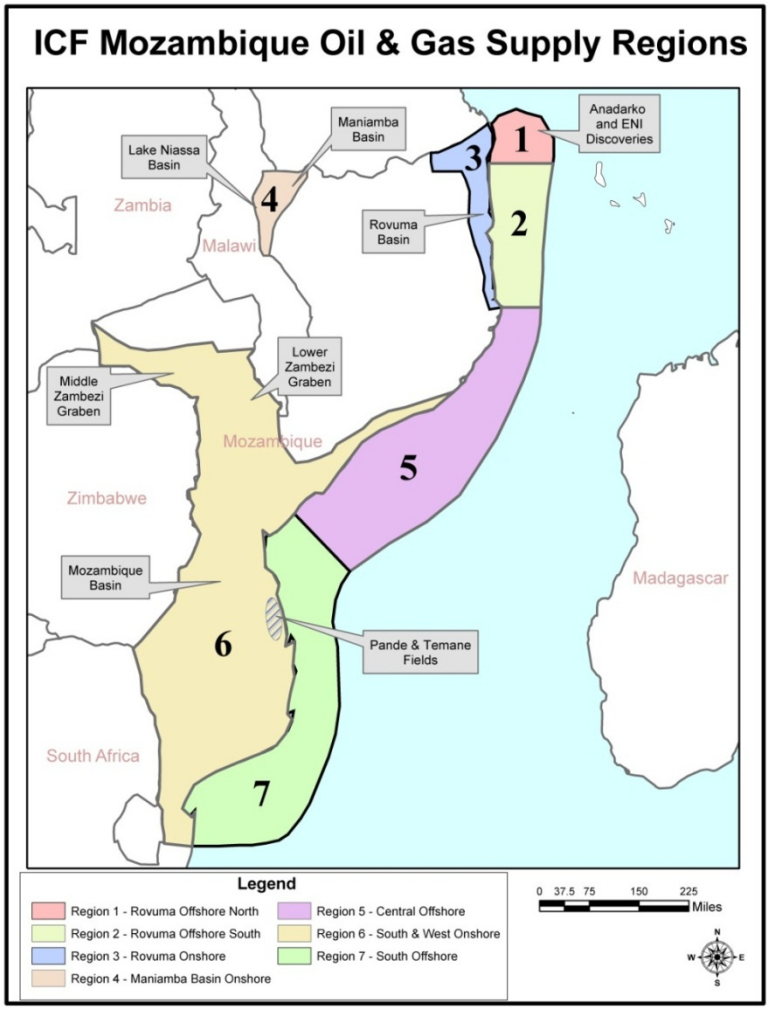


Exhibit ES-2-2. Summary of ICF Analysis of Discovered and Undiscovered Conventional New Field Resources

Resources								
		Total	Total	3P	3P		Undis-	Undis-
ICF		Assessed	Assessed	Discovered	Discovered		covered	covered
Region no	Region Name	MMBOE	TCFE	MMBOE	TCFE		MMBOE	TCFE
1	Rovuma offshore north	33,237	199.4	20,736	124.4		12,501	75.0
2	Rovuma offshore south	5,997	36.0	0	0.0		5,997	36.0
3	Rovuma onshore	524	3.1	0	0.0		524	3.1
4	Maniamba Basin onshore	203	1.2	0	0.0		203	1.2
5	Central offshore	2,988	17.9	0	0.0		2,988	17.9
6	South and west onshore	1,530	9.2	576	3.5		954	5.7
7	South offshore	2,175	13.1	0	0.0		2,175	13.1
Total		46,655	279.9	21,312	127.9		25,343	152.1

Largest Fields - Total and Undiscovered					
				Largest	Largest
		Largest	Largest	Undiscovered	Undiscovered
ICF		Field	Field	Field	Field
Region no	Region Name	MMBOE	TCFE	MMBOE	TCFE
1	Rovuma offshore north	12,288	73.7	6,144	36.9
2	Rovuma offshore south	3,072	18.4	3,072	18.4
3	Rovuma onshore	384	2.3	384	2.3
4	Maniamba Basin onshore	192	1.2	192	1.2
5	Central offshore	1,536	9.2	1,536	9.2
6	South and west onshore	384	2.3	192	1.2
7	South offshore	1,536	9.2	1,536	9.2

Source: ICF

An important aspect of resource assessment is a characterization of the field size distribution of the gas resource base. Exhibit ES2-3 shows ICF's estimate of the field size distribution graphically. This graph illustrates an important point about the gas potential of Mozambique: even though some of the largest fields are assumed to have been already found, the remaining resource base is substantial.

ICF used field distributions and our own upstream gas/oil production cost model to estimate the cost of supply curve for gas production in Mozambique. ICF has evaluated eight existing fields for development costs using the discounted cash flow model. These fields include Pande and Temane (combined 3.0 Tcf), which are the only ones producing, and also Inhassoro (0.4 Tcf), Prosperidad/Mamba (48 Tcf), Golfino/Atum (20 Tcf), Coral (5.1 Tcf), Tubaro (1.5 Tcf), and Njika (1.0 Tcf). ICF analysis indicates that these fields represent approximately 79 Tcf of 3P reserves. Two additional fields, Buzi and Ironclad, have not been evaluated due to lack of production or reserves information.

Exhibit ES-2-3 presents ICF's estimates of the costs of producing from existing fields. This table shows two sets of costs where "Minimum Resource Cost"counts only money that has yet to be spent represents the very lowest price at which a resource could be brought to market assuming that the government would be willing to accept zero revenues from the resource development. The Minimum Resource Cost is used in our construction of the supply curve going into the forecasting model and no resources are allowed to be costs and the prevailing contractual arrangement in Mozambique's oil and gas industry – the Exploration and Production Concession Contract (EPCC). Referred to as the "Resource Cost under EPCC Terms" in this report, it includes all costs allowed under the EPCC, including past exploration costs and government take (production taxes, profit gas shares, income taxes) as specified in the EPCC terms. This can be thought of as the lowest selling price that would be acceptable to the concessionaire and the government under existing terms and expectations. These costs represent wellhead values and do not include undersea gathering pipelines or processing. These are estimated to add an additional $0.75/MMBtu to costs (both EPCC and Minimum Resource).

Exhibit ES 2-3. ICF's Production, Reserve and Resource Cost Estimations for Existing Fields (costs and production over 45 years)

Name	Recov. Gas (bcf)	Recov. Gas (bcm)	Total Exploration and Development Capital Costs (million dollars)	Total O&M Costs (million dollars)	Total Capital and O&M Costs (million dollars)	Production over 45 years (MMBOE)	Total Capital and Operating Costs per BOE of Production	Resource Cost under EPCC Terms ($/BOE, $/MMBtu)	Minimum Resource Cost ($/BOE, $/MMBtu)
Pande	3,660	104	350	541	892	740	$1.21	$2.23 ($0.38)	$1.87 ($0.32)
Temane	830	24	56	67	123	104	$1.18	$1.51 ($0.26)	$1.28 ($0.22)
Inhassoro	400	11	131	89	220	90	$2.45	$5.32 ($0.92)	$4.31 ($0.74)
Njika	1,000	28	1,055	496	1,551	181	$8.55	$33.06 ($5.70)	$23.77 ($4.10)
Prosperidade / Mamba	48,000	1359	12,468	9,813	22,281	8,651	$2.58	$9.93 ($1.71)	$6.82 ($1.18)
Golfhino / Atum	20,000	566	6,600	4,451	11,052	3,605	$3.07	$12.25 ($2.00)	$8.86 ($1.45)
Tubarao	1,500	42	1,595	538	2,133	271	$7.88	$37.38 ($6.44)	$25.57 ($4.41)
Coral	5,100	144	3,064	1,412	4,476	919	$4.87	$21.84 ($3.77)	$15.32 ($2.50)

**For per unit costs (the last three columns), the figures in parentheses are the equivalent costs per MMBtu.*

The results of this analysis are used in the development scenarios to estimate the infrastructure needs to produce natural gas under the different sets of assumptions.

3. Market Opportunities and Netback Analysis

The market for natural gas in Mozambique can be divided into two broad sectors. Understanding these sectors is important for how gas use and infrastructure can develop.

The first sector is made up of the large gas-based industrial users where gas is a major feedstock or the manufacturing process uses gas for large amounts of process heat. Feedstock industries include the production of fertilizer (urea), methanol, and gas-to-liquids. Process heat uses include power generation, aluminum smelting, steel production, petrochemicals, refining. Because these industries use large volumes of natural gas they provide "anchor" loads or markets for gas producers and pipelines. Because gas and energy use is a major factor in their costs, these industries tend to locate near sources of energy (gas). Developers of these kinds of projects have applied to the GoM to receive gas from Rovuma and elsewhere.

The second sector is broadly described as small and medium enterprises (SMEs), small industrial and commercial uses of natural gas for process heat. SMEs will use natural gas *if it is available* at a price competitive with their alternative fuel. These users include facilities that use gas for heating, drying, cooking and other activities and natural gas for transportation – buses, trucks, and automobiles. These facilities' gas use is small and dispersed. Plant location decisions are influenced more by factors other than gas supply, such as market access for their products, where most of their markets are local or regional, labor supply, and access to other raw material inputs. These small scale industries tend to be found in more urban areas. We also refer to these kinds of customers and uses as "opportunistic" loads or markets because they will use gas if it is available.[2]

The basic economics of pipelines and gas infrastructure require that they are constructed to serve the "anchor" loads. Planners often route pipelines in such a way as to make them accessible to clusters of smaller facilities that can eventually tap into the pipeline and thus grow the gas market along the pipeline route. ICF's market analysis has focused on the anchor.

Anchor Market Analysis

The anchor markets are those industries that have been characterized in Mozambique as "mega-projects" and which would manufacture value added products in Mozambique that for the most part would be exported but with some use in Mozambique. Exhibit ES-3-1 presents the list of applications for natural gas supply filed by project developers to ENH. As indicated by this table, the demand for natural gas is quite high at over 2.4 Bcf per day, or the equivalent of a little over three LNG liquefaction

[2] In India, city gas distribution (CGD) is an opportunistic load since there is little domestic demand for gas and CGD systems are developed only when a pipeline passes near a city on its way to a large anchor load. Again, MGC is a prime example of a CGD that gradually is extending its facilities to serve more small factories and domestic uses.

trains. With two exceptions all of the requested projects would be in Palma, near the source of Rovuma gas.

Exhibit ES-3-1: Industry Requests for Gas Supply

PROJECT	Country.	Place of Project	Quantity (MMcf/d)	Quantity (Bcf/year)	Gas Price ($/MMBtu)	Project Duration (Yrs)
GTL	South Africa	Palma	285	93.6	5.00	25
Methanol	Japan	Palma	77	25.3	4.07	20
Methanol	India	Palma	129	42.4	1.00	30
Methanol	Germany	Palma	1,425	468.1	2.00	25
Methanol	Japan	Palma	NA	NA	NA	NA
Methanol	S. Korea	Palma	NA	NA	NA	NA
Fertilizer	Norway	Palma	77	25.3	1.00	25
Fertilizer	Japan	Beira	33	10.8	3.16	20
Fertilizer	Germany	Palma	88	28.9	1.51	20
Electricity	Various	Palma	167	54.9	4.00	30
LPG	South Africa	Palma	NA	0	3.50	20
Pipeline	Mozambique	Mozambique	129	42.4	2.00	25
Total			2,410	791.7		

NA: Not Available

The market analysis has proceeded along two tracks as required by the Scope of Work. First, ICF analyzed the export potential based on world and regional supply demand balances along with a determination of the economic feasibility of the projects based on world commodity prices. In our analysis of these industries ICF has assumed that they will be selling into a global market, where they will be price takers for all that they produce. We therefore have not forecast demand for the various products; rather we have investigated risk associated with these industries.

Second, we also developed a netback analysis from the world market prices, in order 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. Any price of gas above the netback price would render a proposed project uneconomic; a price of gas below the netback price would improve their economics, all else being equal. 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.

The netback analysis is based on world commodity price forecasts shown in exhibit ES-3-2. The first is the International Energy Agency (IEA) 2011 World Energy Outlook (WEO) which has a higher gas price forecast, and the second is a low price forecast is the January 2011 Commodity Price Forecast Update published by the World Bank (WB).

Exhibit ES-3-2. Gas and Commodity Price Forecasts (2011$)

Commodity	Units	2012	2015	2020	2025	2030	2035
Low Price Trajectory (World Bank)							
Coal, Australian	$/mt	102.2	74.9	79.6	81.4	83.2	85.1
Crude oil, av., spot	$/bbl	102.9	96.9	87.7	80.0	73.1	66.7
LNG, Japanese	$/mmbtu	15.7	12.8	11.6	10.0	8.6	7.4
Urea	$/mt	419.2	336.8	311.0	275.4	243.8	215.9
Methanol	$/mt	514.3	494.0	462.8	437.1	413.6	392.1
Diesel	$/bbl	136.1	127.7	114.8	104.2	94.5	85.6
Gasoline	$/bbl	118.7	113.1	104.6	97.6	91.2	85.3
High Price Trajectory (IEA)							
Coal, OECD	$/mt	110.3	113.9	118.7	122.8	126.2	131.3
Crude oil, avg, spot	$/bbl	96.2	115.7	128.6	138.6	146.4	152.4
LNG, Japanese	$/mmbtu	12.7	13.8	14.7	15.5	16.1	16.8
Urea	$/mt	388.7	458.1	503.7	539.3	567.2	588.5
Methanol	$/mt	491.6	557.6	601.0	634.9	661.3	681.6
Diesel	$/bbl	115.8	140.9	157.3	170.2	180.2	187.9
Gasoline	$/bbl	112.5	130.5	142.3	151.6	158.8	164.3

The market prices shown above are reference market prices for the commodities priced in their reference market locations – Japan for LNG, Australia for coal, the Baltic for urea, Shanghai for methanol, etc. To reach a value in Mozambique, ICF estimated the shipping costs to the relevant pricing point to yield an f.o.b. price in Mozambique. ICF then estimated the cost of producing the commodity in Mozambique based on representative capital costs, O&M costs, feedstock costs, and cost of any other input associated with producing the product. ICF also made a number of financial assumptions regarding debt/equity ratios, cost of debt, tax rates, etc.

ICF calculated a levelized cost of producing these commodities over a 20 year period. We then calculated the maximum cost of gas into the plants that produce these commodities and meet the minimum investment criteria we used for our analysis. The resulting netback values under the low and high commodity forecasts are shown in Exhibit ES-3-3

Exhibit ES-3-3. Netback Value of Gas in Each Commodity Market

Facility	Gas Use	Higher Netback Value (IEA WEO 2011) ($/MMbtu)	Lower Netback Value (World Bank) ($/MMbtu)
LNG	340	11.5	6.1
GTL	311	9.9	3.1
Power Plant (150MW)	9.5	9.0	9.0
Methanol	18	7.9	3.0
Urea	11	11.7	0.9

The implications of this analysis are that most of the project proponents that have approached EnH can potentially pay more than they have stated they are willing to pay. However, their viability is very dependent on world commodity prices. Furthermore, the reasonable price of gas to these anchor

projects can be between the cost of gas at the outlet of the processing plant, and the value of gas into the LNG liquefaction flange (as determined by a netback from the LNG market). However, the important determinant will be the delivered price (inclusive of transportation), whether in Palma, or points farther south.

The major risks faced by the anchor industries are summarized briefly below. A common theme across these markets is the overall exposure to world oil prices and the large capital investments required.

- LNG prices are tied to world oil prices, particularly in the Pacific Basin and hence are susceptible to some long term price risk. Major markets are Japan, Taiwan, Korea, China, and potentially India. Besides exposure to the economies of these countries, the major risk may be in additional supplies of LNG from Australia, other African countries and the Middle East. In addition, major shale gas finds are being exploited in China and potential exists for shale gas development in India and South Africa.
- Methanol's primary use is as a feedstock to a number of industrial chemicals, and China would be a major market for methanol production in Mozambique. The major risk associated with methanol is the current over capacity of methanol production, which nevertheless is being worked off. Methanol plants tend to be large and therefore when a new plant comes into operation, prices drop as a consequence of the additional capacity.
- Fertilizer (urea) production continues to grow worldwide with increasing demand led by population growth and increasing agricultural production. There are about 58 new fertilizer plants expected to come into operation in the next 3 years. Some countries like India and China require a measure of self-sufficiency in fertilizer production and subsidize fertilizer plants; however, both are net importers. Major risks are in near term over capacity, competition from low cost Middle east producers, and price pressures. Still, the local and regional markets for fertilizer would make production attractive for Mozambique, and help them reduce or eliminate ongoing imports.
- GTLs demand is dictated by demand for crude oil and oil products and their prices. Present demand is strong in Europe, where GTLs can displace higher cost diesel, gasoline, jet fuel. Major uncertainties are world oil prices, growth in global demand for diesel; and GTL plant expansion plans in Qatar, South Africa, and Canada. GTL plants tend to be large scale, although Sasol indicates smaller plants could be profitably operated in Mozambique. GTLs production in Mozambique could displace imports and open up regional African markets for transportation fuel.
- Power generation gas requirements are driven by local and regional power demand, the transmission network, and competing sources of power (hydro, coal, wind, renewables, energy efficiency). Power plants of 150 to 200 MW would be used for local markets and voltage support for the grid. Larger power plants would sell into the Southern Africa Power Pool (SAPP). The Southern Africa region as a whole is entering a period of generation capacity shortage. Demand for electricity has been growing at about 2.8% annually since 1998.

- Steel and Aluminum manufacturing have a history in Mozambique. With the single Mozal plant, Mozambique is the second largest producer in Africa; and there is a shuttered steel mill in the country owned by ArcelorMittal of South Africa. Aluminum demand continues to grow, but major plants are being constructed in the Middle East. Steel production looks more promising given the growing demand in Mozambique and Africa generally and Mozambque's reserves of coal and access to iron; however, the potential for gas use in this sector appears to be very low.
- Cement production is for local use and depends on growth rates in Mozambique and the region. Gas use in cement is low.

In the exhibit below, ICF presents a comparison of the mega-project industries using the modeling framework developed for this engagement. The comparison is for a standard sized facility for each industry except steel and cement where we have determined that the gas use would be very low.

Exhibit 3-4 Model Results Comparison of Mega Project Industries

	Fertilizer	GTL	LNG	Methanol	Aluminum w/ Power	Power 150 MW	Power 250 MW
D&I Labor (av. annual)	500	6,100	4,200	750	1,400	80	140
Induced Employment (long term av. annual)	9,400	56,900	71,400	11,700	19,000	1,400	2,400
Value added ($million)	200	4,580	6,520	460	970	0.20	0.34
Government revenues (av. annual $million)	180	860	1,040	220	300	150	150

The estimates presented in Exhibit 3-4 are based on assumptions regarding the share of mega-project expenditures in Mozambique, the labor productivity in those sectors stimulated by domestic expenditures, the corporate income tax rate that these projects would pay (16%) and the estimates cover a 24 year period (2012-2035) that includes project construction (with higher peaks of direct and indirect labor use) and project operations (with considerably lower use of labor). Although the absolute values would vary considerably with changes in those assumptions, they provide some insights into the relative benefits of different mega-projects:

- LNG and GTL plants provide greater value added, potential for job creation and government revenue than other mega-projects considered.
- Corporate income taxes, even at a reduced rate, can generate a substantial contribution to government revenues

- When direct and indirect job opportunities are considered, the assets differ little in the skill set of the labor force that would be typically demanded (not shows in Exhibit 3-4): around 24%-31% managerial or professional labor, 37%-40% technical labor and 29% to 35% general labor (less than high-school and no technical training)

Small and Medium Enterprises (SME)

Small and medium enterprises include industrial and commercial gas use, mainly for process heat. From the standpoint of natural gas consumption, SMEs would constitute a small portion of the market. However from a national development standpoint, the extent to which gas is made available to SMEs, and can displace higher cost imported oil, this would benefit them and encourage additional development, employment, and national income.

The model for the SME gas market growth in Mozambique is the MGC pipeline and described above. MGC provides gas to SMEs in the following industries: milling and baking, soap, food processing, cooking oil refining, pharmaceuticals, soft drinks and light industrial. Most of these industries pre-existed the MGC pipeline and switched to natural gas from heavy fuel oil or diesel oil. On the MGC pipeline, these uses account for less than 10 percent of pipeline throughput.

The challenge with estimating SME usage is that there is little data on commercial and small industrial energy use in the country and especially in the provinces. ICF has not developed a forecast and in our recommendations for additional studies, we propose that a detailed review of SMEs be undertaken. We also recommend that any pipelines that are constructed should be routed near cities in order to provide an opportunity for expansion of distribution systems, including service to SMEs and residential consumers eventually.

4. Development Scenarios

ICF has developed a Mozambique Gas Planning Model (MGPM) that was used to evaluate different development scenarios. The MGPM is a linear programing model in Excel that provides an integrated assessment of the oil and gas field development activities (i.e., the supply outlook) combined with downstream transportation, processing, and transformation include liquefaction, power generation, domestic uses, and energy and feedstock uses in the industrial sector (i.e., demand outlook). The model user can develop multiple scenarios by providing alternative specifications for the development of downstream assets over time. The model then uses these specifications as input and determines the optimal development of the oil and natural gas fields and dispatch of the downstream assets to maximize the net value to Mozambique.

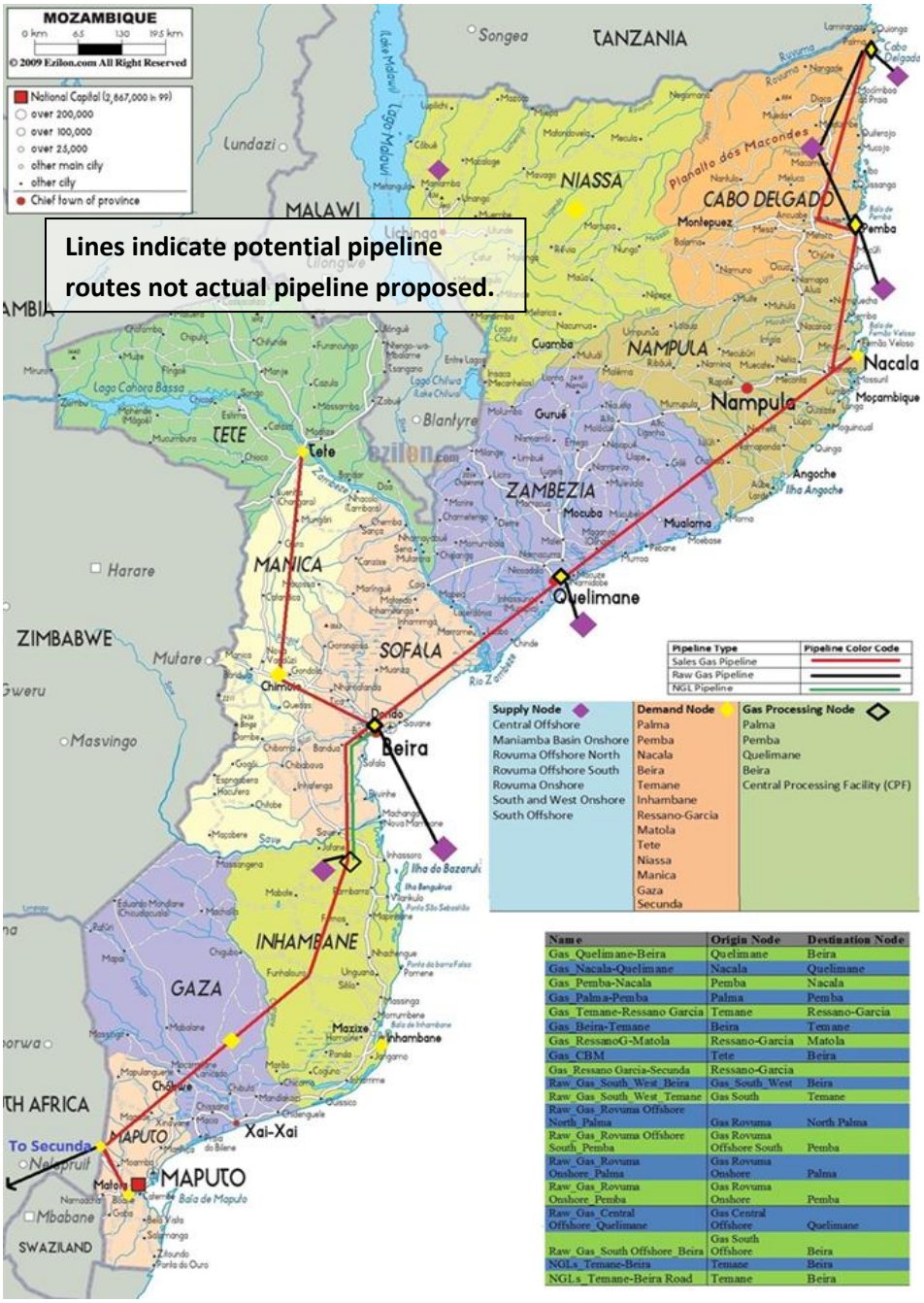
The MGPM consists of four main elements: Oil and Gas Field Development (upstream), Gas Processing, Transportation, and Industrial Assets. The supply-side analysis includes the resource base, production costs, and volume of gas available for production. Various transportations options, including pipelines,

LNG and CNG barges and trucks are represented. Different industrial options were developed based on the market analysis and assumptions discussed above, and price options based on the two market price trends for various commodities were included in the model. The model determines the optimum production, gas processing and transportation options, and the dispatch of the various industries selected by the user, by maximizing the overall net value to Mozambique.

Exhibit ES 4-1 below shows the various potential demand nodes, transportation options, gas processing nodes, and supply nodes for the model. Natural gas pipelines are shown in red while NGL pipelines are shown in green. The pipelines connect the major supply nodes with the major demand nodes. Supply nodes are denoted by purple diamonds while demand nodes are denoted by yellow diamonds. It is important to recognize that the model does not use of develop all of these potential nodes or transport options, but only those required to meet the demands as selected by the user.

The outputs of the model include information on the production of different fields, size of the raw gas pipelines that supply raw gas to gas processing nodes, outputs of the gas processing facilities, optimized size and throughput of pipelines, dispatch of selected industrial assets, price of sales gas and other products, mass balance of key natural gas components, and net value and employment resulting from all of these developments.

Exhibit ES 4-1: MGPM Nodes and Transportation Options



ICF developed a set of metrics for evaluating different model scenarios that employ a combination of quantitative and qualitative measures. These metrics are shown below:

Technical Feasibility

Sound technical and economic proposals

Economic Impact and Value Parameters

Employment – initial and long term
Fiscal impact – increase in government revenues and implications
Value added to the economy – contribution to GDP
Netback value of gas from industry – implied value of gas
Import substitution/regional export potential – improved balance of payments
Support for Growth Pole Strategy
Support for SME development
Timing – sooner the benefits the better

Socio-Political Objectives

Contribution to less developed regions
Contribution to education and other poverty reduction (PARP)
Environmental impacts – mitigate environmental impacts

ICF developed four development scenarios, as described below in Exhibit ES4-2.

Exhibit ES 4-2: Description of Model Cases

Scenario 1. Only LNG in Palma –10 trains, 2 in 2018, 2 more added every 2 years

Scenario 2. Palma Centered Development -- with Rovuma onshore supply and Power, Fertilizer and GTL come online in 2018, 2019 and 2020, respectively in Palma

Scenario 3a. Pemba Centered Development -- same as Option 2 + offshore development in southern Rovuma and 2nd LNG plant with 2 trains in 2020. power, GTL, fertilizer in Pemba, and power in Palma. Pipeline from Palma to Pemba.

Scenario 3b. Nacala Centered Development -- same as Option 3a, but the power, fertilizer, GTL developed in Nacala and power in Palma. A pipeline between Pemba and Nacala is allowed.

Scenario 4. Palma LNG with pipeline to Beira. Same as Option 1, but now fertilizer and GTL plants are built in Beira.

Exhibit ES4-3 presents the scenario modeling results in terms of the evaluation metrics.

Exhibit ES 4-3. Scenario Model Results Quantitative

	Scenario 1 Palma LNG only	Scenario 2 Palma Development	Scenario 3a Pemba Development	Scenario 3b Nacala Development	Scenario 4 Beira Development
D&I labor (av. annual)	19,400	26,400	29,500	31,300	27,700
Peak D&I employment (2019, 2020)	48,800	71,700	94,800	97,100	82,800
Long-term D&I employment (av. 2030-2035)	9,700	11,600	14,000	15,000	12,900
Long-term induced employment (av. 2030-2035)	284,200	343,900	384,100	417,500	347,300
Value added ($billion)	29.1	33.5	40.0	40.0	33.1
Tax revenues ($billion)	8.9	9.5	11.5	11.5	9.5
Royalties (av. annual $million)	549.8	549.8	674.4	674.4	549.8
Profit gas (av. annual $billion)	5.3	5.3	6.4	6.4	5.3
Corporate income taxes (av. annual $billion)	2.5	2.9	3.5	3.5	2.8

The quantitative model proved most useful in providing insights on the potential magnitude of impacts of the scenarios evaluated. Under any scenario, the development of natural gas in Mozambique in the next two to three decades has the potential to double or triple Mozambique's current GDP. However, much of this value added is foreign and would not contribute to the national income.

A considerable share of direct expenditures by the natural gas industry and mega-projects is expected to be made with imported goods and services and quality controls may favor suppliers making use of relatively capital intensive technologies. However, the domestic expenditures made by those employed by the gas industry, mega-projects and their suppliers has the potential to employ around 1% of the current labor force, assuming current Mozambican non-agricultural labor productivity levels (induced employment). The potential for greater employment generation depends on a) the extent to which Mozambique is able to gradually stimulate the domestic supply of goods and services that the natural gas related industry and mega-projects would otherwise import; b) the extent to which forward linkages can be fostered based on the infrastructure set by the natural gas industry and its related mega-

projects; and c) the extent to which the natural gas related government revenues are generated and used to stimulate job creation and use of the domestic labor force.

In addition to royalties and profit gas, corporate income taxes can be an important source of revenue for the Government of Mozambique. Even with a reduced tax rate (16%) we estimate they could be comparable to the total tax revenues currently collected by the Government of Mozambique.

The qualitative considerations are shown in Exhibit Es 4-4. The qualitative analysis was based on the existing literature, GOM documents and meeting with GOM authorities and other stakeholders. More regional output and industry data, for example, would be desirable to better evaluate the geographic distribution of benefits from the various scenarios.

Exhibit ES 4-4 Scenario Model Results Qualitative

	Scenario 1 Palma LNG	Scenario 2 Palma Development	Scenario 3a Pemba Development	Scenario 3b Nacala Development	Scenario 4 Beira Development
Impact on Local Trade	Low (only promotes LNG sales)	Medium (if GTL and urea built)	Medium (if GTL and urea built)	High	High
Support to Growth Pole Strategy	Low	Medium	Medium	High	High
Support to SME Development	Low	Medium	Medium	High	High
Timing	Shortest lead time	Longer lead time	Longer lead time	Longer lead time	Longest Lead Time
Contribution to Less Developed Regions	Low	Medium	Medium	High	High
Contribution to Employment and Poverty Reduction	Low	Medium	Medium	High	High

The scenarios assume different regional settings for the various mega-projects. These different regional settings have social and economic implications, the main distinction being between scenarios 1, 2 and 3a with investments concentrated in Cabo Delgado, and scenarios 3b and 4, with investments extending to more populated areas. These distinctions include the following:

> Because of the larger population and greater business activity around the urban areas of Nacala and Beira, SMEs would be more likely to be able to take advantage of mega-project related infrastructure and low-priced gas.

The geographic area that benefits from regional investments typically depends on trade and commuter patterns, often following existing infrastructure. The greater economic activity in the aeas of Nacala and Beira suggest investments in scenarios 3b and 4 would be more likely to be able to leverage local suppliers, a local labor force and allow a greater share of the benefits to remain in the region.

A share of the labor demanded by natural gas related projects will likely need to in-migrate to the project area from other parts of the country as well as neighboring countries. In-migration would likely include both those employed by natural gas related projects, as well as in-migration from individuals in search of better paying work opportunities, even without a job in hand. This in-migration will likely put pressure on existing housing, land, infrastructure and public services and would tend to contribute to friction between local residents and newcomers. This situation is likely to be more severe under the isolated conditions of Cabo Delgado, than under the already mos populated areas of scenarios 3b and 4.

The main factor determining the benefit of natural gas related investments for poverty reduction is the extent to which they create jobs accessible to Mozambicans. This depends on the number of jobs created and on the match between the skill and training required for those jobs and the skill and training of the Mozambican labor force. The current labor force in Mozambique is ill prepared to take advantage of potential job opportunities.

Environment

Offshore gas exploration interferes with the marine environment and the areas of the Rovuma basin are environmentally sensitive areas with the presence of coral reefs and marine mammals. The drilling of wells typically does have adverse effects on local marine resources and increased navigation interferes with the normal movement of marine life.

Environmental impacts of construction of the various potential mega-projects depend largely on their exact location and proper siting can be key to avoid or minimize adverse impacts. Best practices during construction typically also minimize impacts to soil, water and air resources. Among the mega-projects under consideration, operations of LNG plants require considerable water for cooling and thermal power plants are energy intensive. ICF developed a system to categorize environmental impacts based on extent of geographic impact, duration and intensity of impact. Exhibit ES-4-5 shows characteristics of the proposed assets regarding their potential to impact selected environmental resources.

Exhibit ES 4-5. Impacts of Mega-project on Selected Environmental Resources

	Aluminum w/ Power	Fertilizer	GTL	LNG	Methanol	Power 150 MW	Power 250 MW
Air	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Water	Medium	Medium	Small	Medium	Medium	High	High
Soil	Medium	Small	Small	Small	Small	Small	Small
Noise	Small	Small	Small	Small	Small	Small	Small
Biological Resources	Highly Location Specific	Highly Location Specific	Highly Location Specific	Highly Location Specific	Highly Location Specific	Highly Location Specific	Highly Location Specific

In practice, environmental impacts are all very location dependent. Scenarios 3a, 3b and 4 would all require the construction of a pipeline crossing the Quirimbas National Park. Construction of the pipeline would require clearing and disturbing of land and maintaining a right of way and a construction and management plan would need to incorporate environmental management and monitoring tools to minimize adverse impacts. Under all scenarios, environmental impacts can be managed within acceptable levels provide appropriate planning/siting is done and enforceable environmental management and monitoring systems are developed and implemented.

Key Model Insights

There are at least 150 Tcf of additional undiscovered resources above the 130 Tcf of discovered gas offshore Cabo Delgado and Inhambane. Additional resources will be discovered, as exploration increases. A large amount of the gas can be produced in the Rovuma Basin at a wellhead cost of about $2/MMBtu and an ex-processing cost under $3/MMBTU; enough to satisfy 10 LNG trains and other mega-projects. The amount of gas from GoM's royalty share and profit share vary depending on gas price, project cost, and recovery factor. Our estimate:

Year	LNG Trains	Bcf/day	Bcf/year	Royalty Volume Bcf/year	Profit Volume Bcf/year	
					$4.00	$8.00
2018	2	1.5	548	11	25	25
2020	4	3	1095	22	49	49
2022	6	4.5	1643	33	74	148
2024	8	6	2190	44	99	477
2026	10	7.5	2738	55	329	600

There is sufficient gas in Rovuma North to support 10 trains of LNG and several domestic mega-projects in Cabo Delgado. The amount of gas that would be available as in-kind royalty will be less than the volume of gas requested by the mega-project developers: 790 Bcf/year. If full mega-project development occurs, additional "sales" gas will be needed at a price that makes producers indifferent between selling gas in Mozambique and as LNG. The total value of royalty and profit gas will be substantial depending on world gas prices, cost and cost recovery, and the "R" factor in the underlying EPCC. Our estimate:

Year	Royalty Volume (Bcf/year)	Royalty Value (mill. $/year)		Profit Volume (Bcf/year)		Profit Value (mill. $/year)	
		$4.00	$8.00	$4.00	$8.00	$4.00	$8.00
2018	11	$44	$88	25	25	$99	$197
2020	22	$88	$175	49	49	$197	$394
2022	33	$131	$263	74	148	$296	$1,183
2024	44	$175	$350	99	477	$394	$3,816
2026	55	$219	$438	329	600	$1,315	$4,802

Production of LPG is important for Mozambique, and as such it is important to develop the condensate field at Inhassaro. ICF also believes there is a possibility for LPGs in Palma, depending on how much of the condensates in the gas would be processed (i.e., not retained in the LNG). A fractionation plant there may prove economic at some point.

Mega-projects are necessary to support gas pipelines to make gas more widely available to the country. Their locations and size are critical to pipeline and infrastructure development. All of the mega-project requests for gas (2.4 Bcf/d—equivalent to 3 LNG trains) have been for gas priced below our estimate of their netback values. The major opportunity for small industry and commercial uses of gas is with a pipeline located in or near urban centers.

LNG production is critical for development of offshore fields in Mozambique. LNG has the highest netback value for gas produced in Mozambique but other industries also produce netbacks higher than $3/MMBtu. In order: GTL, electricity, methanol, fertilizer (urea), steel, aluminum. But GTL, methanol, urea are highly sensitive to world energy prices (and capital costs) and can swing to unprofitability when prices fall.

Pipeline transportation of gas within Mozambique is more economical than LNG transportation and regasification. Adding a long pipeline between Palma and Beira, however, is very expensive—making

delivered gas prices too high for the market in Beira. It would be better to develop gas resources that are closer: offshore or CBM in Tete. However, pipelines (where economic) can induce the development of small-scale industries and substitution of other fuels with natural gas. Nacala and Beira have greater potential than Palma and Pemba to foster backward and forward linkages to mega-projects, given the existing infrastructure and proximity to developing growth corridors.

5. Financing and Fiscal Issues

ICF proposes a policy framework for funding development in Mozambique. The framework consists of two broad steps. First, segment the challenge into three distinct areas, to segregate and direct financing appropriately. Second, ensure that key elements of the investment framework and business climate are in place and will be maintained in a transparent, stable and enduring fashion.

Segmenting the Financial Challenge

Turning to the first step, the ***Primary Segment*** of development and financing is that necessary for the proposed LNG development (exploration, production, processing, liquefaction, export). Both Anadarko and ENI have informally confirmed that they will finance the primary segment out of their own (internal and/or external) resources.

The ***Secondary Segment*** refers to the need to develop both a gas transportation infrastructure and large mega-projects to serve as drivers of development and anchor customers for the transportation infrastructure. Transport infrastructure requires financing that could involve elements of public (i.e. state-based) ownership and funding, purely private ownership and funding, or some combination of Public-Private Partnership (PPP), as provided for in Mozambique's new PPP Law of 2010. Mega-projects will probably be self-financing in the same fashion that IOCs will finance the Primary Segment.

The **Tertiary Segment** includes distribution infrastructure, installations and appliances which will be needed for the gas to reach and be used a number of smaller local gas users like SMEs, public facilities, eventually residences. Financing for these uses will involve local financing entities: local Government budgets for public facilities; by local commercial banks for smaller industrial and commercial users; and by micro-credit institutions for the very smallest users who may need to finance gas-using appliances and equipment.

Securing the Investment Environment

The second framework step is to identify those key elements of the investment environment and business climate that are necessary to encourage general investment in the Mozambique economy and that are in place and are maintained in a transparent, stable and enduring fashion. Since the development of its gas resources will involve very large investments with gestation periods stretching for decades, it is vital that this climate be sustained and improved upon where needed. The critical factors in this will be:

- Sound, stable *macro-economic management*, to give investors confidence that their earnings will not be inflated away, denuded by exchange rate instability or confiscated by unexpected new taxes;
- *Investment in infrastructure* to enable the delivery of suitable services to investment projects;
- *A legal and regulatory framework* governing gas development, that gives investors the fiduciary security they need;
- *Markets for the gas*, such that the large capital outlays to be made in developing the gas will find a sufficient scale of demand for the gas to make the investment worthwhile (markets were addressed above);
- *Gas pricing structures* that will enable investors to secure an acceptable yield on their investments, given the risks involved; and
- *A banking and financial sector* that will enable the required local investments to be made as the Mozambique economy continues to grow.

*Macro-economic Management***.** Since 1992 the GoM has managed to achieve a highly creditable economic performance. The country remains in good standing with the IMF, it is subject to Policy Support Instrument (PSI) reviews and agreements and is now on a 24-month (as against 12-month) Article IV consultation cycle with the Fund.

At present Mozambique enjoys an investment rate of around 22% of GDP (12% public, 10% private sector)[3], which is above the average of a number of similar African countries. The World Bank expects and this investment rate to rise, led by an increase in private sector. Foreign direct investment totaled US$890 million in 2009 and increased to US$1 billion in 2010 (i.e. around 7% of GDP). However, the Bank also points to the need for Mozambique to obtain non-concessionary financing if it is to sustain these increased investment rates.

Infrastructure in Investment. This relates to the overall business "climate" for securing investments needed for infrastructure to support natural gas and other resource developments. Investors aiming to participate in the Secondary and Tertiary segments may be deterred by questions whether the GoM is committed to implementing policies that can support private sector. Part of the problem is that Mozambique needs external borrowing and until recently it has been constrained by the IMF on what it can borrow on non-concessional terms. Mozambique's a new Foreign Exchange Law was passed in 2010 under which all companies have to retain at least 50% of their profits within a Mozambique bank account. It is not clear whether this will act as a deterrent to future investment (in our view, probably not). Another aspect concerns the disconnect between how the GoM strives to provide a "business friendly" investment climate and the reality that Mozambique ranks 139 out of 183 on the *Doing Business Index* by the World Bank Country Partnership. Business developers face an extensive bureaucratic process to formally register their business. It also remains particularly costly and/or

[3] See World Bank CPS 2012-2015 Table 1, page 6.

burdensome to deal with construction permits, employ workers, register property, trade across borders, and enforce contracts.

Legal and Regulatory Framework. Starting with the passage of the Petroleum Law (No3/2001) passed in that year, Mozambique has over the past decade been steadily building a regulatory framework under which to manage the development of its gas resources. The approach has been to use the Law of 2001 as the bedrock and to supplement it with a combination of Decrees and Regulations in different operational areas.

There remains a need to extend and fine tune the system given the large gas finds and the scope of interest by many new players. GoM has already drafted a new Petroleum Law (April 2012. One key new provision (Article 7) appears to mandate that of any gas extracted and sold, one percent will have to be channeled to the development of the community from which the gas was extracted.

Mozambique has chosen to operate under a hybrid system which combines selected features of Production Sharing Contracts (PSC), Service Contracts (SC) and Concessions. A Model EPCC Contract is on the INP web site. However, within this framework concessions and contracts are signed between developers and the GoM (i.e. INP/ENH), and these more detailed documents actually dictate what terms are to govern the extraction and sale of gas, and what will be the GoM take.

The issue of government take is vital to ICF's analysis undertaken in this project. Our understanding of the government take focuses on three elements: royalties, profit gas, and income taxes. Royalties on Rovuma are 2%, on other developments 6% and on Pande Temane, 5%. Calculation of royalties value depends on whether a netback pricing rule is used or a buildup cost rule is followed. We recommend the netback calculation as being more favorable to Mozambique and more transparent. Profit gas is Mozambique's share of the sales value of LNG and depends on a complex calculation involving the recovery ratio (R value) used in calculating what is profit. Mozambique's share starts out low and grows to about 50% eventually, depending on costs. Finally there is the 32% income tax on profits which nevertheless is subject to a number of tax policies that effectively reduce tax burden.

In sum, Mozambique has been developing a regulatory framework under to which to manage the exploitation of its natural gas resources for more than decade. A recent World Bank Study[4] provides a template against which to assess how well Mozambique has provisioned for all of the key variables that should enter into a well formed regulatory framework (See Exhibit ES-5-1).

[4] *Fiscal Systems for Hydrocarbons Design Issues* World Bank Working Paper No 123 2007. Appendix A.

Exhibit ES-5-1. Key Elements of Successful Petroleum Legal Frameworks

Area	Key Components	Mozambique Status
Government Authority	Ownership of natural resources; powers granted to Government officers; enforcement; penalties and fines; the authority to negotiate contracts; the taxing authority; and approvals authority.	**Completed, in force.** Petroleum Law 3/2001 and follow on decrees/regs.
Access to the acreage	Qualifications for authorization to explore, develop, produce and process; areas closed to mineral activity; areas subject to special controls or conditions; right of ingress and egress; resolution of conflicting land disputes; and the relation between surface and subsurface rights holders.	**Completed, in force.** New Model Exploration and Production Concession Contract (EPCC) – 2005. Land use Law
Exploration and production rights and obligations	Extent of the exploration and production area; duration of the term for exploration and production rights; renewal of exploration and production rights; unitization; cancellation or termination of a right; area relinquishment; minimum work programs; security of tenure; reporting; transferability of rights and mortgageability; surface fees.	**Completed, in force.** EPCC 2005 **Unitization has not been completed**
Protection of the Environment	Environmental impact assessment; environmental impact mitigation; social or community impact; monitoring and reporting; abandonment liability; reclamation; and environment sureties.	**Completed, in force.** Environmental Regulation Specific for Petroleum Activity
Fiscal Terms	State participation; royalties; production sharing rate and base; custom duties; income tax rate and base; special petroleum taxes; other taxes and levies; gas production incentives and other incentives; ring fencing; and stability clauses.	**Completed, in force, being improved.** Fiscal Law on Petroleum activities: Law 12/2007. Mining and Petroleum Tax Incentives: Law 13/2007. Petroleum Production Tax Regulations, Decree No. 4/2008.

Gas Pricing Structures. The pricing of gas internally may be the most critical single factor affecting whether gas-using investors will decide to proceed with their investments, because the price is the key determinant of what will be the returns to their investment. A regulated price was put forth in the November 2010 draft Decree. The formulaic basis for the maximum gas prices contained in the Decree are shown in ES-5-3 below.

Exhibit ES-5-2. Gas Pricing Concepts

Price Concept	Derivatives/Explanations
Global Export Price (GEP = X)	Price determined by IOC on world markets, where maximum achievable price is best for Mozambique
Discount Factor (d)	Where d = An incentive margin needed to stimulate purchase of Mozambique gas within the country, for use as feedstock or fuel, where minimum value of d is best for Mozambique.
Cost (C)	Where C includes the sum of: Capital Cost of delivery (Transmission/Distribution): (C1) Processing/Operating Cost (C2), and Depletion Cost (C3).
Net Back Value (NBV = n)	Calculated as the value of gas to Mozambique, within a given sector, using the opportunity-cost of the cheapest alternative fuel from the world market (to include Mozambique's own export gas, priced at GEP)
Feedstock Price (FSP = n - d)	A minimum price issued by a Mozambique regulatory authority, as a basis on which ENH is to negotiate the sale of gas to a user, as fuel or feedstock, and where (n-d)=or>C
Multiplier Benefits (MB = m). Assumption: m > d.	The Multiplier Benefits factor (m) is calculated as the cumulative sum of economic (and social) benefits to Mozambique expected to be derived from the direct and indirect investment and other economic activity that will result from the gas-user's investment, demand for industry inputs and services, including labor, and from the sales of its products. The value of (m) provides a benchmark for the size of the discount (d) such that the Multiplier value (m) should always exceed the value of the discount (d), since if not Mozambique would lose value.

Aside from the commodity price of gas the GoM will have to set a price for transportation charges. These generally are based on cost of service principles where the transport entity (a gas pipeline) is allowed to recover his costs plus a return on equity that is sufficient to attract investors in the transportation infrastructure. Tariff design then sets the cost per GJ of throughput that is "just and reasonable."

It should be a high priority to finalize a pricing framework that will provide an adequate return on investment, an incentive to use gas over more expensive imported fuels, a reliable pricing regime, and fair and reasonable prices to consumers.

The Banking and Financial Sector. Mozambique has access to three principal sources of capital which can be tapped to finance different aspects of its gas development programs: global financial markets, which include the IOCs already active in the country, together with their capital sources; the international donor community; and the local banking and financial sector. Each of these can be tapped to some extent to provide funding for development. Each has its limitations. A key issue is how the financing of needed development for gas-related investments can proceed in a timely way.

Options for Channeling Gas Revenues for Development

From ICF's standpoint, the major financial and fiscal issue facing Mozambique in context of the GMP is how to channel gas revenues into development in a timely and desirable way. As pointed out, even if Mozambique takes some royalties and profit gas in kind, it will still benefit from substantial revenues in

the form of taxes and revenue from the sale of gas to mega-projects and others. We envision at least three options for addressing this issue.

OPTION 1: Using royalty revenues to finance public-private investment projects in various sectors under Mozambique's new PPP Law. The *advantages* of this approach are, first, that this is a channel already open to the GoM and it could be expanded once gas revenues become available. The PPP law is already in place. Secondly, there would be minimal new institutional requirements needed to implement this approach. Possible *disadvantages* of the approach are that in many cases the pace of investments would be reliant on finding private partners. There may also be issues of how to manage royalty revenues that accumulate without being invested.

OPTION 2: A Sovereign Wealth Fund (SWF). Such funds have been used in different ways, but these include both investments in the local economy, and investments in external markets where the returns may be higher. The possible *advantages* of this approach include the impact on reducing the effects of the "resource curse," the fact that they can invest in financial assets, and can therefore serve to store wealth over time. They also promote local banking and capital markets. Possible *disadvantages* of a SFW could include the fact that money is being invested elsewhere when the needs are in Mozambique. Also there are the usual concerns about political interference, governance, and transparency.

OPTION 3: A National Development or Transformation Bank (NTB). This alternative would use royalty revenues to provide capital to establish a development bank which could be used as a vehicle to direct investment in development projects both in support of gas development and in other needed areas of support. This has a number of *advantage*s: to store wealth and counteract "resource curse" tendencies, to attract participation from other capital sources for investment in Mozambique, and to be lead source of investment capital and expertise to implement the GoM development strategy. Such a bank should be majority state-owned (in order to be eligible to receive the royalties) but would also have substantial minority partners. *Disadvantages* of this alternative include some requirement for cooperating with and including the local banking community and determining how this would work. And as with the SWF, there are concerns about political interference, governance, and transparency. Mozambique's prior experience with a national development bank was not a happy one.

These and other options should be considered by the GoM and its advisors to address the integration of revenues into the economy. ICF recommends that given the importance of this issue GoM should launch a special study of the options. GoM should call together a Working Group, consisting of key relevant GoM representatives, World Bank Group and IMF officials, to prepare a Workshop to discuss the alternatives in more detail. Part of the Workshop could involve participation of some representatives of the Mozambique banking sector and other private sector interests.

6. Experience in Other Countries

The GoM can learn from the experiences of other countries where governments have faced similar issues to those raised by the development of natural gas in Mozambique. Our review has focused on three areas: how other countries have used development to bring gas into the local economy; how countries have used resource development to support socioeconomic initiatives like poverty reduction; and what are the fiscal and financial instruments countries have used to avoid the "resource curse" problem.

Introducing Natural Gas into the Economy (Peru, Indonesia, Trinidad and Tobago)

Peru has been very successful in introducing natural gas to its economy primarily because of its relatively high level of economic development and the fact that the gas production is located on-shore, requiring a pipeline to pass through the country to reach the coast. The LNG facilities, although constructed later in the development process than the pipeline to the capital, were from the start seen as an economic support for development, and served as an incentive for the development of the main gas fields. Now in operation, they provide an anchor supporting the economics of natural gas pipelines.

Trinidad and Tobago has managed a major shift of its economy towards gas-based industries in a way that suggests options for Mozambique. The past five years have seen the oil and gas sector consistently contribute over 70% of foreign exchange earnings, over 40% of total GDP, 50% to government revenue and 89% to export earnings. Given the limited nature of domestic demand, export-oriented industrial projects have played a major role in monetizing its natural gas resources by exporting LNG and developing industries that export natural gas indirectly by promoting downstream gas-using export industries. The model of management of the country's hydrocarbon assets is one where the state facilitates growth and development of industry through private international capital. The country's history of political and economic stability has provided a healthy environment for attracting gas-based investments to the country.

Indonesia's gas industry was initially export-oriented with large LNG markets in Japan, South Korea, and Taiwan. The decline in oil production caused the country to begin importing oil in 2004, which drove the interest in expanding access to natural gas for domestic markets. To promote domestic use of natural gas, Indonesia is building small-scale LNG receiving terminals in areas around the country, as well as retrofitting one of the liquefaction plants to allow receipt of domestic LNG shipments. In addition, institutional reforms began in 2001, when legislation was passed to limit Pertamina's dominance of the natural gas sector (previously, all gas production was managed under Pertamina, the state-owned oil and gas company; after the reforms, gas sales and purchase agreements were allowed between any seller and producer). Pricing reforms have included the ban on private use of subsidized transportation gasoline, in favor of non-subsidized versions and natural gas. Although these efforts will contribute toward increased domestic use of natural gas, a lack of infrastructure (e.g., natural gas service stations, distribution network) continues to limit such efforts.

Summary. It is more likely that substantial natural gas development would arise where there are pipelines. This has been true in Peru and the experience in Mozambique to date with Matola Gas Company supports this. The need for infrastructure of gas transmission and distribution is a key issue in Indonesia and at present a limiting factor in its expansion of gas into the economy. Pricing issues are important in this respect, where gas should not have to compete against subsidized fuels, nor for that matter should gas itself be subsidized in a way that creates dependency on cheap fuel. Trinidad and Tobago have made impressive expansion of gas into the economy, but we note that most of the gas use is in commodity industries (ammonia, methanol) that are subject to swings in prices and demand and where there is an abundance of world capacity producing these products. Still, the expansion of value-added industry is impressive.

The key metrics for evaluating success in gas use in the economy are

- Miles of distribution pipeline
- Numbers of gas customers
- Domestic as consumption

Socio-economic Development Based on Resource Extractive Industries (Nigeria and Indonesia)

Nigeria. Our major focus has been on the Government of Nigeria's government's various efforts to provide social and economic support to the Niger Delta, the location of the oil and gas production and the region that has seen much of the conflict around the oil and gas development. Over the last 50 years, several organizations have been established to address the development problems in the Niger Delta. All of them have failed. The most recent example, the Niger Delta Development Corporation (NDDC) founded in 2000 developed a master plan for the region over a several years through a broad based participatory process. Projects pursued by the NDDC have tended to be based on top-down decision making, where much of the project work is done through contractor outsourcing. The NDDC has tended to fund large, prestigious, high cost projects, few of which have ever been completed, and in some cases even initiated. The NDDC has been hampered by a general lack of sufficient transparency, under-funding, inadequate planning, and a failure to consult beneficiaries. There also are problems with corruption and political factionalism. These problems have limited its ability to attract donor and partner support.

At the same time, the major oil companies have begun to engage communities in development projects in infrastructure, skills training, business mentoring, health, education and agriculture. While the industry advocates larger involvement of the government in development programs (as it does in Mozambique), supported by the taxes they pay to the government, the companies have leveraged their own social investments through public-private partnerships. Companies appear to be best at programs that support their core business: local hiring, procurement, community engagement.

Indonesia's initial efforts at projecting development into rural Indonesia encountered mixed success, primarily due to a lack of infrastructure connecting urban and rural areas, and the wide gap between the

literacy and skills levels of the Indonesian urban core and the rural periphery. Various subsidies, also intended to benefit the poor, resulted in a net benefit to the middle class, who consumed more fuel and had better access to subsidies foodstuffs.

The Indonesian government began to achieve results in its poverty-alleviation schemes through community engagement, which became the key element to successfully identifying community needs. The oil and gas sector proved to be an essential vehicle to economic development through the vocational and on-the-job training for local residents that companies provide, or that is funded with government income derived from oil and gas activity. Indonesia's poverty-reduction programs have focused mainly on investment in public education, health, and public infrastructure, which helped improve human capital development through creation of an educated middle class. With the reduction in fuel subsidies seen in 2005, the government introduced cash transfers to households in poverty to limit the impact of the smaller subsidies. Eligible households received roughly US$10 a month as compensation.

Summary. Poverty reduction and other related socioeconomic initiatives like education and health are primary responsibilities of governments funded through normal government revenues that arise from the extractive. Companies' efforts are best focused on activities related to their business: training and related development around sites. The best programs appear to have the following characteristics relevant to Mozambique.

- Good governance, transparency, and participation in decision-making by local communities in order to create trust that can lead to better outcomes.
- Extensive and collaborative training and education, focused on skills building can support oil and gas development but also is important for supporting non-gas business development. Coordinating with the oil companies and leveraging off their needs for skilled labor seem to be more effective.
- Environmental degradation associated with oil development in the Niger River Delta was a major source of friction in Nigeria.
- Employment programs seem to be fundamental to engaging local populations in development efforts.

The principal metric for measuring socioeconomic improvements from gas development will be in measures of employment. We would include employment in the following categories.

- Employment -- numbers and rates of employment
- Employment in specific sectors (these are being identified in ICF modeling)
- Employment in the Provinces affected by natural gas development
- Employment of Mozambiquans by international oil companies

We hesitate to include measures of poverty or overall income since these are influenced by many factors and not just natural gas. However, poverty reduction in specific provinces (e.g., Cabo Delgado)

could be useful. The GoM may want to consider beginning a series of quality of life opinion surveys to establish a baseline for the present period and then follow up in 3 to 5 year intervals.

Financial and Fiscal Management (Trinidad and Tobago, Botswana, and Indonesia)

The impetus for developing a country's resource base comes from the desire to both develop the country's economy and to improve the government's fiscal condition. It is therefore an irony that the extractive industries are associated with such terms as "the resource curse," the "Dutch disease," or the slightly more upbeat "paradox of plenty."

***Trinidad and Tobago*.** In the early days of gas development licensing terms varied, and were more advantageous for companies with greater negotiating clout. As the industry continued to develop, it attracted closer public scrutiny, resulting in general concern over the favorable terms some companies received in their contracts. This led to the government's *Green Paper on Energy* and the drafting and implementation of the *Natural Gas Act*. The legislation standardized royalty rates for natural gas along the lines of models adopted by Thailand, Malaysia and Chile.

Because the government of Trinidad and Tobago derives its income from the oil and gas sector on the the budget is heavily skewed towards revenues generated by the hydrocarbon sector subject to the disruptive effects of the commodity cycle. To counter this effect Trinidad and Tobago established the Heritage and Stabilization Fund (HSF), adopted in 2007. It operates under specific legislative guidance for the funding and withdrawals from the fund, including how revenues were calculated, that a minimum of 60% of aggregate excess are to be deposited to the Fund during a financial year, a requirement that disbursements from the HSF be deposited in other government accounts within 48 hours, among others.

Botswana's economy has been heavily dependent on diamonds for most of its GDP and government revenues. In 1993 the government set up the Pula Fund – Botswana's sovereign wealth fund with the dual purpose of accumulating savings for future generations along with liquid assets to smooth out the effects of the commodity cycle on government revenues have translated into a substantial asset base that currently exceeds 50% of Botswana's GDP. The fund's professional management, and a policy of transparency and political neutrality, have enabled the Bank of Botswana to provide the government with a steady income stream and support a safety net for the eventuality of lower revenues in times of economic slowdown.

Botswana has also established a National Development Bank, owned by the government that makes finances agricultural, commercial property development (commercial, industrial and residential commercial), as well as industrial and tourism projects. Among other financing parameters, the Bank is encouraged to finance projects that generate employment, add value to local raw materials, and in export-oriented projects, and in projects that substitute for imports and that transfer technology to Botswana

Indonesia's sovereign wealth fund, the Government Investment Unit, also known as Pusat Investasi Pemerintah (PIP), was established in 2006, with a beginning balance of US$340 million, which now totals over $2 billion. The fund is managed by the Ministry of Finance, and invests in both marketable securities, such as debt and share purchases, and direct investments, such as loans to local government or private projects and equity participation. Sectors prioritized include infrastructure developments (i.e., electricity, oil and gas, roads and bridges, transportation, telecommunications, hospitals, terminals, and clean water). Other sectors include those that benefit the public and promote environmentally-friendly technology (i.e., renewable energy, clean transportation, waste management, biomass).

Summary. Virtually all of the major resource dependent countries have created sovereign wealth funds to manage the swings in commodity markets that have a disproportionate impact on government revenues. At the same time countries create mechanisms to invest in local development, again drawing on the revenues created by the resource development. These appear sometimes to be government owned but independent banks, as in Botswana or managed directly by a finance ministry. A key aspect of these institutions is the presence of professional financial management, operating under strict transparency rules that favor development (i.e., employment, local value-added enterprises) while maintaining rational lending practices and standards.

ICF has not developed metrics for measuring progress in this area. This is still being investigated.

7. Towards a Gas Master Plan

The recommendations for elements for a GMP reflect both the insights from analyses above and our appreciation for the many uncertainties in key aspects of the issues facing Mozambique. Among these uncertainties are as follows:

> We do not know <u>when,</u> <u>where</u> and <u>how much</u> additional gas reserves will be developed. Statoil and Petronas drilling is only now starting and if successful will develop gas fields south of Palma closer to the growth areas of the country. The fourth round of leasing for exploration is under way which will ultimately inform GoM of the potential in the central off shore areas of the country. Sasol's drilling program in the southern offshore also is only now under way. Major finds in the Southern part of Mozambique are likely to result in plans for domestic development in the Inhambane or Zambezi region (e.g., Sasol might be interested in GTL development). Finally, coal bed methane opportunities around Tete may be significant. CBM in Tete would be much more accessible to the central and southern parts of the country as well as the R.S.A. and other nearby countries. All of these potential gas developments have serious implications for whether major investments in pipelines or mega-projects in the far north.
>
> World gas and oil prices are subject to major supply and demand uncertainties. This goes without saying in so far as LNG and most of the mega-projects rely on oil and gas prices. New supplies of LNG from North America, Australia, Tanzania, Southeast Asia are possible and could

affect LNG prices. In addition, shale gas development and production in R.S.A., China, and India could reduce needs for these countries to import gas.

Key questions on pricing gas which affects profit gas volumes at Rovuma are unanswered and many are still subject to negotiation. This is a major concern of the ICF team, insofar as assumptions about the pricing and volumes have large implications for gas available in country as well as revenues.

Despite the level of interest evidenced by proponents of mega-projects, their economics are uncertain: much depends on gas prices and availability, commodity market conditions, and investment climate. They will insist on large tax breaks and other incentives that may or may not be in the best interest of Mozambique. Furthermore, the fact that Mozambique government does not yet have an input-output economic model implied that ICF had to make a lot of assumptions regarding possible employment potential in Mozambique. These assumptions have significant uncertainties associated with it.

Finally, our concern about the interaction of gas-driven development with coal-driven development raises questions about the capacity to absorb the level of investment and infrastructure building.

GMP Recommendations

Given these uncertainties, ICF has developed a set of recommendations grouped in the following areas:

1. Threshold recommendations about the volumes and revenues from Rovuma finds and future gas production. Threshold recommendations concern very import issues that need to be addressed before other considerations.
2. Mega-projects and the relation to promoting broad based development
3. Socioeconomic and environmental issues associated with development
4. Structures for fiscal management
5. Additional studies and research needs

1. Threshold Recommendations.

1.1. Mozambique should take a combination of cash and in kind in royalty and profit gas.

The principal advantage of taking some royalties and profit gas in cash is that it provides flexibility in addressing a broad array of social development issues. As one reviewer has said, "You cannot build a school with gas." Similarly, gas developers will not build roads (or schools) that are not directly needed for gas development. However, schools that trains people to work in the gas industry or other sectors of the economy should be built and it is important to focus

on that. Another advantage is the overall flexibility that cash will provide for focusing development efforts in Cabo Delgado and other less developed regions in the North.

The disadvantages of cash is that there is the risk, expressed by a number of reviewers, that cash will be misspent or diverted to private ends. At the same time, decisions on how to direct cash (to GoM, to development bank, or SWF) have to be made and can be contentious.

The principal advantage of taking gas in kind is that it will make gas available to industry and allows GoM to secure revenue from sales to industry. The experience with MCG and Pande Temane demonstrates that gas can be directed to mega-projects SMEs and provide benefits. Delaying making sufficient gas available could result in less development than desirable.

The disadvantages of gas in kind are that it limits GoM's options for development. There also is the risk that despite making gas available, targeted industries may not develop due to other factors. Taking gas in kind limits the quantity of gas available to that which is in royalties and profit and that which can be purchased as sales gas. The latter is likely to be expensive.

1.2. A significant portion of the royalty and profit revenue taken as cash should be used to invest in infrastructure that could facilitate broad economic development (schools, road improvement, electrification, small business development, skills training, health programs, etc.).

GoM should use its current Financial Sector Development Strategy (FSDS) planning effort to investigate how to apply these revenues for development. Some consideration should be given to schemes that allocate funding to the various provinces.

The principal advantage of focusing on development projects is that investment decisions can be tied to identified needs that meet economic and financial criteria. Such development can operate through existing institutions and the banking system, or new institutions can be established.

The principal disadvantage is that there is no clear institutional mandate in GoM for such use of public funds. Attempts to guide development in the past and other countries have often led to misuse of funds. Such a program will require oversight and transparency.

1.3 Because little is known about future natural gas discoveries and development, GoM should take steps to accelerate its knowledge about the potential volumes, timing, and location of future developments. GoM should consider providing incentives to companies in exploration and production (tax abatement, royalty holidays). GoM should accelerate negotiation of EPCCs with coal bed methane (CBM) developers to exploit the (CBM) resources in Tete. GoM should incorporate future development in the GMP as more information is developed.

The advantages of this is that obtaining better knowledge of future potential can help prevent uneconomic investments in infrastructure today. Also, more knowledge engenders more confidence in future revenues and therefore flexibility in development plans.

The disadvantage is that Incentives can be too generous and should be used judiciously if at all. In addition, a more deliberate policy based on future expectations can be criticized for slowness and not acting on present knowledge.

2. Mega-projects and the relation to promoting broad based development

2.1. GoM support of mega-projects is necessary to anchor gas pipelines that can eventually supply small and medium sized industry. GoM should prioritize mega-project support: electric power generation (150-200 MW), fertilizer, and GTLs. Detailed power study is necessary to evaluate the need for large gas power plants.

Advantages of mega-projects is that they can generate regional exports and displace key imports, particularly, GTLs, fertilizer and power. Small power plants support rural electrification, larger ones exports and system reliability. Mega projects also generate large income tax revenues. Mega projects are necessary to provide the infrastructure to provide gas for SMEs.

The risks of large mega-projects is that their operating employment is modest over the long term, being capital intensive enterprises. Except for power, mega-projects are exposed to world commodity market volatility as is LNG.

2.2 The GoM should use an "open season" to determine which projects should proceed and to establish how much gas in kind should be taken. Two step process: (1) Seek indicative offers to buy gas with full explanation of project development and operation. Use this to develop plans and estimate costs. (2) Seek binding offers for gas based on prices developed by GoM with significant up-front payments and guarantees. The final design of this can be based on a tender or auction process.

The advantage of this is that it will use market forces and to quickly identify bona fide requests for gas. It will help identify the value of gas by encouraging competition for supply. With evaluation criteria that include social benefits (employment, small industry) can broaden access and promote GoM goals.

The disadvantage is that the process details will have to be worked out for the GoM which may not be familiar with the approach. Some project developers may not be prepared to commit far in advance of the gas availability. Small users interests will have to be represented by pipeline sponsors.

2.3. GoM should consider a special outreach program to make SMEs aware of the potential of natural gas availability and terms of pricing and access to create opportunities for market tansformation. (See recommendation for additional study.)

The advantage of this is that by building up potential demand for gas more broadly, the economics of distribution may become more favorable.

The disadvantage is the building up of expectations for a service that depends on the capacity of mega-projects to stimulate the necessary infrastructure.

2.4. GoM should consider directing some of the cash royalty and profits into PPP investments in gas distribution systems to expand small scale use of gas. The major focus should be on providing access for SMEs.

The principal advantage is to help grow a market for gas and reduce dependence on other imported fuels.

The disadvantage is long lead time and low level of initial customer sign ups. This could take more than 10-20 years to become viable.

2.5. GoM should consider carefully whether to allow all of the mega-projects proposed for Palma to be developed there. Encouraging some mega-projects in other locations can provide additional development opportunities for SMEs and pipeline infrastructure

The advantages of diversified investments are that Palma development can be pursued while also encouraging development at other locations. Places (Pemba, Nacala, Nampula, Beira) have SMEs that can benefit from gas access. This policy could avoid uneconomic investment if gas is produced in other locations.

The disadvantages of concentrated development are that such massive investments in greenfield industrial parks have limited success. Concentrating in one place leads to more enclave, export- oriented development and less local participation.

2.6. GoM should avoid providing mega-projects with excessive tax breaks and other financial incentives to locate in Mozambique.

The advantage of not providing excess financial incentives is to create more tax revenue for the GoM and to ensure that the mega-project investments reflect their true costs.

The disadvantage is that in some cases plants may not locate in Mozambuique without incentives; the key issue is devising incentives that are appropriate and that create long run benefits for the country.

3. Socioeconomic and environmental issues associated with development

3.1. *The GoM should use a portion of its natural gas revenues to strengthen the existing vocational education and labor training programs led by the Ministries of Education and Labor in partnerships with the private sector.*

An adequate structure seems to be in place to support private sector demand driven training and vocational education through public-private partnerships. This would address what has already proven to be a bottle neck for maximizing the job creation and poverty reduction benefits of existing private investments.

The challenges of this are that it requires substantial investment early before the revenues begin flowing in. It also demands substantial coordination across ministries and industry that may be difficult to achieve.

3.2. *The GoM should strengthen its capacity to enforce Environmental and Social Management Plans* agreed with private investors as a result of the ESIA process.

ICF suggests an office be set in MICOA to specifically coordinate natural gas related project and be given the tools and resources needed to monitor and enforce agreed upon Environmental and Social Management Plans.

The advantage of this will be to have in place a single point of monitoring and compliance that will provide some consistency to the process. This will require some commitment of resources prior to the start-up of construction.

4. Structures for fiscal management

4.1. GoM should evaluate options for channeling GoM gas revenues to development. There are four obvious options, but there may be others. Ultimately the GoM in cooperation with the World Bank, IMF and perhaps others would need to evaluate these options and develop an approach.

OPTION 1. *Channel GoM Funds into private banking system to promote local capital markets.* The advantage of this is that it strengthens the domestic banking and capital market sector and promotes lending diversity to enterprises with sound economic foundations prospects. The disadvantages are that there is no mechanism for making public money available to private lenders and the concerns about the process and its transparency. The only guarantee that monies would flow to the right projects would be the self-interest of private bankers.

OPTION 2. *Finance public-private investment projects in various sectors under Mozambique's new PPP Law.* The advantage of this is that mechanisms exist with PPP law already. It works with private sector to channel investments into socially desirable projects and it is consistent with the FSDS. Disadvantages re that there can be difficulty in attracting private partners; there

is the potential for a lack of focus across many ministries; there is no provision for what to do with accumulated, un-invested revenues; and the concern about transparency and accountability.

OPTION 3. *Establish a Sovereign Wealth Fund (SWF).* The advantage is that it can serve as a store of wealth over time; would provide capacity for borrowing and lending by public and private sector; can mitigate "resource curse" tendencies; and can used in local development. The disadvantages are that it would divert money to other investments outside Mozambique and it is subject to political pressure unless insulated with professional staff, oversight, transparency, and legal charter.

OPTION 4. *Establish a National Transformation Bank (NTB) owned by GoM AND other countries/entities.* The advantages are that it would serve as a primary focus on development in country, this would be its sole mission. It can be structured and capitalized to provide lending capacity to Mozambique in advance of the flow of royalty and profit income. The challenges is that it would need to be set up to coordinate and support local banking sector and could be subject to political pressure unless insulated with professional staff, oversight, transparency, and legal charter.

4.2. GoM should undertake a number of steps to coordinate the enormous financing demands required by the natural gas sector as well as the coal and other sectors. These include the following steps.

Because the scale of financing is so large and diverse relative to the Mozambique economy, there is concern that Mozambique's borrowing capacity could be compromised. A watchdog role to monitor the off balance sheet financing is advisable to monitor the flow of financing and to ensure the that non-G0M projects are ring-fenced from GoM's borrowing capacity. The separation of financing requirements into three sectors will help manage this: primary sector (IOC investments in LNG); secondary sector (investments in gas infrastructure and mega-projects); tertiary sector (investments in small business and local infrastructure).

Where donors wish to become involved in the financing of parts of the gas development program, they should not divert funds from existing programs.

Funding for the whole energy sector (gas, coal, electricity) should be coordinated and balanced so that the investments do not overwhelm the capital markets.

5. Additional studies and research needs

We have identified several areas where additional studies are necessary to fully develop the GMP.

- Chief among these is for a Mozambique and regional integrated power study including the South African Power Pool. Gas for electricity generation holds great promise in being able to set

up small, medium, and even large power plants to support the Mozambique grid. However, there is clearly a large uncertainty about what is economic in the face of abundant hydro power and coal generation. R.S.A. has huge requirements for power, as do some of the other southern African states. A key question is whether Mozambique should export gas for power generation, or send gas "by wire." An integrated planning effort can help address this and other issues.

- One of the major frustrations of this study has been the recognition that there may be substantial pent-up and potential demand for gas in SMEs across the country. The question is how to serve this demand. Our analysis indicates that LNG is too expensive on a large scale for SMEs and pipelines need the support of mega-projects. Lacking is sufficient information on SMEs. We recommend that there be a detailed study of SMEs, products they produce, typical firm size, costs, energy use, energy use by type, location (province and town). This could be a PPP effort or a GoM effort. A key element of this analysis would be an evaluation of the ability and willingness to pay for gas.
- Coincident with the above study, we believe there is a need to accelerate the work on a national input-output model centered in the INE and Ministry of Planning and tailored to the Mozambique economy. This would enable there to be more confidence in the assessments of the impacts and implications of various development policies as well as the impact of gas, coal, and other developments on the economy. It also would help to generate a substantial data base to assist planners.
- We also recommend that there be a detailed independent assessment study on projects submitted to ENH to evaluate the techno-economic feasibility of potential megaprojects in Mozambique. This could be undertaken as part of a structured "open-season" or tendering process for acquiring gas as these companies have requested.

Decision Hierarchy and Roadmap

Our decision roadmap is rather brief, principally because of the major unknowns that we have enumerated and the need for additional studies. It also is in keeping with our understanding of a GMP at this stage. Some decisions need to be made before others. As events unfold, future policy decisions will present themselves. We focus below on the immediate set of steps we believe the GoM should take to begin developing a more comprehensive GMP. We list the steps sequentially and when in time they should be made.

Now

Work with concessionaires to establish the pricing calculations for gas in Rovuma. This is <u>critical</u> to understanding economic trade-offs between the cash and in-kind options. A major concern we have had with various parties is the insistence that royalties and profit be taken in kind, but without any clear understanding of the trade-offs this involves or the implications for future development.

2012 – to mid-2013

Decide whether to take royalty gas and profit gas in-kind or a combination of in-kind and cash and how this may change over time. This is a difficult decision and it must be informed by a clear understanding of the trade-offs. ICF believes that deciding to take all royalties and profit in kind is unwise, as can be inferred by our analysis.

Develop (1) a plan for how institutionally to apply cash payments to development programs in Mozambique and (2) a plan for how institutionally and by which process to allocate gas taken-in kind to competing uses. This follows on our recommendation to form a study group to evaluate what institutions should have the responsibility for using revenues to develop the country and how. The same applies to any decision about in kind allocations. We have made recommendations for how this should be done. This decision needs to be taken in the next 18 months.

2013

Delay decisions on large natural gas infrastructure from Rovuma (e.g., pipelines, LNG barging), until GoM better understands the production potential in other areas of Mozambique. There is no need to rush into decisions about major commitments.

Take steps to accelerate knowledge about future gas development beyond Rovuma. We have recommended some use of incentives but we are uncertain whether these would be the best. We believe however that understanding the potential in the rest of the country is vital for making decisions with long term consequences.

Give priority to negotiating EPCCs appropriate for CBM. We are convinced that the CBM potential could be very large. But GoM needs to establish the framework to encourage developers to explore and prove up the reserves. GoM should examine EPCCs related to CBM used in other countries, since CBM has a very different profile of development from that of offshore exploration and production and the present EPCC model may not be appropriate.

Beyond 2013

Finalize transport tariff framework and gas pricing framework for domestic use. As noted earlier, having a clear and stable pricing framework in place will benefit the developers of mega-projects and SMEs.

Implement programs to monitor and enforce compliance with environmental impact mitigation. ICF has found no environmental barriers to the development of the gas resources. There is a need to ensure that regulations and commitments by the developers are adhered to and that there needs to be in advance a clear authority and process for monitoring compliance.

Revisit the GMP and make adjustments. The GMP should evolve with the addition of more knowledge and as events unfold. There should be regular updates.